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# A User Oriented View of Internet as Information Infrastructure

*Harry Bruce*

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## INTRODUCTION

In recent years, the world has been spanned by global computer networks. These networks represent the convergence of computing power with data communications technology. They are underpinned by international connectivity protocols which permit internetworking of local, wide area and national networks into an international infrastructure of networks commonly called *The Internet*. The assumption that internetworking facilitates higher level services for human communication and access to information (National Research Council, 1994, 22) has given rise to a characterisation of Internet as *a global information network or information infrastructure*. *Information infrastructure*, in particular, has been used to promote an agenda for action on internetworking that aims to develop a *Global Information Infrastructure (GII)* (Information Infrastructure Task Force, 1993) that will eventually impact on all aspects of the information process.

The blueprint for National Information Infrastructure in the United States, *Agenda for Action*, defines *information infrastructure* as an aggregate of networks, computers, software, information resources, developers and producers (Information Infrastructure Task Force, 1993). It is widely accepted that this sort of infrastructure is embodied in the Internet together with the many services, applications, and resources that have been built upon it (Kahin 1995). To a large extent, the term *information infrastructure* is used to conceptualise the connectivity with myriad information resources that has been facilitated by internetworking. Indeed, the status of information in modern societies, in some way, recommends the use of a term like *information infrastructure* because it conveys the possible benefits to be derived from Internet access. The term becomes a metaphor for promoting these benefits in the same way that *information superhighway* or *library without walls* have been used to popularise a public access agenda for Internet (Arms 1990; Cerf 1994, 1995; Dempsey 1993; Information Infrastructure Task Force, 1993; Kahin 1995; Lynch and Preston 1990).

There are, however, other contexts for providing a more rigorous explication of the notion that Internet is an *information infrastructure*. This paper explains

the conceptual basis for a study that sought to expound this perception of Internet from a user oriented perspective. The study was informed by the user oriented paradigm. It was, therefore, called *a user oriented view of Internet as information infrastructure*.

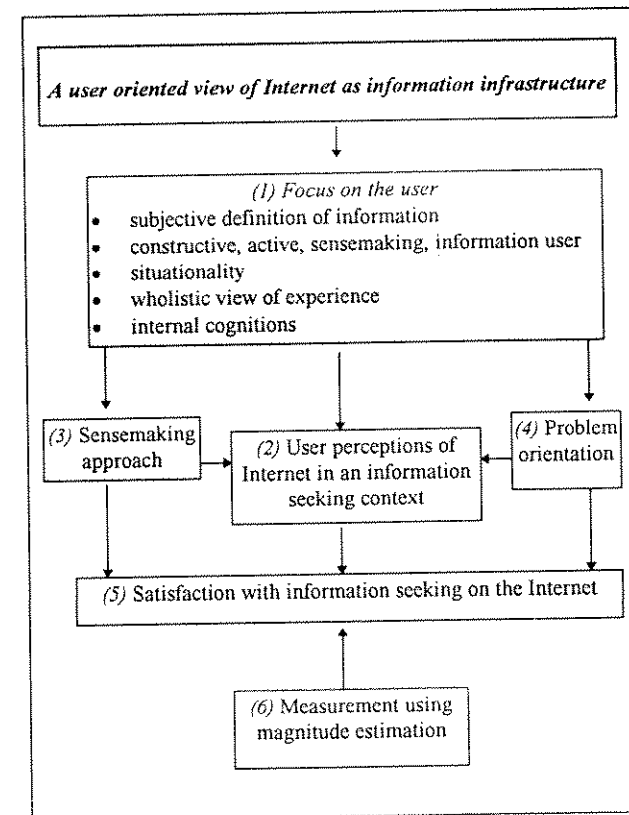
#### A USER ORIENTED VIEW OF INTERNET AS INFORMATION INFRASTRUCTURE

The assumptions and approaches of the user oriented paradigm draw attention to characteristics of an *information infrastructure* beyond interoperability, openness and connectivity with information resources. From a user oriented perspective, the concept *information*, for example, is used to convey very particular connotations about the problems, individual interpretations, cognitions, actions and emotional responses that characterise information behaviour. The assumptions of the user oriented paradigm elucidate a view of *information infrastructure* imputing that Internet, in some way, supports or facilitates end-user involvement with accessing, searching, retrieving, manipulating and using information. In a user oriented context, describing Internet as an *information infrastructure* implies that the network provides a supportive context for effective information seeking by active, constructive sensemaking information users. A user oriented view of Internet as *information infrastructure* requires confirmation that the users of Internet perceive it in this way. The premise for this study was, therefore, that a view of Internet as *information infrastructure* ought to be based on how users perceive the network.

The concept map that appears in Figure 1 explains how these user based perceptions of the Internet might be obtained. In effect, the figure provides a summary or overview of the conceptual relationships that characterised this user oriented view of Internet as *information infrastructure*. Moving through the concept map – user oriented means to *focus on the user* (1). It also implies the acceptance of a range of assumptions about the definition of concepts like *information*, *information need*, and *information seeking*. An important assumption of the user oriented paradigm is that information systems or *infrastructures* ought to be examined from a user's point of view. In other words, *how do users perceive the information system*. Users develop an impression or perception of an information system when they use it to resolve information problems or create sense from an uncertainty, anomaly or discontinuity in their lives. They develop a perception of an information system when they use the system for *information seeking* (2). Information seeking is motivated by the user's *problem state*. It is a process of *sensemaking*. *Sensemaking* (3) and *problem oriented* (4) models of the information seeking process identify *level of satisfaction* as a valid indicator of *how the user perceives the information system*. User satisfaction is the *key variable* at a point in the information seeking process where the information that has been obtained is evaluated and utilised by the information seeker. The outcomes of information seeking are summarised by a level of

FIGURE 1

A user oriented view of Internet as information infrastructure



satisfaction which represents the user's emotional response to the information seeking process overall. Level of satisfaction is, therefore, the key to how users *perceive Internet in an information seeking context*. It represents the user's response to Internet's performance as an *information infrastructure*. Satisfaction with information seeking is *the raw data* for a user oriented view of Internet as *information infrastructure* (5). The measurement of satisfaction is, therefore, a critical issue. Various studies have developed ways of measuring satisfaction using direct or indirect multivariate instruments but, on the whole, these

instruments are not user oriented either by design or application. This study, therefore, adapted a technique originally designed to measure perceptions of physical stimuli and applied it to the measurement of user satisfaction with information seeking on the Internet. The technique was first developed by the discipline of psychophysics and is called magnitude estimation (6). An important part of this study was taken up with verifying the validity and reliability of magnitude estimates of user satisfaction with information seeking on the Internet.

#### A FOCUS ON THE USER

In the past decade and a half, the user oriented paradigm has been embraced as a mainstream theoretical underpinning for research in the discipline of information science (Hewins, 1990). To some extent, this paradigm represents an amalgam of sociological, psychological and cognitive viewpoints that focus on the information user.

This *focus on the user* is often contrasted with the traditional or physical paradigm that represented the dominant approach to research in the discipline of information science up until the late 1970s (Ellis, 1992). Research that was underpinned by the physical paradigm explored the extent to which an information system had been used. It generally reported on any barriers that prevented or diminished satisfaction with use of the system. The information system itself was the focus for this sort of investigation. When Dervin and Nilan (1986) published their views on the development of a user oriented paradigm for information science they, therefore, chose to articulate the assumptions of a *user* approach as *alternative* to those of the traditional paradigm which they called the *system oriented* paradigm (see Table 1).

A *user focus* is elucidated by each of the categories of assumption that appear in the right hand column of Table 1. This begins with a subjective definition for the concept *information*. The user oriented paradigm defines information as the set of events that occur in the head of an individual when a message is absorbed and an individual's image of the world is altered (Dervin, 1977; Pratt, 1977). Put simply, *information* is whatever the user finds informing. It follows then that, wherever, the term information is used (e.g. information infrastructure) the involvement of an active, constructive, sensemaking information user, is implied. Research which applies a user orientation is, therefore, concerned with the factors that might impact on the way a user interacts with information. There is a focus on what the individual user thinks and does as he/she engages in information seeking behaviour because perceptions of an information system are derived from this context of use. In other words, user oriented perceptions of an information system or *information infrastructure* for that matter, are best achieved by gathering data on the information seeking behaviour of users.

TABLE 1  
System oriented and user oriented assumptions  
(Adapted from Bruce and Todd 1993, 88–89;  
Dervin and Nilan 1986, 13–16)

System Oriented paradigm	User Oriented Paradigm
<b>Objective Information</b> Information has constant meaning. It is a commodity or thing. It can be transported. It reflects an absolute correspondence with reality. It will convey the same meaning to all users.	<b>Subjective Information</b> Information does not transmit constant meaning. Information users interpret information and create sense or meaning in accordance with their unique model or image of the world
<b>Mechanistic Passive Users</b> Users are regarded as information processing systems. Being informed or benefiting from information is assumed to result directly from document delivery with no intervening user behaviour.	<b>Constructivist Active Users</b> The user constructs need out of situations and is actively involved in information transfer. The user undertakes activities that will induce sensemaking. The user is actively involved from the time the information arises to the point of problem resolution.
<b>Transituationality</b> Users with similar characteristics in similar situations will react in similar ways, use information similarly and make similar decisions. The information behaviour of users is described in ways that apply across situations.	<b>Situationality</b> An individual's responsiveness to information is governed by a range of variables that are unique to the individual and to the information problem that the user is engaging. Individuals operate from different centres at different times.
<b>Atomistic View of Experience</b> The focus is an attention on user behaviour at the point of intersection with the information system; the moment of contact and exchange.	<b>Wholistic View of Experience</b> A user's behaviour is studied in terms of those factors that lead to an encounter with an information system and the consequences of such an encounter. A broader view of information behaviour from the time need arises to when it no longer exists.
<b>External Behaviour</b> Very concrete. Contact with a system is the basic indicator of information need. Focus on what can be observed as overt behaviour.	<b>Internal Cognitions</b> Acknowledges the premise that what is going on inside a person's mind (the individual's model of the world) will shape the way information is interpreted and used. Interested in what people think as well as what they do when they engage in information behaviour.
<b>Chaotic Individuality</b> Focus on individual information behaviour will cause too much variation. Systems cannot accommodate individual interpretation. Individuality means chaos and prevents systematic research	<b>Systematic Individuality</b> The complexity of individuality can be addressed in a way that is consistent with scientific investigation.

### USER PERCEPTIONS OF INTERNET IN AN INFORMATION SEEKING CONTEXT

Research into information seeking by the discipline of information science has been characterised by numerous attempts to construct models of information seeking behaviour. These models are used to predict the possible effect of variables and allow some form of generalisation about overall perceptions of the process on the part of the end user. These models include simple models of the reference process (Bunge, 1970; Crum, 1969), models which focus on the hierarchy of preferences in information seeking behaviour (Beales et al., 1981; Krikelas, 1983) and management models which focus on variables relevant to policy (Mick et al., 1980).

These early models tended to identify *information need* as the key concept in information seeking. In recent years, however, there has been a trend away from this focus on information need. There are two user oriented approaches to information seeking which reflect this trend. The first approach is the problem orientation which represents the work of writers and researchers like Wersig (1979) and Belkin (1982, 1987) and Saracevic et al (1988) who have promoted the view that information behaviour arises from *problematic situations* or *anomalous states*. Saracevic et al. (1988) describe this orientation as a focus on:

viewing the problem behind the question rather than the information need as central to the information seeking context  
(Saracevic et al. 1988,163)

The second approach which represents a departure from an emphasis on information need is sensemaking. Sensemaking theory assumes a *discontinuity* condition as constant for human beings. The central activity of sensemaking is information seeking which is directed at achieving *continuity* or *sense*. Information seeking is the process and sense is the outcome. (Savolainen, 1993).

The problem orientation and sensemaking theory are closely related in the way they view information seeking. Together, they embody the view that information seeking is a process of balancing the sense achieved from system and document interactions against the desired sense that is defined by the problem state of the user. An example of a model of information seeking from a sensemaking perspective has been provided by Kuhlthau (1991, 367). Belkin and Vickery (1985, 3), Saracevic et al. (1988, 164) and Ingwersen (1992, 86) have presented models of the process that are based more on a problem orientation.

Kuhlthau's (1991, 367) model was empirically derived. It incorporates cognitive and affective aspects of the information seeking process together with the documentary actions that are followed by information users. The model identifies six stages in the information search process. The final stage is the presentation stage. At this point in the information seeking process, Kuhlthau

(1991, 367) observed that information users summarise information seeking with a personalised synthesis of the topic or problem. This synthesis is based on the extent to which information seeking has moved the user from uncertainty to understanding. In the Kuhlthau (1991, 367) model, the information user summarises his/ her perception of the outcomes of information seeking with feelings of satisfaction or disappointment. In a similar way, problem oriented models (Belkin and Vickery, 1985, 3; Ingwersen, 1992, 86; Saracevic et al. 1988, 164) identify user satisfaction as the most appropriate variable for observing those stages of the information seeking process where information is evaluated and used.

### SATISFACTION WITH INFORMATION SEEKING ON THE INTERNET

Both types of model, therefore, indicate that satisfaction with information seeking is a key to user based, summative assessment of the information seeking process. The problem oriented models (Belkin and Vickery, 1985, 3; Ingwersen, 1992, 86; Saracevic et al. 1988, 164) and the sensemaking model (Kuhlthau, 1991, 367) take slightly different views of satisfaction, however. The problem oriented models emphasise satisfaction as a *material* response to information seeking. The user is making a summative judgement of the information seeking process based on the relevance and utility of the documents retrieved. But, in Kuhlthau's (1991) model, satisfaction represents an *emotional* response to the cognitions and actions associated with the final stage of the information seeking process.

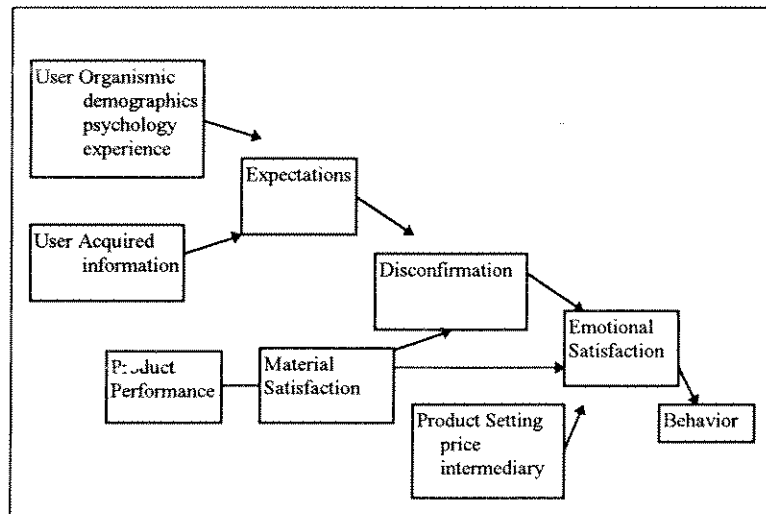
This distinction between *material* and *emotional* satisfaction has been accepted by the discipline of information science for some time. Early work by Tessier et al. (1977), for example, emphasised the view that satisfaction is a *state of mind* experienced by the user. There have been numerous studies since which have examined the mental constructs of user satisfaction (Applegate, 1993; Hiltz and Johnson, 1989; Sandore, 1990; Waern, 1989). Applegate (1993), in particular, focused on the relationship between material and emotional satisfaction and information seeking.

Applegate's (1993, 533) model, The Emotional Satisfaction Model – Multiple Path, represents the view of satisfaction with information seeking that was adopted by this research study. This model has several important aspects. Firstly, it establishes a link between emotional satisfaction and the product setting or context in which information seeking is taking place. Secondly, the model makes it clear that emotional satisfaction is related to the material satisfaction that a user will derive from the performance of an information system. Emotional satisfaction is linked to the relevance and utility of the information that is retrieved from the information seeking incident. In this way, satisfaction with information seeking is seen as an emotional response to the

difference between what a user expected from the information seeking process and what was actually achieved.

In addition to expectation, an information user brings a range of other characteristics to the information seeking process which may also affect his/her satisfaction with information seeking. These are the variables that have been described in a user oriented framework by concepts like *situationality* and the *problem state of the user*. They can include variables that distinguish the demography, psychology or experience of the user. Several of these variables have been observed by the body of research that has examined end-user searching of electronic information resources. This research has, for example suggested that, among other factors, training (Simon, 1981; Sewell and Teitelbaum, 1986), frequency of use (Fenichel, 1981; Sandore, 1990) and conceptualisation of the system by the user in the form of analogy or metaphor (Borgman, 1986; Carroll and Thomas, 1982) can influence information seeking. It is, therefore, reasonable to suggest that some of these factors may influence the satisfaction that users derive from information seeking on the Internet. In the model in Figure 2, these factors are represented as user organismic variables.

FIGURE 2  
Emotional satisfaction – multiple path  
(Applegate 1993, 533)



In summary, the assumptions of the user oriented paradigm provide a conceptual framework which recommends a focus on the information user. Specifically, this means to focus on the way a user perceives an information system or infrastructure when he/ she uses it to resolve information problems. The information seeking process is motivated and shaped by the problem state and situationality of the user. It is characterised by the actions, emotional responses and cognitions that are embodied in an information user's transition from uncertainty to understanding. When a user engages in information seeking, perceptions of the information system are consolidated from an individual response to variables that are associated with the problem state and system performance together with what is expected from the information seeking incident itself. The user will express this perception as satisfaction with information seeking.

This study, therefore, accepted the notion that research which aimed to explore and expound a user oriented view of Internet as *information infrastructure* should focus on the information behaviour of Internet end-users. The study was interested in how these end-users perceive Internet in an information seeking context. User oriented approaches (the problem orientation and sensemaking) suggest that the indicator that will best measure data for this perception is user satisfaction with information seeking. So, the main premise for the study was that measures of satisfaction with information seeking are the raw data for a user oriented view of Internet as *information infrastructure*. Measuring user satisfaction with information seeking on the Internet was, therefore, an important part of the investigation.

MEASURING USER SATISFACTION WITH INFORMATION SEEKING

The problem with user satisfaction is that it is difficult to measure but it is an important variable for research across a number of disciplines so there have been numerous attempts to develop a valid and reliable instrument. Generally, the instruments that have been developed are multivariate. In other words, they operationalise satisfaction with a list indicators for the variable. The general equation for multivariate approaches is:

$$S_i = \sum_{j=1}^n R_{ij} W_{ij}$$

- where
- $S_i$  = The satisfaction of individual  $i$
  - $R_{ij}$  = The reaction to factor  $j$  by individual  $i$
  - $W_{ij}$  = The importance of factor  $j$  to individual  $i$
- Bailey and Pearson (1983, 531)

Multivariate instruments are distinguished by whether they use a *direct* or an *indirect* method for articulating the various indicators for satisfaction. An indirect multivariate instrument uses indicators that, it is claimed, infer a level of satisfaction. The word satisfaction is not used, so indirect measures ask questions like:

What grade would you give the search experience?  
(Applegate, 1993, 529–530)

A direct multivariate instrument, on the other hand, asks questions using the word satisfaction. A direct measure asks questions like:

Are you satisfied with the online search?  
(Applegate, 1993, 529–530)

Multivariate measures for user satisfaction are similar in a number of ways. Firstly, individual ratings for the factors that have been used to operationalise satisfaction are based on a subject responding to a category rating scale provided for each indicator. Secondly, satisfaction is generally calculated as the sum of an individual's ratings for each of the indicators used to operationalise the variable. Thirdly, the validity of this type of instrument is generally based on a similar set of statistical tests or data from previous research studies. And finally, multivariate instruments, overwhelmingly, purport to measure satisfaction if the data obtained are consistent with an overall judgment of satisfaction that has been procured using a category rating scale.

Although widely used to determine the strength of beliefs, preferences, perceptions and so on, category rating scales have a number of weaknesses. Because they provide ordinal data they preclude the use of statistical methods based upon interval assumptions (Lodge, 1981, 5–6). More importantly, from a user oriented perspective, category rating scales restrict responses to a fixed type and number of categories. The measuring scale is imposed by the researcher and may not reflect the individual user's desired response. A technique for gathering data which overcomes these weaknesses and allows research subjects to select their own response scale is magnitude estimation.

#### MAGNITUDE ESTIMATION

Magnitude estimation is a technique which was first developed by the discipline of psychophysics to measure the strength of a subject's response to physical-sensory stimuli such as light, sound, heat and so on. The techniques of magnitude estimation have since been successfully adapted to social-psychological stimuli (Eisenberg, 1986; Lodge, 1981; Stevens, 1975). Magnitude estimation has, therefore, been used for research in social sciences such as business

(Sturges, 1990), psychology (Mori and Ward, 1990) and educational psychology (Schriesheim and Novelli, 1989, Schriesheim and Gardiner, 1992). In information science, magnitude estimation has been used to gather and analyse data on relevance as estimated by end-users (Bruce, 1994; Eisenberg, 1986). It is a reasonable assumption that similar techniques could be used to achieve reliable and valid data on user satisfaction with information seeking on the Internet.

The beauty of magnitude estimation from a user oriented point of view, is that subjects choose their own scale against which responses to stimuli are reported. In other words, each subject is simply asked to assign a number that for him or her matches the intensity of the stimuli presented by the researcher. Proponents of magnitude estimation claim that human subjects have a capacity for subjective proportional judgement of most physical sensations. They refer to this as the Power Law which states that:

equal stimulus ratios produce equal subjective ratios  
(Lodge, 1981, 12–13).

The Power Law assumes that magnitude estimates function as ratio data and provide *direct measurement* (Lodge, 1981). In other words, that there is:

a constant linear relationship with a zero intercept, between the reported magnitude estimation of the subjective state (Y) and the actual subjective magnitude of that subjective state  
(Wills and Moore, 1994, 233).

Although this claim is somewhat contentious, it is generally accepted that magnitude estimates preserve proportionality and can therefore be used for higher level statistical analysis (Lodge, 1981; Marks, 1974; Schriesheim and Gardiner, 1992).

A criticism of the Power Law, however, is that it is based upon numeric estimation – a single, *well-learned*, *conscious*, and *judgemental* measure (Cliff, 1973; Marks, 1974). The technique that the discipline of psychophysics developed to overcome this criticism is called the cross-modality matching paradigm. (Lodge, 1981).

The cross-modality matching paradigm requires subjects to match the strength of their perception of a stimulus with measures other than numeric estimates. The measures commonly chosen are, force of hand grip, line production and sound pressure. For force of hand grip, subjects squeeze a calibrated hand dynamometer. For sound pressure, they adjust a potentiometer such that the sound through a pair of headphones matches their subjective perception of the strength of the stimulus to which they are being exposed.

Substantial testing of the cross-modality paradigm has established that the Power Law is not dependent upon numeric estimation. It has also established a technique for confirming the *validity* of social-psychological magnitude scales. The premise that establishes validity is that the ratio between a subject's response modalities for physical-sensory stimuli will approximate the ratio between the same response modalities when matched to social-psychological stimuli. It is possible, therefore, to obtain the ratio of a subject's response to physical-sensory stimuli across response modalities and to use this correlation to examine the extent to which the same subject can apply magnitude estimation techniques for registering the strength of their perceptions of other types of stimuli. In the case of this research, these stimuli were those factors which promote an overall perception of user satisfaction with information seeking on the Internet.

The *reliability* of magnitude estimates of user satisfaction is established by examining the relationship between category rating and magnitude estimation data on the variable. When plotted on a semilog graph, the shape of the line of best fit that represents this relationship becomes an indicator of the type of variable being measured. If the relationship is linear, the variable is *metathetic*. If the relationship is described by a concave, downward facing curve, the variable being measured is *prothetic*. These labels were first used by Stevens (1975) to differentiate between two types of variables. *Metathetic* variables are those which are measured on what appears to be a *more or less than* or qualitative continuum. Eisenberg (1986) used the example of pitch as a metathetic variable, where measurement in terms of quantity is quite elusive. A prothetic variable, on the other hand, can be described in terms of *how much*. With prothetic variables such as loudness, it is possible to describe the variable in terms of how much or degrees of quantity (Eisenberg, 1986). The assumption of this research study was that users perceive and express the extent of their satisfaction as a specifiable amount (prothetic) not simply more or less (metathetic). If satisfaction with information seeking on the Internet is a prothetic variable, then it is characterised by a perceptual, quantitative continuum which means that information seekers are capable of judging and articulating exactly *how much* satisfaction they have derived from a particular information seeking incident. The study described in this paper aimed to demonstrate that satisfaction with information seeking on the Internet is a prothetic variable. Once this was established, the magnitude estimates of user satisfaction collected during the study were used to expound a user oriented view of Internet as *information infrastructure*.

FIGURE 3  
Overview of the research study

#### Aims of the research

1. to explicate a user oriented view of Internet as information infrastructure
2. to examine some of the characteristics of end-user information seeking on the Internet
3. to discover how satisfied end-users are with information seeking on the Internet

#### Objectives of the research

1. to develop a methodology for obtaining interval level data on user satisfaction with information seeking on the Internet
2. to identify the extent to which certain factors influence user satisfaction with information seeking on the Internet

#### Research questions

1. Are magnitude estimates of user satisfaction with information seeking on the Internet reliable and valid?
  - a. Is user satisfaction with information seeking on the Internet a prothetic variable?
  - b. Can end-users apply magnitude estimation techniques to express their satisfaction with information seeking on the Internet?
2. How satisfied are users with information seeking on the Internet
  - a. Are users more satisfied with information seeking on the Internet if they have attended an Internet training course or courses?
  - b. Does frequency of Internet use predict the amount of satisfaction a user will derive from information seeking on the Internet?
  - c. Does expectation of success predict the amount of satisfaction a user will derive from information seeking on the Internet?
3. How do users conceptualise the Internet?
  - a. Are there categories of end-user analogy for Internet?
  - b. Do particular analogies for Internet predict the amount of satisfaction a user will derive from information seeking on the Internet?

## CONCLUSION

In conclusion, this research study examined Internet from a user oriented perspective. It attempted to explicate a user oriented view of Internet as *information infrastructure*. It aimed to find out whether end-users perceive and conceptualise the Internet in this way. It focused specifically on user based perceptions of Internet in an information seeking context. The key variable was user satisfaction with information seeking on the Internet. A significant by-product of the research was that it introduced an approach to gathering and analysing interval level data on user satisfaction that is concordant with the assumptions and approaches espoused by the user oriented paradigm. This data collection and analysis technique may have broader applications for research conducted in the discipline of information science. An overview of the complete study appears in Figure 3.

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