Communications of the Association for Information Systems

Volume 2 Article 21

November 1999

The Diffusion of the Internet in a Pro-IT Cultural Environment: A Content Analysis of the Singapore Experience

Margaret Tan
Logistics Institute - Asia Pacific, National University of Singapore, tlitanm@nus.edu.org

Thompson S. H. Teo
National University of Singapore, fbateosh@nus.edu.sg


Communications of the Association for Information Systems

Volume 2, Article 21
November 1999

THE DIFFUSION OF THE INTERNET IN A PRO-IT CULTURAL ENVIRONMENT: A Content Analysis of the Singapore Experience

Margaret Tan
Logistics Institute-Asia Pacific
National University of Singapore

Thompson S.H. Teo
Department of Decision Sciences
National University of Singapore

fbateosh@nus.edu.sg

RESEARCH:
INTERNET

THE DIFFUSION OF THE INTERNET IN A PRO-IT CULTURAL ENVIRONMENT: A Content Analysis of the Singapore Experience

Margaret Tan
Logistics Institute-Asia Pacific
National University of Singapore

Thompson S.H. Teo
Department of Decision Sciences
National University of Singapore
fbateosh@nus.edu.sg

ABSTRACT

Despite the magnitude of the Internet phenomenon, relatively few studies investigate the factors influencing its diffusion. This paper seeks to provide a better understanding of the forces that influence the diffusion of the Internet in Singapore. A push-pull framework that incorporates the political, technological, economic, and social factors is developed as the basis for examining this phenomenon. Based on this framework, a content-analytic approach is used to analyze the messages conveyed in Singapore's two local English-medium newspapers. The results show that both push and pull forces predominated in the early stages of Internet diffusion. However, as time went by, the pull forces predominated over the push forces. The results also show that factors such as building telecommunication infrastructure, having on-line information and services, and creating business opportunities were important in the diffusion of the Internet in Singapore.

Keywords: Internet, innovation diffusion, supply-push and demand-pull, driving and restraining forces, Singapore

I. INTRODUCTION

As most innovation diffusion research originate from the West, especially the United States, it is beneficial to understand the differences or similarities of Internet diffusion in other parts of the world. Thus far, the diffusion of the Internet in Singapore has not been analyzed, despite its exponential growth locally. The authors believe that Singapore is an ideal place to study Internet diffusion because the city state is well known for its information technology (IT) innovations and usage especially since the launch of the IT2000 master plan in the early 1990s [National Computer Board, 1992].

Singapore's IT2000 master plan is aimed at leveraging IT to provide the nation state with a competitive thriving economy and improving the quality of life of Singaporeans [National Computer Board, 1992]. The government in Singapore is very much pro-IT and has been instrumental in developing the IT infrastructure for the island state [Gurbaxani et al, 1990b]. Today, Singapore is reputed to have one of the highest penetration rates of Internet in the world. Correspondingly, it also has the most chat groups which, in turn, send out the largest number of Internet messages in the world [Tan, 1995] relative to the size of its population. A late-1997 survey found that 25 percent of Singaporeans surf the Internet [The Business Times, 1998a]. In 1997, Singapore ONE (One Network for Everyone), a nationwide broadband high-speed network to deliver interactive, multimedia applications and services to every home, school and office in Singapore was launched officially. This network facilitated the demand-pull for Internet growth because users were no longer hindered by slow access speed. Indeed, Singapore is being cited as one of the five countries recognized as world leaders in electronic commerce [Corey, 1998; Vogel and Gricar, 1998].

Because the Internet, unlike any other IT innovation, attracted much more mass media coverage and publicity, it is interesting to analyze how the media convey messages about the Internet. Past research acknowledged that mass media and channels play a pivotal role in spreading information and creating awareness and knowledge about an innovation [Rogers, 1995]. Similarly, Groth

[1993] found that the wide media coverage of an innovation could also lead to forces that facilitate or inhibit its adoption. Therefore, the aim of this study is to examine the forces presented in mass media communications that influence Internet diffusion.

This study's contributions are two-fold - theory and practice. In terms of theory, this study uses the supply-push and demand-pull framework to understand the factors that influence the diffusion of the Internet [Kendall and Kendall, 1999]. If the findings are congruent with the framework, it provides evidence of the applicability of the supply-push and demand-pull model in the diffusion of the Internet. Further, this study provides IS researchers with another approach [that is, using content analysis] that is not widely used in information systems research to analyze data. Hence, this paper serves as a useful source for understanding content analysis since we provided detailed explanations of this methodology.

In terms of practice, although the findings may be specific to Singapore and therefore may not be representative to many countries or cultures, certain important lessons can be highlighted. Singapore is an interesting "test-bed" of IT innovations, and is often used as an example for countries in the Asia Pacific to model their IT plans and developments [Corey, 1998]. Hence, understanding the factors that influence the diffusion of the Internet provides insights and lessons for other countries. However, for regions where the Singapore cultural context is not applicable, this study forms the basis for future cross-cultural investigations. Thus, if this study is replicated elsewhere, cross-cultural comparisons may highlight various interesting insights on the diffusion of the Internet in other countries.

THE INTERNET IN SINGAPORE

In Singapore, the Internet was first available to academics at the National University of Singapore in the late 1980's. In January 1992, Technet was set up to make the Internet available to the rest of the research and development

community. In 1993, the National Computer Board, the National University of Singapore, and the Ministry of Education introduced the Internet to schools.

The launch of the first commercial Internet service provider (ISP), Singnet, in July 1994, was a milestone. This service provided a gateway for the general public and businesses to tap into the vast variety of information on the Internet, thus enabling Singapore to move closer to attaining its vision of the "Intelligent Island". In September 1995, Technet became the second ISP when it was privatized and renamed as PacificNet. The third ISP, Cyberway, was launched in March 1996.

An estimated 25 percent of the population are Internet users (including dial-up subscribers, commercial users, schools, cybercafes, etc.) [The Business Times, 1998a] (or about 1 million out of a population of about 4 million by December 1999), and this represents a substantial growth from the 52,000 users in early 1995. With the massive growth of the Internet, a thorough understanding of the dynamics behind the diffusion of the Internet has important implications. As noted by Huff [1987], “if we ever hope to control and shape a new technology to our own ends, we must understand as much as possible about the forces with which we are dealing” (p. 7). Hence, this research aims to provide some insights into the driving and restraining forces of Internet diffusion. In particular, the focus is on how the printed mass media communicates and brings about the awareness of the Internet that leads to its diffusion.

II. THE RESEARCH FRAMEWORK

The supply-push and demand-pull model is widely used to analyze the motivations and driving forces behind technology innovations [e.g., King et al., 1994]. However, the issue of whether the diffusion of the innovation is assisted more by the supply push action or the demand-pull for the technology is often debated [Scherer, 1982; Schmookler, 1966; Verspagen and Kleinknecht, 1990; Kendall and Kendall, 1999]. The supply-push concept assumes that the major

motivating force for innovation comes from the production of the innovation. The main argument is that the innovation is created by the results of forces and the effects of the efforts is traceable to the proponents of the technology [Groth, 1993; Gurbaxani et al., 1990a]. In other words, the technology is created based on the advancement of science and its inventions move into usable practical form.

The demand-pull concept, on the other hand, implies that the innovations can be used in practice and thus fulfill certain needs. Such needs of the society will be articulated through the mechanism of the market to create or spread the capacity of use. Thus, before the innovation can be widely adopted, there must be demand-pull incentives such that the innovations can fulfill economic and social needs. Hence, the demand-pull forces have their origins in the market forces in contrast to the supply-push forces that are derived from the proponents of science and technology. If the Internet is to play an important role in the national economic development of Singapore, then it is appropriate to study the roles of the supply-push and the demand-pull in the context of their contributions as mechanisms of economic growth.

King et al. [1994, p 140] define diffusion as "the spread of the capacity to produce and/or use an innovation, and its use in practice." This study uses the supply-push and demand-pull model to analyze the driving forces that influence the capacity to produce more Internet services or products and the restraining forces that limit the motivation to spread its use or production. Figure 1 shows the research framework. It consists of two forces - driving and restraining - that stem from a complex interplay of the four constructs comprising

- political,
- technological,
- economic and
- social

factors used in other research [Groth, 1993; Gurbaxani et al., 1990a]. However, the notions of supply push and demand-pull are applicable to the driving forces.

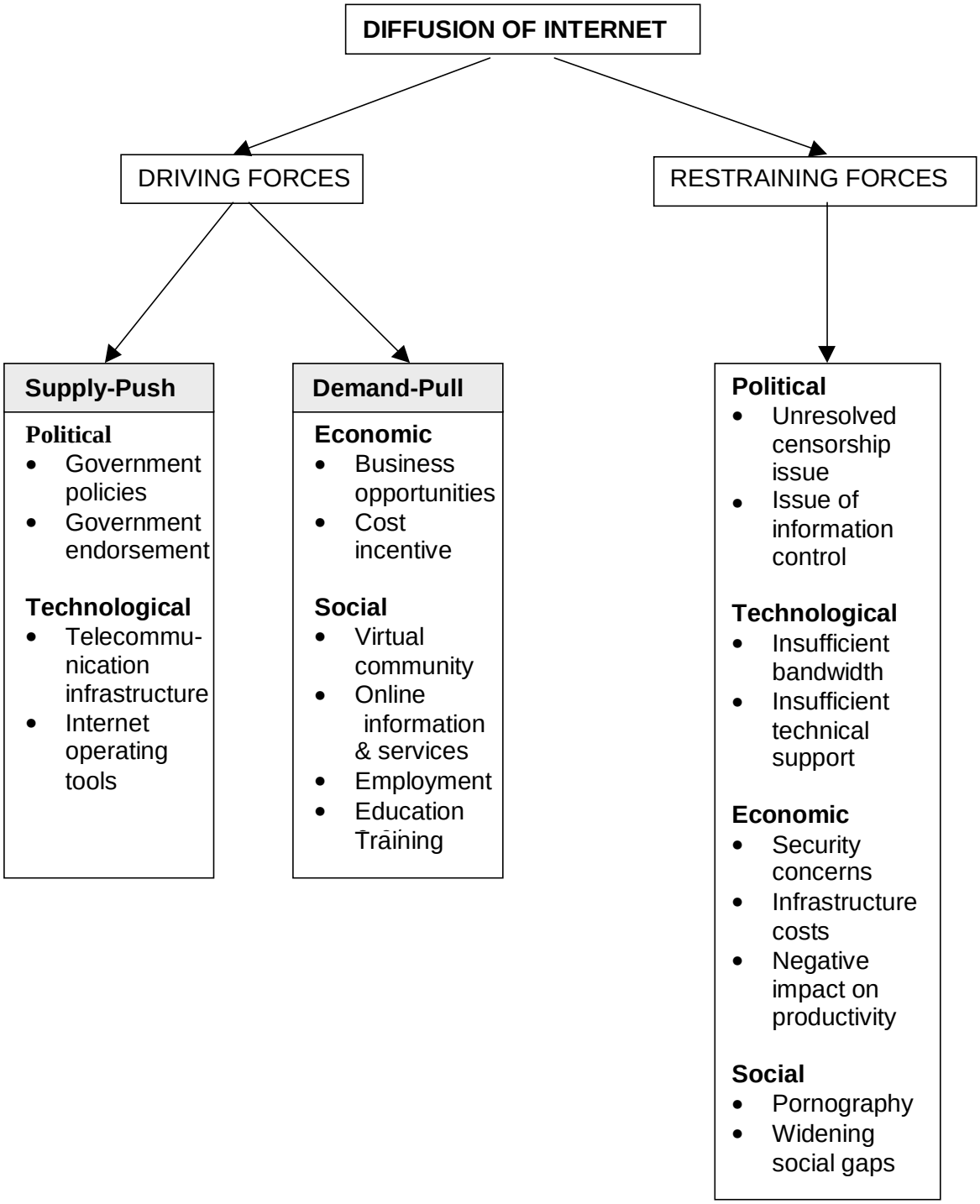

Figure 1. Research Framework

It is logical to connote the ideas of push and pull with positive driving forces because of the growth in the Internet. The restraining forces, although not classified as push or pull forces, nevertheless do contain the four constructs to explain their negative implications or impacts.

POLITICAL FACTORS

Driving Forces

The role played by the government can influence the diffusion of the Internet. Woon [1993] and Blanning [1999] found that government policies provide the momentum to *push* and encourage greater use of IT. For example, if the government leads in the adoption of the innovation, it would provide confidence to the population that the innovation is useful. Thus, government intervention may constitute a key push factor [Muzumdar and Madey, 1995]. For example, Lai and Reeh [1995] found that government intervention was one of the key factors that *pushed* ISDN to success in Singapore. Goodman et al. [1994], found that the diffusion of the Internet around the world is based on the following factors:

- nations building their national information infrastructure and telecommunication backbones;
- deregulation of telecommunications encouraging international and regional initiatives; and
- establishing of grass root nets.

In Singapore, the government plays a major driving force in the adoption and diffusion of IT [Corey, 1998; Gurbaxani et al., 1990b; Jussawalla, et. al., 1992; King et al, 1994; Toh and Low, 1993]. The National IT Plan in 1986 [National Computer Board, 1985] and the IT2000 blueprint in 1991 [National Computer Board, 1992] are examples of initiatives taken by the Singapore government to promote the use of IT to boost its economy. The government took many initiatives to endorse and encourage Internet use. For example, Technet, the first Internet gateway in Singapore, was set up with a grant from the National

Science and Technology Board. Public Internet access services were made available through explicit government policies designed to proliferate Internet usage in Singapore. Government departments and institutions were encouraged to create their own Web pages. Furthermore, frequent ministerial endorsements made through public speeches encouraged the use of the Internet.

Although the role of the government in Internet diffusion was widely recognized, Goodman et al. [1994] also argued that strong government controls in all aspects of electronic communication can effectively cripple the network through ignorance. However, in a study that examined the role of the government in the evolution of the Internet, Kahn [1994] argued that government involvement is still essential for the Internet to continue its commercial and international trajectory. For example, the ability to conduct network-based business between countries requires the resolution of many legal issues such as intellectual property protection. In other words, government legislation on the Internet, such as cyber-laws or copyright laws that help to resolve the legal issues, is considered a driving force in the diffusion of the Internet because it provides users a platform of certainty or direction in its use or abuse.

Restraining Forces

Muzumdar and Madey [1995] highlighted that unresolved issues related to governance, regulation, and censorship constitute major factors that might restrain the diffusion of the Internet. Similarly, Henry et al. [1999] emphasized that political and regulatory issues may influence Internet diffusion. In Vietnam, although the physical infrastructure for the Internet is now in place, the government used the argument of national security to keep the Internet off-limits to most of its people [The Straits Times, 1996b]. Similarly, the Chinese government censored Internet access nationwide in a bid to stamp out ‘spiritual pollution’ [The Straits Times, 1996a]. When the governments of Vietnam and China realized the importance of the Internet in facilitating economic growth, restrictions on Internet access were relaxed [The Straits Times, 1997; The Business Times, 1998b].

In Singapore, although the government promotes the widespread use of the Internet, it is also concerned over the difficulties of regulating information flow that may threaten political stability, national harmony, and community values of Singaporeans [Ang and Nadarajan, 1996]. Hence, a desire to control information may lead to restrictions and constraints on Internet use, thereby acting as a restraining factor.

TECHNOLOGICAL FACTORS

Driving Forces

Although the goodness of the innovation itself constitutes a push factor in its subsequent adoption, it is insufficient to be a push factor by itself. The innovation must be readily available for its use and be widely adopted to create the critical mass for widespread diffusion. This growth will often arise from the rapidly increasing range of the improved technological resources, advanced features, and useful applications [Finnie, 1994]. For example, improved and user-friendly graphical interfaces, powerful search tools, and directories are key factors that may drive the pervasive use of the Internet. Indeed, Batty and Barr [1994] noted that the emergence of user-friendly interfaces is an important factor that contributes to the rapid growth of the Internet.

Besides the technology itself, numerous researchers found that technological infrastructure is also a crucial factor necessary for the rapid adoption and sustained usage of the innovation [Choi, 1988; Lee, 1988]. In Singapore, Ko [1990] and Teo and Lim [1998] noted that Singapore cannot succeed in exploiting information technology in all sectors of the economy unless the right IT infrastructure, products, and services are in place to meet the demands of the users. Thus, for widespread diffusion of the Internet, adequate telecommunication facilities and capabilities are important drivers [Muzumdar and Madey, 1995]. In Singapore, the government recognized the importance of a good technological infrastructure since the mid-1980s, when it spearheaded what is now the IT2000 plan to wire up the island. The IT2000 plan literally aims

to transform Singapore into an "intelligent island" where easy and expedient access and use of information is a way of life [National Computer Board, 1992].

Restraining Forces

Batty and Barr [1994] pointed out that insufficient bandwidth to move information and graphics along the rapidly increasing numbers of host computers is a key factor that may constrain the widespread diffusion of the Internet. In addition, Jones [1995] found that insufficient technical knowledge might also restrain individuals from adopting the Internet. In Singapore, the government intends to mitigate the bandwidth problem through the implementation of a nationwide broadband network that enables multimedia applications and services to be delivered in a speedy manner to every home, school and office [National Computer Board Web site, 1999].

ECONOMIC FACTORS

Driving Forces

Economic factors, in terms of financial benefits and cost savings, are major forces that motivate the adoption of a technology [Groth, 1993]. Although economic factors are present in the supply-push environment, it is the demand-pull scenario that propels the speed of adoption when the market recognizes that the use of the innovation will enable cost savings or earning revenue. This argument is well supported, as economic advantages are usually key justifications for the adoption of an innovation [Auger & Gallaugher, 1997; Tan & Teo, 1998].

Many studies [e.g. Hoffman et al., 1995; Kannan, Chang & Whinston, 1999; Teo & Tan, 1998] highlight commercial interests as an important contributing factor in the rapid growth of the Internet. Firms perceive various benefits such as new business opportunities and cost saving advantages as the Internet provides a cost effective way to access the global market [Teo & Tan, 1998]. Also, by linking buyers and sellers electronically, the Internet can help reduce transaction costs by facilitating communication, speeding up information exchange, and reducing the amount of paperwork [Finnie, 1994; Poon &

Swatman, 1999]. In summary, if the Internet could provide better coordination of the many business activities and facets amongst the business partners, it is likely that its adoption would be widespread and its use pervasive.

Restraining Forces

However, despite the exploding commercial interests in the Internet, some businesses are still hesitant to adopt it. There are concerns over security, vulnerability to intrusion of privacy [Wang, Lee and Wang, 1998], and the possibility of theft or destruction of key databases [Finnie, 1994; Soh et al., 1997]. In addition, companies may be inhibited from adopting the Internet because they expect to lose productivity when employees surf the Internet for personal use. Nejmeh [1994] and Chaumeil [1999] found that the high infrastructure and telecommunication costs required to access and exploit the Internet deter potential adopters. In a study on the adoption of open systems, Chau and Tam [1997] found that companies tend to focus more on their "ability to adopt" than on the "benefits of adoption."

SOCIAL FACTORS

Driving Forces

Salomon [1989] argued that the innovation has to satisfy some social needs before it can be diffused. Given, as evidence in support of his argument is the example of Minitel system in France. This innovation was initially intended to be a professional messaging service. However, its widespread adoption took place when it was used as an interactive personal messaging service to satisfy social and communication needs. This example clearly illustrates that social factors are more pronounced under the pull environment.

In terms of the Internet, Nejmeh [1994] cited the availability of a wealth of expertise and knowledge sources as one of the main factors which pull individuals and businesses to use the Internet. However, Smolowe [1995] highlighted that the vast majority of people access the Internet in search of social interaction, and not solely for information. He estimated that about 80 percent of all Internet users are looking for contact and commonality, companionship, and

community spirit. Elmer-Dewitt [1995] also argued that the Internet is less about commerce and more about community bonding. In particular, people are drawn into the Internet to communicate and socialize, as evidenced by the number of debates and discussions in the electronic chat rooms and newsgroups.

Palvia et al. [1995] examined the level of Internet awareness and usage at the two universities in Singapore. They found that the Internet, other than being a research and information gathering tool, was fast becoming a popular communication tool used to keep in touch with friends. The study also found that users were drawn into the Internet for recreation and entertainment. Similarly, Teo, Lim and Lai [1997] found that messaging and browsing activities are performed frequently by Internet users compared to purchasing and downloading activities. In a similar vein, Muzumdar and Madey [1995] argued that providing employment opportunities on the Internet might constitute a factor that pulls individuals into adopting it.

Restraining Forces

The widening social gaps between those who have access and those who do not have access to the Internet are social concerns over the use of the Internet [Muzumdar and Madey, 1995]. Batty and Barr [1994] noted that a new geography of information rich and poor is emerging with the information poor being deprived of access to the Internet and its vast array of information and services. Ratan [1995] voiced a similar concern that the Internet technology will widen the gaps between the rich and poor, the educated and uneducated, the computer literate and those who do not know how to use computers. Similarly, Katz and Aspen [1997] found evidence that Internet users are generally wealthier and more highly educated, and blacks and Hispanics are disproportionately unaware of the Internet.

Although the concern over widening social gaps may not necessarily be a restraining factor in Internet adoption, the existence of such social gaps usually mean that not everyone has the opportunity and economic means to adopt the Internet, thereby influencing the diffusion rate. For example, Chaumeil [1999]

highlighted that diffusion of the Internet in Argentina is constrained by affordability as the per-capita wage is US$500 while the price of a computer is about US$1000. In Singapore, the government tried to address this problem by making the Internet readily available at community centers, public libraries and schools.

Elmer-Dewitt [1994] and Van [1995] highlight the presence of widespread pornography on the Internet. Jones [1995] found that the fear of exposing children to pornographic materials is a major concern over the widespread use of the Internet. A study found pornographic sites popular among Internet users and these sites generate nearly 70 percent of revenue from online content market in the US and Western Europe [Kavanagh, 1999]. Indeed, it is this freedom of accessing such objectionable information readily that may lead many authorities to regulate the Internet with legislation and laws, and to impose and prosecute those who disseminate undesirable information. In Singapore, the government implemented regulations to cope with the problem of the presence of undesirable materials on the Internet. For example, Internet access providers are required to use proxy servers to screen and block out pornographic sites and objectionable information. Proxy servers can also be used to monitor sites visited by Internet users (although the ISPs have assured users that they have not taken such actions). The purpose of a proxy server is to act as a deterrent for Internet users who try to visit such sites. In the relatively conservative Asian culture in Singapore that frowns upon pornography, the penalty of being caught with pornographic materials is severe. In this regard, it is considered a restraining force.

RESEARCH HYPOTHESES

Given the increasing interests of the Internet in the various facets of commerce, education and entertainment, it is expected that the driving forces would predominate over restraining forces in the diffusion process [Chen, 1995]. Hence, hypothesis 1 is stated as:

Hypothesis 1: Driving factors predominate over restraining factors during Internet diffusion.

The above literature review shows that political, technological, economic, and social factors influence the diffusion of the Internet. However, each factor or force has a different impact during the course of the diffusion process. The prominent viewpoint is that the political and technological forces tend to emerge in the early stage of the innovation diffusion process, followed by the demand pull forces of economic and social forces in the later phase of the diffusion process [Freeman, 1994]. For example, Katz and Phillips [1982] showed that in the early days of electronic computer, the science and technology push predominated, with the demand-pull of economic and social factors prevailing only in the later stage. The works of Fleck [1983, 1988] on robotics showed a similar pattern of the early science-technology push, followed by the numerous system improvements driven by users and market demands in the subsequent stage. It is hypothesized that the Internet diffusion process be characterized by a similar pattern. Therefore, hypotheses 2 and 3 are stated as:

Hypothesis 2: Supply-push driving factors will predominate over demand-pull driving factors in the early period of Internet diffusion.

Hypothesis 3: Demand-pull driving factors will predominate over supply-push driving factors in the later period of Internet diffusion.

Note that this study focuses on taking a time slice of the diffusion process since the Internet is still growing rapidly. Specifically, we examine the forces covering the period when access to the Internet was made available to the public between the middle of 1994 and the end of 1995. Consequently, the terms "early period" and "later period" in hypotheses 2 and 3 refer mainly to the early awareness and late awareness or early knowledge stages of the diffusion process respectively (rather than the beginning and end stages of the diffusion process).

IV. RESEARCH METHOD

The study uses content analysis to analyze the data obtained from two local English-medium newspapers to test the hypotheses. Content analysis is a popular method used to examine the content of mass-media messages. Researchers in the field of mass communication primarily use content analysis to study how messages embedded in mass-mediated and public texts, such as public speeches and newspapers, are portrayed. Berelson [1952], a pioneer on content analysis, defines it as “a research technique for the objective, systematic and quantitative description of the manifest content of communication” (p.18).

Content analysis is “a research method that uses a set of procedures to make valid inferences from text" [Weber, 1990, p. 9]. As content analysis can provide vicarious knowledge about things which are not directly observable, it is, therefore, appropriate for this study since the driving and restraining forces of the Internet diffusion may not be directly observable. Further, content analysis is context sensitive, thereby enabling us to process the symbolic forms of the Internet phenomenon. It can also be used to describe trends or patterns of protocols over time, thus enabling us to trace the relative interplay of the factors over time.

THE SAMPLE

The data for content analyses were collected from two local English newspapers in Singapore: *The Straits Times* and *The Business Times.* These two papers were chosen because they are the main daily English newspapers in Singapore. The former is most widely read by the general public and the latter by the business community [Lee and Tan, 1993]. Both newspapers are independent and may cover the same news. However, their reports are written by different journalists. Hence, even though both papers may cover the same event, the write-up is different for the two newspapers. Therefore, we treated the two sources as independent.

The remaining local English newspaper (*The New Paper*) in Singapore was not used. It is a casual afternoon newspaper that tends to focus on sensational news. Furthermore, its major stories appear in *The Straits Times* the following day. Other sources such as magazines were not considered because their readerships would not be representative of the general population. Thus, considering them in the sample would unnecessary bias or flaw the findings.

Televisions and radio reports were not used. Television and radio news are covered in the two daily newspapers. Coding from television and radio would be unduly complex, complicated and expensive as coders would need special equipment to view and code the audio-and video-tapes that profile news on the Internet. Further, the training of coders would be more complex. A simpler data collection technique allows other researchers to duplicate the study in another cultural context. Thus, for the purpose of this study, only content analysis of printed form was used. It is therefore important to note that this study is valid only for newspaper sources. Generalizability of the results to countries where newspapers have small circulation and literacy levels are low may be limited as television and radio may have more influence compared to newspapers.

A sampling period of nineteen months, from 1st June 1994 to 31st December 1995 was selected for this study. Because we expected considerable publicity and media coverage in the month prior to the commencement of the first Internet service provider, Singnet on 1 July 1994, we selected 1 June 1994 as the starting point for the research. As 1995 was the year in which the Internet became a hot topic in the media, analysis of the entire year would ensure that the time period is sufficient to examine any changes in the media coverage and reporting of the Internet phenomenon.

All items or articles written about the Internet in the newspapers were taken as data. This choice is in accordance with Krippendorff [1980] who stated that anything connected with the phenomena of interest qualifies as data for content analysis. Thus, any news, feature stories, commentary articles, and letters to editors that mentioned for example, “Internet,” “cyberspace,” “information superhighway,” “net,” or "www" qualified as data for the study. A

total sample consisting of 767 articles (extracted electronically using Dow Jones retrieval services) was used as our data. To ensure that all the items reported were captured, a manual scanning of every issue of the two newspapers for the entire period was also conducted. Two students were used to scan the newspapers and verify the articles.

DEFINING THE CODING SCHEME

Central to any content analysis is the coding scheme used to classify and translate the content into sets of meaningful categories to provide the researcher with a symbolic account of the underlying phenomenon. A valid coding scheme can be accurately and consistently applied to permit reproducibility of the research. The coding scheme must satisfy three properties:

- mutually exclusive,
- exhaustive, and
- reliable

[Wimmer and Dominick, 1994]. Mutually exclusive means that a unit of analysis can be placed in one and only one category; no unit can fall simultaneously into two different categories. The coding scheme is deemed exhaustive if every unit of analysis fits into one of the categories. And finally, the coding scheme is reliable if different coders agree on the assignment of the categories for the data. To meet the above properties, the coding scheme was constructed based on the research framework in Figure 1. Thus, the coding scheme is derived from the supply-push and demand-pull framework, and in particular, the structure of the scheme is organized in accordance with the driving and restraining forces in the four categories: political, technological, social, and economic. The category pertaining to the driving forces consists of positive messages that are likely to facilitate diffusion by fostering positive beliefs towards the Internet. On the other hand, restraining forces consist of negative messages that are likely to inhibit Internet diffusion by fostering negative beliefs. As the categories for content analysis must be comprehensive and precise [Weber, 1990], we further developed more specific items to measure each variable in the category. For

example, we developed two items - ‘licensing requirement for the Internet service providers’ and ‘legislation on the Internet' to operationalize the variable, “government policies" in the supply-push construct. The detailed items for each category are in the coding scheme in Appendix A. The eight categories used are based on the research framework and include four driving forces and four restraining forces as illustrated in Figure 1.

To ensure that the coding scheme is comprehensive, a trial test was carried out to clarify the coding scheme and to provide further insights to maximize the mutual exclusiveness and exhaustiveness of the coding categories. Two undergraduates and two lecturers were asked to code a sample of the articles using the coding scheme. Any ambiguous categories were discussed and then fine-tuned for comprehension and precision.

SPECIFYING THE UNIT OF ANALYSIS

For the content of the newspaper articles to be analyzed and coded accurately, the unit of analysis needs to be defined. The unit of analysis is defined as the specific segment of content that is characterized by placing it in a given category [Holsti, 1969].

A simple approach is to code the newspaper article based on the over-all theme. However, as each newspaper article may contain several paragraphs with each paragraph having a different message, it would have been incorrect to place a specific code for the entire article. For a more precise analysis of the messages in each article, the paragraph is considered more appropriate, since each newspaper article is characterized by many short paragraphs. Thus, in this study, the *paragraph* is used as the unit of analysis within each newspaper article.

Smaller units allow more parsimonious coding of a series of relatively unambiguous task assertions [Newell and Simon,1972]. Thus, the paragraph is further decomposed into messages. A message is defined as a specific thought unit that conveys an idea or theme. Each message can be a sentence, a clause, or even a phrase that refers to the specific category identified in the coding

scheme. In cases where the paragraphs in the article relate to the same message, the article was considered to contain a single message, and therefore it carried one code. Conversely, when each paragraph of the same article carried different messages, the count is taken as the number of different messages carried in the article. In other words, the number of different codes is based on the number of different messages conveyed in the paragraphs. In this regard, the numbers of messages extracted for coding may exceed the number of articles, assuming some articles may convey more than one message.

TRAINING THE CODERS

The validity of the coded messages depends largely on the maturity of the coders in understanding the coding scheme and procedures. The coders must be trained sufficiently to understand the coding scheme and to undertake the coding procedures and structure consistently. Two newly graduated students were employed as coders for the study. As these graduates were frequent and ardent users of the Internet, they would find the task interesting and meaningful. Further, as each coder has 4 years of university education, it is assumed that each is sufficiently mature to understand the content of the newspaper articles and the coding task.

The two coders were given three training sessions, with each session lasting for three hours over a two-week period. The coders were first briefed on the coding scheme and were shown several examples on how to code the newspaper articles. Then, each coder was asked to code five articles that were obtained from other issues of the Straits Times and the Business Times that were taken outside the sampling period. The coders met with the researchers three days later with their coded articles. They compared and discussed each coded article resolving any coding ambiguity of the first trial batch of coding. Having explained some of the ambiguities, they were given the second round of ten trial articles. Again the coders and the researchers met three days later to verify and discuss the second trial batch. In the second round of independent coding, the coefficient of agreement between the coders increased to 0.84, from

0.72 in the first round. Following this improved coefficient of agreement, the coding scheme is deemed reliable because it satisfied the reliability requirement of 0.70 stipulated by Bowers and Courtright [1984].

After the two trial tests, the two coders then proceeded to code the actual sample of the data independently. Following Tan's [1991] argument, the newspaper articles were given to each coder in reverse order so as to minimize the effects of order as a result of coders' fatigue. That is, coder 1 received the Straits Times articles in ascending date order and the Business Times articles in descending order, while coder 2 received the Straits Times articles in descending date order and the Business Times articles in ascending date order. The entire coding process took two months. Each coder recorded the counts of each category of the article in a summary sheet from which the data was entered into the spreadsheet for analysis.

PROCEDURES FOR CODING

In content analysis, the procedures for data analysis comprise three steps: aggregation of each coders' ratings, totaling the overall counts of messages coded in each category, and the analysis of the messages [Weber, 1990]. In aggregating the codes, the evaluations of the two coders were aggregated according to the procedure used by D'Aveni and MacMillen [1990], David [1989] and Pearce and David [1987]. That is, an article was coded as containing certain messages if *both* coders indicated that these messages were conveyed in the same article. For example, in an article X, if coder 1 identified two messages, "*a"* and "*b",* whereas coder 2 only identified message "*a,"* then article X was deemed to contain only message "*a*." One count was registered for message "*a*." The total counts for message "*a*" are based on the aggregated coding of the entire sample of 767 articles.

The over-all counts for each message category, for example, political factor, were derived from the aggregate sum of messages grouped under the specific variables. For example, the frequency counts for "government policies" were first obtained by adding the counts of "licensing" and "legislation'. Similarly,

the frequency counts for "government endorsement" were obtained by adding the counts of "government use of the Internet", "Internet as part of IT2000 vision", and "global trend of the Internet". In turn, the over-all counts for political category were then derived from the collective sum of "government policies" and "government endorsement".

Occurrences of the messages in each category were then analyzed to determine relative importance. Higher relative counts reflected significance of the particular message within the specific category. In this study, relative counts of the various messages constitute the relative importance of the different factors in influencing the diffusion of the Internet in Singapore.

RELIABILITY TESTS

In this study, reliability in terms of stability and reproducibility were measured [Krippendorff, 1980]. Stability refers to the degree that a process remains invariant overtime, and this is termed intra-coder reliability. It is ascertained when the same content is coded by the same coder at two different points in time and yields consistent result. To assess stability, a random sample of 40 articles (approximately 5 percent of the sample) was given to each of the two coders to re-code at two different time points about one month apart. Cohen's [1960] kappa coefficient of agreement is used to assess the intra-coder consistency. The intra-coder coefficients for coders 1 and 2 are 0.86 and 0.92 respectively.

Reproducibility, which is the degree to which a process can be recreated under varying conditions and using different coders, should also be established. To obtain reproducibility based on the robustness in the coding structure, the inter-coder coefficient of agreement is computed based on the entire sample of 767 articles [Weber, 1990]. This coefficient is calculated using Cohen's kappa coefficient of agreement and the inter-coder coefficient was 0.85.

In using the minimum requirement of 0.70 as the coefficient of agreement as stipulated by Bowers and Courtright [1984], these results indicate that stability and reproducibility as validity tests were attained in this study. Therefore, we

conclude that the measures, procedures, and coding scheme used are sufficiently reliable, robust, and valid.

DATA ANALYSIS

To test the hypotheses, we segment the sampling periods into three different time frames: June to December 1994 as time period 1; January to June 1995 as time period 2; July to December 1995 as time period 3. Classifying the time periods is based on two reasons. First, we want to separate year 1994 from year 1995 as the latter year was the period in which the Internet gained widespread awareness in Singapore. For example, from June to December 1994, the number of Internet users increased by 4 percent from 50,000 to 52,000; from January to June 1995, the number of users rose by 8 percent from 52,000 to 56,000. However, from June to December 1995, the number of Internet users grew by almost 52 percent to reach 85,000 [Yap, 1996a]. Table 1 summarizes the number of Internet users and Figure 2 depicts the data in graphical form. Second, we want to ensure an approximate same number of months within each time frame for a more comparable and meaningful analysis [Kenkel, 1989].

Table 1. Growth of Internet Users in Singapore

Month and Year	Dial-in Subscribers	Number of Internet Users
June 94	-	50,000
December 94	2,000*	52,000
June 95	6,000*	56,000
December 95	35,000*	85,000
June 96	100,000*	291,000
December 96	150,000*	-
June 97	196,000	-
December 97	267,400	380,000
June 98	328,800	-
December 98	393,600	-
June 99	452,700	800,000
December 99	520,000*	1,000,000*

Source: Business Times [1999], Goh [1996], Ng [1996], TAS Website http://www.tas.gov.sg,Yap [1996a; 1996b]

* estimated

Notes:

(1) There are three ISPs: Singnet started in July 94, Pacific Internet started in Sept 95, and Cyberway started in Mar 96.

(2) For dial-up subscribers, the figures are obtained from TAS Website from June 97 to June 99. Prior to June 1997, the figures are estimated from press reports.

(3) The total number of Internet users (include dial-up subscribers, commercial users, schools, cybercafes, etc.) are derived from press reports. The estimated total number of Internet users is about 25% of the population [The Business Times, 1998a] or about 1 million users by December 1999

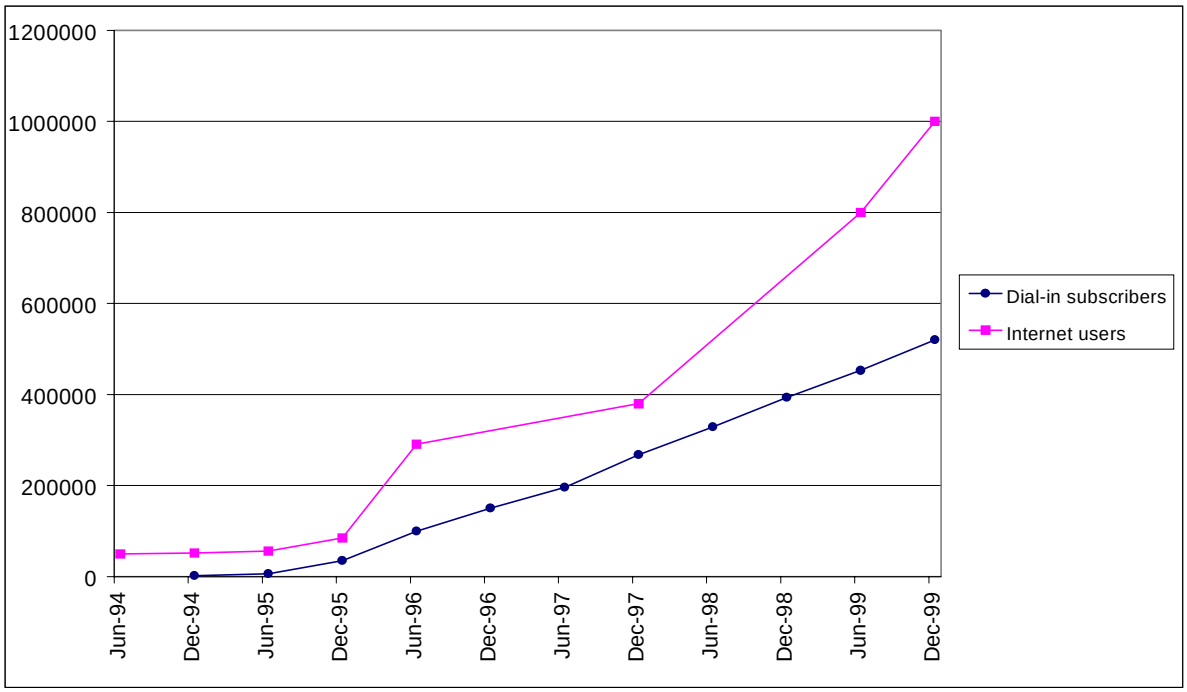

Figure 2. Growth of Internet Users

V. RESULTS AND FINDINGS

Table 2 summarizes the number and percent of driving and restraining messages. Altogether, an aggregate number of 894 messages were coded from the two local newspapers consisting of 767 articles. Out of the 894 messages, about 88 percent were driving messages while about 12 percent were restraining messages. This profile shows that the media appeared to place greater emphasis on those messages likely to promote diffusion by cultivating positive beliefs toward the Internet.

Table 2. Driving and Restraining Messages

Message	Number	%
Driving	784	87.7
Restraining	110	12.3
Total	894	100.0

Note: The total number of driving and restraining messages exceeded the number of articles because an article may contain more than one message.

Figure 3 shows the relative proportion of driving and restraining messages across the three time periods. This figure indicates that driving messages were portrayed to a greater extent than restraining messages throughout the three time periods. However, it is interesting to note that the relative percentage of restraining messages appears to increase over time. This finding appears to suggest that the press is reporting an increasing concern over the negative aspects of the Internet over time as the Internet becomes more familiar. One potential explanation is that as the Internet is more widely adopted and people gain more experience with it, they discover some negative unintended side effects (e.g., pornography, negative effects on productivity) that eventually receive media coverage.

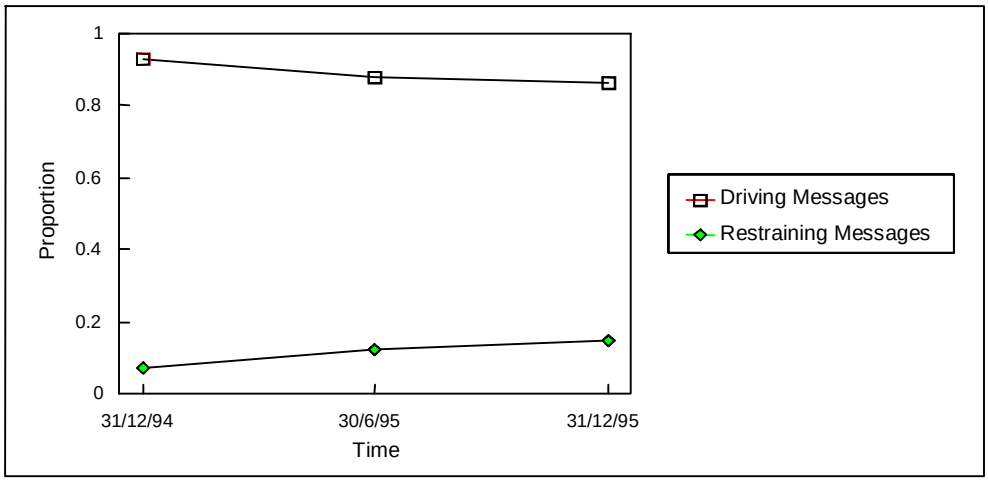

Figure 3. Relative Proportion of Driving and Restraining Messages across Time

Table 3 presents the results of chi-square tests carried out to determine whether there are any significant differences between the proportion of driving and restraining messages. For all the three time periods, the results show that driving messages were significantly greater than restraining messages. Thus, hypothesis 1, which states that driving factors will predominate over restraining factors during the Internet diffusion process, is supported.

Table 3. Results of Chi-square Tests (Driving vs. Restraining Messages)

Time Period	Driving Messages	Restraining Messages	Chi-square
1 (Jun-Dec 1994)	70	6	53.89*
2 (Jan-Jun 1995)	223	31	145.13*
3 (Jul-Dec 1995)	491	73	309.79*

*$p < 0.001$

Table 4 examines the detailed breakdown of the driving messages. It is seen that pull messages comprise nearly 60 percent of the driving forces while push messages constitute about 40 percent.

Table 4. Push and Pull Messages

Message	Number	%
Push	319	40.7
Pull	465	59.3
Total	784	100

An examination at the relative proportion of the various push-pull messages across time is shown in Figure 4. The results suggest that during the initial time period, push and pull messages were approximately equal in number. However, during the third time period, the proportion of pull messages dominated the push messages.

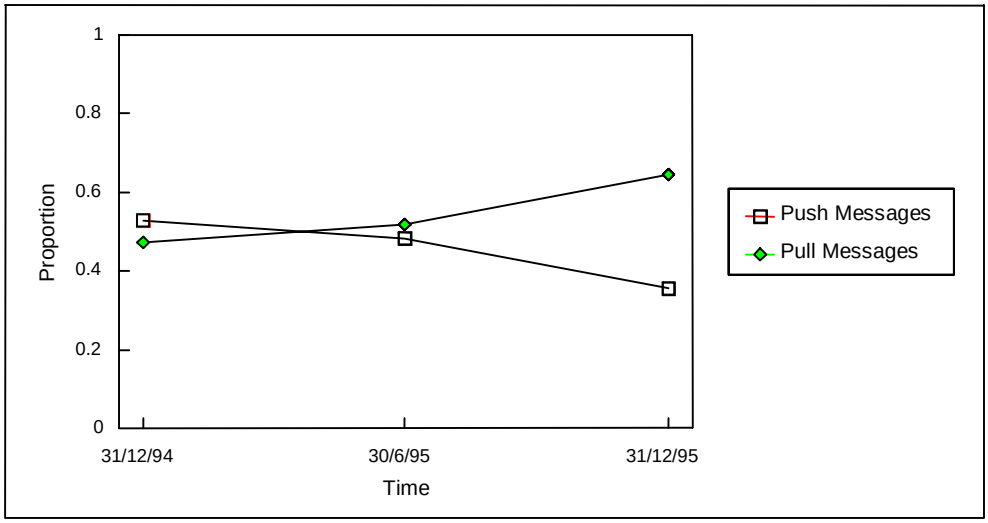

Figure 4. Relative Proportion of Push-Pull Messages across Time

Table 5 shows the results of chi-square tests carried out to compare the proportion of push and pull messages in the three time periods. For time periods 1 and 2, no significant differences were detected. Thus, hypothesis 2, which states that supply-push factors will predominate at the early stage of the diffusion, is not supported. This result is probably due to our definition of early period of diffusion. We defined the early period as comprising the second half of 1994 when public access service to the Internet was first made available in Singapore. However, the Internet was first available to the research and academic communities in Singapore in the late 1980s. This definition may explain why our results do not support the early preponderance of supply-push forces found by Katz and Phillips [1982] and Fleck [1983, 1988].

Table 5. Results of Chi-square Tests (Push vs. Pull Messages)

Time Period	Push Messages	Pull Messages	Chi-square
1 (Jun-Dec 1994)	39	31	0.91
2 (Jan-Jun 1995)	104	119	1.01
3 (Jul-Dec 1995)	176	315	39.35*

* $p < 0.001$

However, in time period 3, the results show pull messages were significantly greater than push messages. Thus, hypothesis 3, which states that demand-pull factors become more dominant during the later phase of the diffusion process, is supported. This finding is generally consistent with the findings of Katz and Phillips [1982] and Fleck [1983, 1985]. The results also point to the importance of demand-pull forces in speeding up the diffusion of the Internet, and further reaffirm the notion that no innovation will survive unless there are some genuine needs for it [Gurbaxani et al., 1990a; Kendall and Kendall, 1999]. In other words, it appears that the innovation must satisfy some perceived needs for a demand-pull presence.

ANALYSIS OF PUSH MESSAGES OVER TIME

To provide further insights into the driving factors, we examine in detail the relative proportion of push-pull messages over time. Figure 5 shows the relative proportion of various types of push messages across the three time periods.

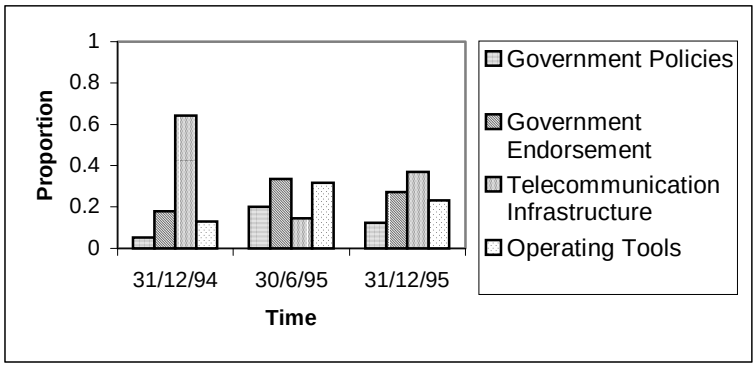

Figure 5. Relative Proportion of Push Messages across Time

As seen in Figure 5, the factor on "Telecommunication Infrastructure" appears to be the main push in the initial period of the diffusion time frame. Intuitively, this result is not surprising since the availability of such infrastructure is necessary for accessing and using the Internet. This period also coincided with the launch of Singnet. Singnet is the first public Internet access service provider in Singapore. The launch of Singnet suggests the importance of having

the first Internet gateway available to the general public in order for widespread Internet diffusion to take place.

"Telecommunication Infrastructure" is also the main push factor in the later stage of Internet diffusion. This observation may seem contradictory, as telecommunication infrastructure should be more predominant during the initial stage of the diffusion process. However, this result may not be entirely surprising because of the way Internet developed in Singapore. For example, in September 1995, Technet was privatized and the third Internet service provider was announced. Period 3, as defined in the study represents another phase in the development of the Internet access facilities in Singapore. During this period, there were two Internet gateways, and they were offering many incentives to hook up to the Internet. Further, numerous cyber cafes were also set up.

In time period 2, "Government Endorsement" was the dominant push factor. This finding reaffirms the key role, played by the Singapore government in pushing the diffusion of IT in Singapore [Jussawalla, et al., 1992; Teo and Lim, 1998; Toh and Low, 1993]. The trend parallels the government's strategy to use IT in every facet of economic and social development for the country. The government did not stop short of just motivating the use of the Internet. Indeed, the government became a lead-user of the Internet itself. For example, most government bodies and agencies put up their web pages not only for information purposes, but also to perform basic transactions (see http://www.gov.sg/).

"Operating Tools" appears to be a push factor in the second phase of the Internet diffusion period. This period saw the emergence of new types of software and tools that help to reduce the complexity of accessing and using the Internet. For example, "Hot Java" launched in May 1995 created excitement. "Hot Java" is a tool used to help individuals to incorporate animation into their Internet pages. Various other search tools and engines were marketed to make searching for information on the Internet easier and more convenient. This observation supports the arguments of Batty and Barr [1994] and Finnie [1994] that user-friendly interfaces and improved search tools are key factors that would drive the growth of the Internet.

ANALYSIS OF PULL MESSAGES OVER TIME

Figure 6 shows the relative proportion of the various pull messages across the three time periods. An examination of the messages shows that the category "On-line Information and Services" appears to be the key pull factor throughout the entire period. This finding is not surprising since the widely increasing range of information on the Internet is often seen as the key benefit of the Internet technology [Batty and Barr, 1994; Teo, Lim and Lai, 1997].

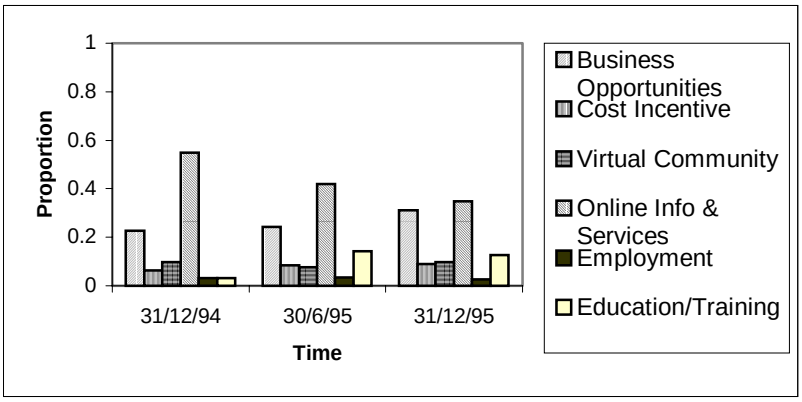

Figure 6. Relative Proportion of Pull Messages across Time

Notably, periods 2 and 3 coincide with the launch of a great number of local information sites and home pages on the World Wide Web, for example, Singapore InfoMap, InfoYouth, National Library, and AsiaOne. This phenomenon suggests that the novelty of having local content may be a contributing factor to the explosive growth of the Internet in Singapore. Local content [Yap 1996a] makes the Internet less foreign because:

- Singaporeans are able to identify the content easily, and
- They can see the convenience of obtaining information which used to be cumbersome to obtain

thereby, attracting more locals to join in the Internet wave. It is, therefore, not surprising that the Singapore InfoMap hit rate was about 10,000 times in the first

three weeks of its existence [Yap, 1995], while AsiaOne attracted an estimated 6 million hits a month in its first year of launch [Tay, 1996].

However, while "On-line Information and Services" remained the most prominent pull factor throughout the time period, the relative proportion of "Business Opportunities" increased over time. The rising commercial interests in the Internet may drive the prevalence of demand-pull factors during the later phase of the diffusion. This result appears consistent with previous studies that identified surging business interests as the key driving force of Internet diffusion [Ives and Jarvenpaa, 1995; Tan and Teo, 1998].

The rising commercial interests are probably due to the global and borderless nature of the Internet. Businesses are no longer confined to their physical domestic or local environment. Small businesses can now have the same opportunities as their bigger counterparts to reach worldwide markets and customers, and to explore new opportunities with the massive and rapidly increasing numbers of Internet users around the world. More and more local companies (such as Ken-Air Travel, Charis Natural Lab Pte Ltd) exploited the potential of using the Internet to provide information to customers and to create new services and products.

A pull factor "Education/Training" appears also to increase steadily over time. This increase is due to the sharp increase in the number of messages on "Internet Courses & Seminars." Intuitively, this trend seems to mirror the evolution of widespread awareness and diffusion of interests of the Internet in Singapore. It is only with the extensive interests in the Internet that many courses, seminars and conferences emerged to educate and train individuals and businesses to exploit its deployment and use more effectively.

ANALYSIS OF RESTRAINING MESSAGES OVER TIME

Figure 7 illustrates the relative proportion of restraining messages across time. It appears that economic factors received the most extensive coverage of restraining messages followed by social factors. A detailed examination of the economic factors shows that "security concerns" is the dominant concern over

the use of the Internet. This finding is in line with past studies that identified security weaknesses as the key inhibitor to further diffusion of the Internet [Jones, 1995; Shon and Swatman, 1998]. Probably, the concern over security issues is caused by businesses wanting to conduct electronic transactions and payments on the Internet.

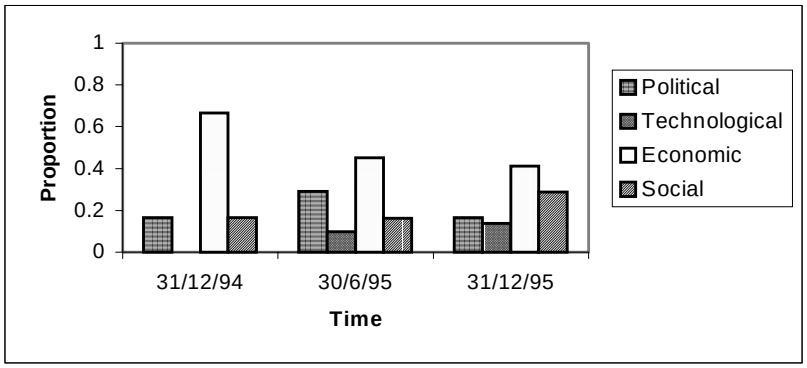

Figure 7. Relative Proportion of Restraining Messages across Time

Figure 7 also suggests that social factors become increasingly important over time. Further analysis reveals that the increase in importance of social factors is mainly driven by the rising concerns over the presence of "pornography" and other undesirable information on the Internet. Parents are unlikely to adopt the use of the Internet if such undesirable materials are easily accessible by their children. As the result, there is a need to implement regulations to curb such undesirable influences that may result from riding on the Internet wave. Further, the government is also concerned that objectionable and sensitive materials on the Internet may adversely influence its citizens [Jones, 1998; Van, 1995].

Despite the relatively small numbers of messages on technological factors, its relative proportion increases steadily across the time periods. Intuitively, this data seems to suggest that with the increasing traffic on the Internet, concerns over insufficient bandwidth, data congestion, and lack of

technical support would undoubtedly be critical success factors for Internet service providers.

A trend for political factors was less discernible. Further analysis showed that that the “issue of information control & regulation” remained as the most dominant political factor throughout the time period. This is to be expected given the considerable interests on how the local government can strike a balance between controlling information and developing Singapore to build an information society that will not affect its social, economic, and political stability [Ang and Nadarajan, 1996].

VI. DISCUSSION AND CONCLUSION

The results of the content analysis of the two main local newspaper articles on the diffusion of the Internet led to the following insights into the Internet phenomenon in Singapore:

First, the findings indicate that the press placed a greater emphasis on reporting messages that are likely to drive and foster positive beliefs towards the Internet. Although this study cannot claim any direct linkages and causal effect between the role of media and the diffusion of the Internet, the intriguing parallel between the widespread media coverage and the rapid growth of the Internet is in itself notable. However, it is important to note that the relationship is a "chicken and egg" question as to which came first, i.e., if there were no growth, there would be no media coverage; conversely if there were no media coverage, there would be much less growth. Hence, there is a symbiotic relationship between the role of the media and the diffusion of the Internet and it is difficult to say whether one drives the other.

Second, the findings illustrated that the Internet diffusion process is characterized by a dynamic interaction between the supply-push and demand-pull forces. The results did not support the hypothesis for an early-preponderance of supply-push factors found by Katz and Phillips [1982] and Fleck [1983, 1988]. Instead, both supply-push and demand-pull factors were

found to be equally significant during the early phase of the diffusion process. Nevertheless, the prevalence of the demand-pull factors at the later phase of the diffusion process was generally supported. This result reaffirms the notion that understanding the needs of the potential adopters plays a crucial role in stimulating the innovation diffusion process. However, as this investigation of Internet diffusion is in a pro-IT culture country, the results must be interpreted with caution. The generalizability of the results to a non pro-IT cultural environment may be limited. Nevertheless, we feel that there are lessons to be learned from this study by other less developed countries in Asia and other parts of the world that are beginning to use the Internet.

Third, the results suggest that a good telecommunication infrastructure (in particular, the facilities for accessing the Internet) was the most significant push factor in the early stage of Internet diffusion in Singapore. The availability of a vast array of local information and services was found to be the major pull factor that drives Internet growth throughout the three diffusion periods. The surging economic interest in the Internet appeared to drive the predominance of demand-pull forces at the later period.

Fourth, although the press generally provided messages likely to cultivate positive beliefs toward the Internet, the results show that the press also emphasized negative aspects of the Internet over time. In line with Finnie [1994] and Aldridge, White and Forcht [1997], this study found that the issue of security pertaining to the Internet is the single most important concern. In addition, a rising concern was found over the availability of pornographic and other objectionable materials on the Internet.

The above four findings hold important institutional implications to policy makers in both private and public sectors. First, for policy makers who want to introduce Internet technology into their nations or organizations, the study suggests that they should place significant emphasis on both the supply-push and demand-pull factors at the initial stage, following by greater focus on the demand-pull factors in the later phase of diffusion. Presumably, by having more demand-pull messages to create the needs for the technology as the Internet

matures, the interest in adopting it will increase, thus creating a critical mass for its rapid diffusion.

To increase Internet diffusion, efforts should initially be directed to provide telecommunication infrastructure and facilities for accessing the Internet more expeditiously. In particular, the important task is to ensure access facilities are affordable and available to the general public both for individuals and organizations. This prescription is in line with Wu's [1996] findings that an inadequate information infrastructure coupled with high costs of computers and Internet services adversely affected the diffusion of the Internet in China.

In Singapore, access is made affordable through price and service competition among the three ISPs. Wide availability of Internet services is provided in public libraries and community centers. The Telecommunications Authority of Singapore also plays a part in the diffusion process by imposing penalties on any ISP that failed to attain at least 98 percent service level. However, the provision of access facilities alone is not sufficient. Efforts should also be directed towards the demand-pull factors to highlight how the technology can fulfill users economic and social needs. Specifically, education campaigns should aim at creating awareness on the varieties and richness of appropriate and useful on-line information and services in order to pull individuals and organizations into adopting the Internet.

Second, for policy makers who seek to increase the rate of Internet diffusion, this study suggests that the current focus should be placed on the demand-pull factors. As noted by Groth [1993], “it is easier to pull than push a string” (p. 23). Thus, this study brings glad tidings to policy makers since intervention through demand-pull factors usually require less efforts, resources, and time than one that centers on supply-push factors. In particular, efforts should concentrate on promoting the two key pull factors - “On-line Information and Services” and “Business Opportunities.” The continuing growth and diffusion of the Internet will depend on the quality and relevance of its information content [Nejmeh 1994; Kendall and Kendall, 1999]. Thus, information providers should concentrate on creating more stimulating content to meet the needs and

aspirations of the users. Since “local” content seems to be a key pull factor initially, organizations should continue to develop and provide new and updated local information on their Web sites.

As pointed out by Freeman [1994], much innovation research neglect the supply side and treats diffusion as a demand phenomenon. However, this study illustrates that both supply-push and demand-pull forces play important roles during the diffusion process. More important, the study shows the dynamics of the interaction between these two forces may change over time. Future studies should take into account the changing interplay of supply and demand forces over time. The developments of more sophisticated innovation models that embody dynamic interactions between these forces are warranted for future investigations.

ACKNOWLEDGEMENTS

The authors would like to thank Hwee Peng Goh for her assistance in this paper.

Editor’s Note: This article was received on July 24, 1999. It was with the authors for approximately one month for 1 revision. It was published on November 6, 1999.

REFERENCES

EDITOR’S NOTE: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
2. The contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. The author(s) of the Web pages, not CAIS, is (are) responsible for the accuracy of their content.
4. The author(s) of this article, not CAIS, is (are) responsible for the accuracy of the URL and version information.

Aldridge, A., M. White and K. Forcht (1997) "Security Considerations of Doing Business Via the Internet: Cautions to be Considered," *Internet Research: Electronic Networking Applications and Policy,* (7)1, pp. 9-15.

Ang, P.H. and B. Nadarajan, B. (1996) "Censorship and the Internet: A Singapore Perspective," *Communications of the.ACM*, (39)6, pp. 72-78.

Auger, P. and J.M. Gallaugher (1997) "Factors Affecting the Adoption of an Internet-Based Sales Presence for Small Business," *The Information Society*, (13), pp. 55-74.

Batty, M. and B. Barr (1994) "The Electronic Frontier: Exploring and Mapping Cyberspace," *Futures*, (26)7, pp. 699-712.

Berelson, B. (1952) *Content Analysis in Communication Research*. Chicago: The University of Chicago Press.

Blanning, R.W. (1999) "Establishing a Corporate Presence on the Internet in Singapore," *Journal of Organizational Computing and Electronic Commerce,* (9)1, 83-99.

Bowers, J.W. and J.A. Courtright (1984) *Communication Research Methods*. Glenview, IL: Scott, Foresman.

Chau, P.Y.K. and K.Y. Tam (March 1997), "Factors Affecting the Adoption of Open Systems: An Exploratory Study, *MIS Quarterly*, (21)1, pp. 1-24.

Chaumeil, T. (May/June 1999) "The Internet in Argentina: Study and Analysis of Government Policy," *On the Internet*, pp. 22-30.

Chen, T. (March 6, 1995) "Cyberspace Will Make Us All Global Citizens," *The Business Times*.

Choi, H.S. (1988) "Science Policy Mechanisms and Technology Development Strategy in Developing Countries, *Technological Forecasting and Social Change,* (33), pp. 279-292.

Cohen, J. (1960), "A Coefficient of Agreement for Nominal Scales," *Educational and Psychological Measurement*, (XX)1, pp. 37-46.

Corey, K.E. (May 25-29, 1998), "Electronic Space: Creating and Controlling Cyber Communities in Southeast Asia and the United States," *Electronic Space Workshop - CyberChoices: Determining Sociotechnical Futures*, Michigan State University, Sophia Antipolis, France, http://www.ssc.msu.edu/~Dean/K_ESPACE.htm

D'Aveni, R.A and I.C. MacMillan (1990) "Crisis and Content of Managerial Communications: A Study of the Focus of Attention of Top Managers in Surviving and Failing Firms," *Administrative Science Quarterly*, (35), pp. 634-657.

David, F.R. (1989) "How Companies Define Their Mission," *Long Range Planning,* (22)1, pp. 90-97.

Elmer-DeWitt, P. (July 25, 1994) "Battle for the Soul of the Internet," *Time*, pp. 34-40.

Elmer-DeWitt, P. (March 22, 1995) "Welcome to Cyberspace," *Time*, pp. 4-11.

Finnie, G. (May 30, 1994) "The Internet: Life in the Fast Lane," *Communications Week International*, pp. 22-27.

Fleck, J. (1983) "Robots in Manufacturing Organizations," In Winch, G (eds), *Information Techniques in Manufacturing Processes*. London: Rossendale.

Fleck, J. (1988) *Innofusion or diffusation? The Nature of Technological Developments in Robotics*, ESRC Programme on Information and Communication Technologies (PIC), Working paper series, University of Edinburgh.

Freeman, C. (1994), "The Economics of Technical Change," *Cambridge Journal of Economics*, (18), pp. 463-514.

Goh, A. (Nov, 11, 1996) "Service providers Invest Millions to Stay Ahead," *The Straits Times.*

Goodman, S.E., L.I. Press, S.R. Ruth and A.M. Rutkowski (1994) "The Global Diffusion of the Internet: Patterns and Problems," *Communications of the ACM,* (37)8, pp. 27-31.

Groth, J.C. (1993), "Critical Factors in Exploiting Technologies," *Management Decision Illustrative Issue 1994/95*, pp. 19-32.

Gurbaxani, V., J.L. King, K.L. Kraemer, F.W. McFarlan, K.S. Raman and C.S. Yap (1990a) "Institutions and the International Diffusion of Information Technology," *Proceedings of the 11th International Conference of Information Systems,* pp. 87-98.

Gurbaxani, V., J.L. King, K.L. Kraemer, S. Jarman, D. Jason, K.S. Raman, and C.S. Yap (1990b) "Government as the Driving Force Toward the Information Society: National Computer Policy in Singapore," *Information Society*, (7), pp. 155-185.

Henry, D., S. Cooke, P. Buckley, J. Dumagan, G. Gill, D. Pastore and S. LaPorte (1999) *The Emerging Digital Economy II,* US Department of Defence.

Hoffman, D.L., T.P. Novak, and P. Chatterjee (1995) "Commercial Scenarios for the Web: Opportunities and Challenges," *Journal of Computer-Mediated Communications,* Special Issue on Electronic Commerce, (1)3, http://www.ascusc.org/jcmc/vol1/issue3/vol1no3.html

Holsti, O. (1969) *Content Analysis for the Social Sciences and Humanities.* Reading MA: Addison-Wesley.

Huff, S.L. (1987) "Computing as Innovation," *Business Quarterly*, (52)1, pp. 7-9.

Ives, B. and S. Jarvenpaa (1995) *Electronic Commerce on the World Wide Web: A Case Study*, 1995 http://www.cox.smu.edu/mis/cases/webcase/introduction.html

Jones, G. (Aug 7-9, 1998) "The Good, the Bad and the Ugly," *Asia Magazine,* pp. 9-12.

Jones, M. (September 1995) "Technophobia: Afraid of Technology or the Hype?," *Internet Australasia*, (1)9, pp. 30-33.

Jussawalla, M., M.H. Toh, and L. Low (1992) "Singapore: An Intelligent City-State," *Asian Journal of Communication*, (*2*)3, pp. 31-54.

Kahn, R.E. (1994) "The Role of Government in the Evolution of the Internet," *Communication of the ACM,* (37)8, pp.15-19.

Kannan, P.K., A.M. Chang and A.B. Whinston (1998) "Marketing Information on the I-Way," *Communications of the ACM,* (41)3, pp. 35-43.

Katz, J. and P. Aspden (1997) "Motivations for and Barriers to Internet Usage: Results of a National Opinion Survey," *Internet Research: Electronic Netowrking and Policy,* (7)3, pp. 170-188.

Katz, B.G. and A. Phillips (1982) "Government, Technological Opportunities and the Emergence of the Computer Industry," in Giersch (eds), *Emerging Technologies*, Tubingen: J. C. B. Mobr, pp. 419-466.

Kavanagh, M. (May 27,1999) "Porn will Continue to Dominate Web Revenue," *Marketing Week,* London.

Kenkel, J.C. (1989) *Introductory Statistics for Management and Economics,* Boston: PWS-Kent Publishing Company.

Kendall, J.E. and K.E. Kendall (1999) "Information Delivery Systems: An Exploration of Web Pull and Push Technologies," *Communications of the AIS,* (1)14, 42pp.

King, J.L., K.L. Kraemer, F.W. McFarlan, K.S. Raman and C.S. Yap (June 1994) "Institutional Factors in Information Technology Innovation," *Information Systems Research,* (5)2, pp. 139-169.

Ko, K.H. (1990) "Promotion of IT Applications in Singapore: Policy Issues and Strategic Thrusts," in C.Y. Kuo, C.M. Loh and K.S. Raman (eds), *Information Technology and Singapore Society: Trends, Policies and Applications.* Singapore: Singapore University Press.

Krippendorff, K. (1980) *Content Analysis: An Introduction to its Methodology*. Beverly Hills CA: Sage Publications.

Lai, V.S. and B. Reeh (1995) "ISDN Implementation in the United States and Germany: A Cross-Country Assessment," *Information & Management*, (29), pp. 131-140.

Lee. C.O. (1988) "The Role of Government and R&D Infrastructure for Technology Development," *Technological Forecasting and Social Change,* (33), pp. 33-54.

Lee, S.K. and H.H. Tan (1993) "Rhetorical Vision of Men and Women Managers in Singapore," *Human Relations,* (46)4, pp. 527-542.

Muzumdar, M. and G. Madey (August 25-27, 1995) "The Information Superhighway: Key Elements Affecting its Development and a Framework for Analysis," *Proceedings of the First American Conference on Information Systems*, Pittsburgh, Pennsylvania, pp. 217-219.

National Computer Board (1985), *National IT Plan: A Strategic Framework,* National Computer Board, Singapore.

National Computer Board (1992). *The IT2000 Report: A vision of Intelligent Island,* SNP Publishers Pte Ltd, Singapore.

National Computer Board Website (1999) http://www.ncb.gov.sg

Nejmeh, B.A. (1994) "Internet: A Strategic Tool for the Software Enterprise," *Communications of the ACM*, (37)11, pp. 23-27.

Newell, A. and H.A. Simon (1972) *Human Problem Solving*. Englewood Cliffs, NJ: Prentice-Hall.

Ng, W.J. (April 8, 1996) "300,000 could Subscribe to Internet by Next Year," *The Straits Times*.

Palvia, S., L.T. Lai, T.L. Poh, C.E. Soh and P.L. Wong (29 June - 2 July, 1995) "A Study of Internet Awareness and Usage of the Two Universities in Singapore," *Proceedings of the 1995 Pan Pacific Conference on Information System*, Singapore, pp. 118-120.

Pearce, J.A.II and F. David, F (1987) "Corporate Mission Statements: The Bottom Line," *Academy of Management Executive,* (1)2, pp. 109-115.

Poon, S. and P. Swatman, (1999) "A Longitudinal Study of Expectations in Small Business Internet Commerce," *International Journal of Electronic Commerce,* (3)3, pp. 21-33.

Ratan, S., (March 22, 1995) "A New Divide Between Haves and Have-Nots?," *Time,* p. 25.

Rogers, E.M.(1995) *Diffusion of Innovations.* NY: The Free Press.

Salomon, J. (1989) "Policy-Making on Innovation: From Reflection to Action," in *Innovation at the Crossroads between Science and Technology*. The S. Neaman Press, pp. 35-49.

Scherer, F.M. (1982) "Demand-Pull and Technological Invention: Schmookler Revisited," *Journal of Industrial Economic,* (XXX)3, pp. 225-237.

Schmookler, J. (1966) *Invention and Economic Growth,* Cambridge: Harvard University Press.

Shon, T.H. and P.M.C. Swatman (1998) "Identifying Effectiveness Criteria for Internet Payment Systems," *Internet Research: Electronic Networking and Policy,* (8)3, pp. 202-218.

Smolowe, J. (March 22, 1995) "Intimate Strangers," *Time*, pp. 20-24.

Soh, C., Q.Y. Mah, F.Y. Gan, D. Chew and E. Reid (1997) "The Use of the Internet for Business: The Experience of Early Adopters in Singapore," *Internet Research,* (7)3, pp. 217-228.

TAS (Telecommunications Authority of Singapore) Website
http://www.tas.gov.sg/website/home.nsf/html/indexConsumers

Tan, M. (1991) *An Investigation of the Communication Behaviors of Systems Analysts*. Unpublished Doctoral Dissertation, University of Queensland.

Tan, M. and T.S.H. Teo (1998) "Factors Influencing the Adoption of the Internet," *International Journal of Electronic Commerce,* (2)3, pp. 5-18.

Tan, T. (May 30, 1995) "S'pore Sends Out Biggest Number of Internet Messages, Has Most Chat Groups," *The Straits Times*.

Tay, C.C. (Mar 22,1995) "Internet Explosion Opens Up New Business Opportunities," *The Straits Times*.

Teo, T.S.H. and V.K.G. Lim (1998) "Leveraging Information Technology (IT) to Achieve the IT2000 Vision: The Case of the Intelligent Island," *Behavior and Information Technology,* (17)2, pp. 113-123.

Teo, T.S.H., V.K.G. Lim and R.Y.C. Lai (1997) "Users and Users of the Internet: The Case of Singapore," *International Journal of Information Management,* (17)5, pp. 325-336.

Teo, T.S.H. and M. Tan (1998). "An Empirical Study of Adopters and Non-Adopters of the Internet in Singapore," (34), pp. 339-345.

The Business Times (January 19, 1998a) "25% of All Singaporeans Surf the Internet."

The Business Times (March 16, 1998b) "Great Leap in Number of China Internet Surfers."

The Business Times (June 5, 1999) "28% of Teens, Adults Surf the Net Each Week."

The Straits Times (September 6, 1996a) "China Blocks Access to World Wide Web Sites."

The Straits Times (September 12, 1996b) "World of Internet Still Off-Limits to Vietnamese."

The Straits Times (November 20, 1997) "Vietnam Poised to Surf the Internet."

Toh, M.H. and L. Low (1993) "The Intelligent City: Achieving the Next Lap," *Technology Analysis & Strategic Management,* (5)2, pp. 187-202.

Van, D.L. (May 1995) "Twilight Zone of the Id," *Time*, pp. 44-45.

Verspagen, B. and A. Kleinknecht (1990)"Demand and Innovation: Schmookler Reexamined," *Research Policy,* (19), pp. 387-394.

Vogel, D and J. Gricar (1988) "A Global Perspective on Electronic Commerce," *International Journal of Electronic Commerce*, (2)3, pp. 3-4.

Wang, H., M.K.O. Lee and C. Wang (1998) "Consumer privacy Concerns about Internet Marketing," *Communications of the ACM,* (41)3, pp. 63-69.

Weber, R.P. (1990) *Basic Content Analysis*. London: Sage Publications.

Wimmer, R.D. and J.R. Dominick (1994) *Mass Media Research: An Introduction.* Belmont CA: Wadsworth Publishing Company.

Woon, Y.S. (1993) *Government Policy and Diffusion of Information Technology Use in the Public Sector: A Comparative Study of Singapore and Hong Kong*. Unpublished Thesis, National University of Singapore.

Wu, W. (1996) "Great Leap or Long March: Some Policy Issues of the Development of the Internet in China," *Telecommunications Policy,* (20)9, pp. 699-711.

Yap, J., (April 23, 1995) "Information Center on Singapore a Hit with Internet Users," *The Straits Times*.

Yap, J. (January 2, 1996a) "1995: The Year Internet Became Household Word," *The Straits Times*.

Yap, J. (March 22, 1996b) "Singapore: The Next Internet Capital of Asia?," *The Straits Times.*

APPENDIX. CODING SCHEME

This appendix presents the definitions provided to the coders about how to categorize Internet news stories.

DRIVING FORCES

1. Political Factors

Government Policies

[1.1] Licensing

The licensing requirement for the provision of Internet services. E.g. bidding for Internet access licenses issued by Telecommunication Authority of Singapore.

[1.2] Legislation

The laws and regulations on the Internet. E.g. US's Communication Decency Act, Singapore's inter- ministries committee on the Internet to review changes in laws.

Government Endorsement

[1.3] Government Use of the Internet (Singapore Government Only)

The use of the Internet by the Singapore government and its related bodies. E.g. use of the Internet as feedback medium, setting up of web pages by the various ministries, statutory boards, & town councils.

[1.4] The Internet as Part of IT 2000 Vision

The Internet as a component of the IT2000 plan. E.g. provision of free Internet access facilities at schools & public libraries by the government, smart home concept.

[1.5] Global Trend (Other Countries & Governments)

The global trend of getting into the Internet. The focus is on countries and governments (other than Singapore) who get into the Internet.

2. Technological Factors

Telecommunication Infrastructure

[2.1] Telecommunications Facilities & Capabilities

The telecommunication facilities and capabilities for the Internet. E.g. cable link, ISDN, optical-fibre link, LIVEwire, wireless data communication, Internet backbone network.

[2.2] Internet Access Facilities & Services

The facilities or services that provide Internet access. E.g. Televiewe-Singnet service, Singnet/Pacific Net/Cyberway Internet services, PC's built-in access to Internet, cybercafes, SPH reading rooms & other places that are set up by ***private organizations*** *to provide Internet access facilities.*

Operating Tools

[2.3] Internet Tools & Protocols

The different types of Internet tools & protocols (excluding security tools). E.g. Internet basic service tools (e.g. e-mail, telnet, FTP, WWW, Gopher), resource/information discovery tools (e.g. Veronica, Workgroup agents, Archie), browsing/ surfing tools (e.g. Mosaic, Netscape, HotJava), language software (e.g. Mandarin, Tamil software), access protocols (e.g. PPP, SLIP).

[2.4] Security Tools

The security tools for use on the Internet. E.g. data encryption tools, firewall devices, filtering software.

3. Economic Factors

Business Opportunities

[3.1] Electronic Commerce

New business opportunities arising from doing transactions over/on the Internet. E.g. virtual retailing & storefronts, electronic publishing, electronic banking, marketing, advertising.

Cost Incentive

[3.2] Cost Savings

Cost savings opportunities arising from the use of the Internet. E.g. lower communication costs, lower cost of assessing & gathering information on the Internet, faster communication & information exchange, faster business transactions.

[3.3] Promotional/Discount Schemes

Promotional or discount schemes for Internet usage.

4. Social Factors

Virtual Community

[4.1] Social Interaction

The sense of community and social interaction on the Internet. E.g. making friends, falling in love, networking, keeping in touch, newsgroups.

On-line Information and Services

[4.2] Information Resources

Information resources and services available on the Internet. E.g. travel information, health information, movies, games.

Employment

[4.3] Job Opportunities

Career opportunities available on the Internet.

[4.4] Teleworking/Telecommuting

Opportunities of working from home using the Internet.

Education/Training

[4.5] Internet Courses & Seminars

Seminars/conferences/training courses on the Internet. It includes in-house Internet courses/seminars as well as courses/seminars targeted at the general public & the businesses.

[4.6] Guides on the Internet

All kinds of guides that help people to use the Internet. E.g. books, CD ROMs, Directories on the Internet.

RESTRAINING FORCES

5. Political Factors

[5.1] Copyrights Concerns

The issue of copyrights or intellectual property protections on the Internet.

[5.2] Issue of Information Control & Regulation

The difficulties involved in regulating & controlling information flow on the Internet. E.g. difficulty in controlling political propaganda.

6. Technological Factors

[6.1] Insufficient Bandwidth

The concerns over insufficient bandwidth, leading to Internet traffic congestion & slow transmission time.

[6.2] Insufficient Technical Support

The concerns over insufficient technical support from the Internet service providers.

7. Economic Factors

[7.1] Security Concerns

The concerns over intrusion, destruction or theft of data on the Internet, as well as the fears of getting computer viruses from use of the Internet.

[7.2] Usage & Infrastructure Costs

The concerns over the high costs involved in using the Internet. It includes both infrastructure costs and usage costs.

[7.3] Negative Impacts on Productivity

The concerns over the negative impacts on productivity when employees spend too much time on the Internet.

8. Social Concerns

[8.1] Pornography

The concerns over pornographic materials available on the Internet. E.g explicit pictures, on-line sexual solicitations, obscene communication.

[8.2] Widening Social Gaps

The concern over widening social inequalities between people who have access and those who have no access to the Internet.

ABOUT THE AUTHORS

Margaret Tan is an adjunct associate professor at The Logistics Institute - Asia Pacific at the National University of Singapore. Previously she was an associate professor in the Department of Decision Sciences and the Graduate School of Business, and a Program Director of the International Business Institute at the National University of Singapore. A founder of the Pacific Asia Conference for Information Systems (PACIS), she is currently its executive chair. She is also the Chair of the Asian Assembly for the Decision Analysis Society (DAS) of INFORMS; an advisory board member for McGraw-Hill (UK) in the Information Systems Series, an associate of the ORBICOM UNESCO Network, and a Fellow of the International Center for Electronic Commerce in Korea. Her research interests include the national information infrastructure of Asia Pacific, diffusion and adoption of electronic commerce, telemedicine, and port management and strategies.

Thompson S.H. Teo is Information Systems Area Coordinator in the Department of Decision Sciences at the National University of Singapore. He received his Ph.D. from the University of Pittsburgh. His current research interests include IS planning and management, teleworking, IT personnel, IT adoption and diffusion, and electronic commerce. He has published more than 40 papers in international refereed journals such as *Accounting, Management and Information Technologies, Behavior and Information Technology, Communications of the ACM*, *Database, Decision Sciences*, *European Journal of Information Systems*, *Information and Management*, *Information Technology and People, International Journal of Electronic Commerce, Journal of Economic Psychology*, *Journal of Information*

Technology Management, Journal of Management Information Systems, and *Omega*.