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The Profiles of Software Pirates among Tertiary Institutions in Singapore

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Abstract

The study seeks to examine the perception of software piracy as well as to discover its underlying factors among Singapore's three university communities. Some five hundred responses were gathered from students and staff. By means of cluster analysis and factor analysis, the results identify three clusters of pirate profiles as influenced by factors such as attitudes towards software publishers, general acceptance, convenience, and ethics. The decision tree method links each pirate profile to demographic and computer-related variables. It shows that while age is negatively related to software piracy, computer experience and computer usage demonstrates an ambiguous relationship to software piracy respectively. Further, the undergraduate students tend to be pirates more often than university employees, and the Malays tend to be less frequent pirates as compared to other races. It is hoped that the study will help the relevant policy makers to develop better strategies to protect and to enforce the intellectual property rights among the universities as well as in an increasingly knowledge-based economy such as Singapore.

Keywords: Software Piracy; Software Policy; Protection and Enforcement of Intellectual Property Rights; Cluster Analysis; Factor Analysis.

JEL Classifications: O34, K42

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1. Introduction

Software piracy has been described by some as the practice of "pirating" or "unauthorized copying" of a computer program that is neither site licensed nor in the public domain (Shim and Taylor, 1993). It is becoming economically devastating to companies that develop and market software as the business world becomes increasingly global and digital. A survey by Business Software Alliance (BSA) estimated that illegal software duplication cost the worldwide software industry US$29 billion in 2003 (Business Software Alliance, 2004). In Singapore, revenue losses due to software piracy alone rose dramatically to US$90 million in 2003, a rise of 182 percent from US$31.9 million in 2002. The piracy rate for Singapore was estimated at 43% in 2003, as compared to 22 and 29 percent respectively for the U.S. and U.K during the same period.

Numerous studies have found that the unauthorized copying of software has received increased attention as a form of unethical behavior in recent years and has developed into a widespread problem in university, government, and business environments (Sim et al, 1996, Athey, 1993), as well as among individuals (Athey, 1993). Recent studies have suggested that software piracy is a bigger problem in the academic community when compared with the business community (Karon, 1986; Swartz, 1986; Pallette, 1986; Shim and Taylor, 1989, 1988). Unauthorized software copying by faculty, staff and students has been identified as a key issue (DeLoughry, 1987; Im and Koen, 1990; Oz, 1990; Turner, 1990). A 1988 survey among member schools in the American Assembly of Collegiate Schools of Business revealed that 75.1% of the respondents agreed that software piracy indeed does occur in their

schools (Im and Koen, 1990). Further, in a study by Shim and Taylor (1988), about 90 percent of business school faculty members believed their colleagues had duplicated software illegally. A significant number of studies have reported an overwhelming use of pirated software by university students. This applies to universities in the U.S. (Sims, et al, 1996; Im and Epps, 1992; Solomon and O'Brien, 1990; Hosmer, 1988), New Zealand, Denmark (Fritzche and Becker, 1983), Canada and Sweden (Kowalski and Kowalski, 1990), Australia (Ang and Lo, 1998), Hong Kong (Wong et. al, 1990; Moores and Dhillon, 2000), Singapore (Moores and Dhaliwal, 2004), and Brunei (Rahim et. al, 1999).

In this study, we investigate the claim that software piracy is believed to be prevalent in educational institutions by conducting a study on the perception of the use of pirated software as well as its contributing factors among the three universities in Singapore. Models are formulated to identify the clusters as well as their underlying characteristics. The models will then be further analyzed using the data gathered from some five hundred respondents in the three universities. The study will identify factors that influence respondents' behavior in addition to linking profiles of pirates to demographic and computer-related variables. The results can help policy makers to develop better strategies for protecting and enforcing intellectual property rights among the universities and in Singapore generally.

2. Literature Review

It had been suggested by several studies that school was the worst place to inculcate honesty (Schab, 1991). Using data from Denmark, New Zealand, and the U.S., Fritzche and Becker (1983) found that students seemed to be no more ethical

than the practicing managers. Both Slater (1991) and Solomon and O'Brien (1990) specifically noted that business students seem to worry less about computing ethics than business executives. Oz (1990) observed that software piracy actually began before young business students became practicing managers. However, Beltramini et al. (1984) claimed that students of business behave in a more ethically conscientious way than those of other major disciplines.

A number of forces can explain the implied lack of ethical standards among business students. Hollon and Ulrich (1979) blamed it on the emphasis of analytical methods in business programs. Hosmer (1988) noted that students were not likely to appreciate the group impact they made on an organization and society if they were not trained in ethical principles. However, Martin (1982) found that students who had completed two mandatory university courses in ethics did not respond differently in ethical situations from students who failed to take these courses. Boxton and Rarick (1987) suggested that the fragmentation of education in universities did not foster moral sensitivity and growth, which led to insensitivity concerning ethical issues.

Sociologists suggested that moral principles evolved according to the experiences individuals had over their lifetimes (Lynn and Oldenquist, 1986; Kohlberg, 1972, 1982). Some researchers (Eining and Christensen, 1991; Reid et al., 1992; Ajzen and Fishbein, 1977; Lin et al., 1999) attributed widespread of software piracy to individuals' attitudes toward piracy behavior and peer norms. A few studies (Eining and Christensen, 1991; Peace and Galletta, 1996; Loch and Conger, 1996) have shown that students' piracy attitudes were significantly correlated with their actual software piracy behavior. However, Logsdon et al. (1994) did not find a strong link between levels of moral judgment and attitudes towards softlifting and they

argued that there were other factors in addition to moral judgment that can influence moral behavior.

Vitell and Davis (1990) highlighted that software piracy was so prevalent that it had become socially acceptable. In a study by Muncy and Vitell (1989), they observed that the most acceptable forms of "questionable" consumer practices were taping a record album or a movie or copying computer software. Even in the U.S and Canada, a significant number of businesses still viewed pirate copying as victimless crime, and an easy way to lower their technology spending (Field, 2004). Some students genuinely believed it was all right to make copies (Cohen and Cornwell, 1989). Some even believed that it was justifiable to use shareware ('free' trial versions of the actual application) before buying a legal copy of the actual software (Malhotra, 1994). Such behavior was viewed by software manufacturers as unethical.

One reason for softlifting might be acceptable cultural norms. According to Swinyard et. al. (1990), copyright and patent protection were inherent values in the Western world in which individual freedom and benefits were emphasized over social benefits, whereas Asian cultures had traditionally stressed the sharing of the originators' creative works with the society. Evidently, software was slow to achieve copyright protection in Japan and the Philippines (Greguras and Langenberg, 1985), and it is still only "partially" enforced in Malaysia, Indonesia, and Thailand. Although an attractive market for foreign software firms, the lack of legal protection for software in mainland China had raised major concerns (Blois, 1988; Greguras and Foster-Simons, 1985).

Generally, piracy control measures can be classified as: (1) technological solutions and innovative pricing, distribution and promotion; (2) enforcement of

software policy; and (3) legal strategies (monitoring and regulation). Some examples of technical protection were making laser-burn holes on floppy disks, writing data between sectors and imbedding counters to keep track of the number of copies made (Fersko-Weiss, 1987). More recently, technical-based protection generally used "dard" hard disks and dongles, while the software-based one used copy-protection codes that prevented software from being repeatedly copied or being loaded onto multiple machines (Prasad and Mahajan, 2003). It is probably true that no technological protection system yet devised is completely effective. In fact, more than one study (Cheng, 1995; Odier, 1987) had observed that the piracy act had become a 'rewarding' experience for those who successfully broke the technical protection!

Next is the economics debate of whether including technological protection on the software will be effective in lowering software piracy, or whether it will produce a socially efficient outcome. Novos and Waldman (1984) argued that software piracy produced inefficiency by lowering the publishers' incentive to produce in addition to reducing the consumers' demand for the legal copy of the product. Johnson (1985) concluded that software piracy reduced the producers' returns but its effect on price was ambiguous. In contrast, Besen (1986) and Liebowitz (1985) independently concluded that producer returns could increase with piracy. Takeyama (1994) argued that software publishers should price-discriminate by charging a lower price to those who were more likely to make copies. King and Lampe (2003) showed that when the producer was allowed to choose the degree of piracy prevention, piracy would not lead to higher profits if the monopoly producer could price-discriminate potential

pirates from buyers. In the absence of price discrimination, piracy would only lead to maximum profits when it was negatively linked to consumer willingness-to-pay.

Other research discussed the role of network effects on the marketing of software. Earlier network externality literature (Katz & Shapiro, 1986; Farrell & Saloner, 1986; Nascimento and Vanhonacker, 1988) concluded that a larger network size should be encouraged as it increased the software utility to potential buyers. Conner and Rumelt (1991) especially found that increased protection raised both price and profit, but with a network externality present, it was possible for increased protection to harm both the manufacturer and paying customers. This is supported by Shy and Thisse (1999) who showed that for strong network effects, no protection against piracy is equilibrium for a non-cooperative software industry. Looking at the role of the government in controlling piracy through choice of policy instrument, Banerjee (2003) found that if it was profitable for a monopolist to prevent piracy by installing a protective device, then not monitoring is the equilibrium.

An empirical study conducted by Givon et al. (1995) demonstrated that higher software piracy actually boosted the demand for legal software, as seen in the UK where pirated software was responsible for generating at least 80% of the legal sales of spreadsheets and word processors. In this case, a software firm would actually tolerate piracy by choosing minimal protection since doing so has the consequence of speeding up software adoption (Prasad and Mahajan, 2003); thus a firm needs a calculated trade-off between a hastened adoption of its software and a focus on the initial number of legal buyers.

Chen and Png (1999) examined the trade-off between pricing and monitoring of software publishers and suggested that since higher monitoring imposed greater

social loss than a price reduction, software publishers ought to focus on cutting pricing rather than spending more on enforcement to control software piracy. In contrast, Gopal and Sanders (1997) modeled potential users as forming a "club" to share the cost of copying. In this case, monitoring is more cost-effective for publishers than copyright protection.

3. Methodology

3.1 Data Collection

A pilot test was first carried out among 20 respondents in October 2003 before the administration of the actual survey. Finally, a survey of attitudes towards software piracy was conducted from November 2003 to May 2004. The data were collected from a sampling of 566 students and university employees from the three local universities in Singapore. Fieldwork was conducted in the form of street-intercept interviews at high human traffic locations at the three universities. Questionnaires were distributed to respondents who then completed them on site.

3.2 Factor Analysis Results and Cronbach's Alpha Coefficients

Based on Kini *et al* (2003) and Wong *et al* (1990), we used 19 variables (i.e., attitudinal statements) to measure attitudes towards software piracy. All 19 statements were anchored on a Likert-type scale ranging from (1) strongly agree to (5) strongly disagree. Based on the existing literature and the content of the statements, the 19 variables were a priori categorized into major groups of similar or related statements. Factor analysis was performed on each of these groups. The results are summarized in Table 1.

<Insert Table 1 here>

As shown, 17 of the attitudinal statements can be grouped into the following six underlying dimensions: (1) ethics, (2) property rights protection, (3) attitude towards software publishers, (4) convenience, (5) general acceptance, and (6) specific acceptance. Two statements ("unfair to copy" and "unethical to use") did not appear to fit into any of the underlying dimensions and did not seem to measure any construct substantially. Hence, they were removed from further analysis.

Eigenvalues in terms of percentage explained for each of the factors are also presented in Table 1. They are as follows: (1) attitudes towards software publishers (80.2%), (2) general acceptance (71.5%), (3) convenience (61.1%), (4) ethics (59.6%), (5) property rights protection (55.3%), (6) specific acceptance (55.2%).

To check the reliability of the six constructs listed above, Cronbach's alpha coefficients were also computed and they are presented in Table 1. As can be seen, the alpha coefficients are all above 0.70 and hence the constructs can be deemed reliable.

3.3 Cluster Analysis Results

Next, cluster analysis was performed on the sample of 566 respondents using the six factors derived from factor analysis as the clustering criteria. The SPSS TwoStep algorithm was used and a 3-cluster solution was found to be optimal. The cluster profiles are summarized in Table 2 and the multiple comparison results for each cluster in Table 3. As expected, the three clusters have very different profiles.

<Insert Tables 2 & 3 here>

The multiple comparison results further indicate the significant differences within each cluster with respect to the relative importance of the different clustering criteria. In particular, a distinct alphabet (e.g., A, B or C) under the "Group" column denotes a significantly different mean. To illustrate this with the results for Cluster 1, "rights" (mean = 2.19; Group = A) has the lowest mean that is significantly lower than all the other means. Also, the means for "attitude" (mean = 2.48; Group = B) and "ethics" (mean = 2.5; Group = B) are not significantly different from each other but are significantly higher than the mean for "rights" and significantly lower than the means for "convenience", "general acceptance" and "specific acceptance". Finally, the means for "convenience" (mean = 3.70; Group = C), "general acceptance" (mean = 3.73; Group = C) and "specific acceptance" (mean = 3.74; Group = C) are not significantly different from each other but are significantly higher than the means for all the other factors.

The following describes each cluster and its corresponding characteristics. The cluster profiles are plotted in Figure 1.

Cluster 1: Frequent pirates. This cluster contains 221 or 39 percent of the total respondents, representing the largest proportions of the respondents. It comprises individuals who are highly tolerant of convenient copying and they tend to use the university software either for non-university related work or use the software at home. These individuals usually possess low ethical codes, hold somewhat negative attitudes towards software publishers and have very low regards for property rights protection. Clearly this cluster is the most crucial group to target for combating software piracy.

Cluster 3: Infrequent pirates. This cluster is represented by 191 or 33.7 percent of the total respondents, and forms the other extreme. They possess very high

ethical codes, hold very positive attitudes towards software publishers and view property rights protection highly. They have fair tolerance for using university software for non-university related work or using the software at home but are very intolerant of convenient copying.

Cluster 2: Occasional pirates. They are the hybrid of the two extreme clusters, representing 154 or 27.2 percent of the total respondents. On one hand, they have very positive attitudes towards software publishers, hold somewhat high ethical codes and are intolerant of convenient copying. On the other hand, they are also highly tolerant of using university software for non-university related work or using the software at home. Further, they view property rights protection very lightly.

<Insert Figure 1 here>

3.4 Decision Tree Results

Finally, a decision tree (i.e., recursive partitioning using the Chi-square Automatic Interaction Detection [or CHAID] algorithm) is constructed to explore the associations of the three clusters identified above with the following demographic and computer-related characteristics: (1) computer experience [Exp], (2) computer usage per day [Use], (3) software use for assignments [Assign], (4) personal software use [Person], (5) job-related software use [Job], (6) gender [Gender], (7) ethnic group [Race], (8) age [Age], (9) student/faculty status [Sstat], and (10) affiliation/major [Major]. More details on CHAID can be found in the decision tree results as shown in Figure 2.

The decision tree results indicate that age is the most important demographic variable associated with the three clusters (p-value = 0.0001). In particular, respondents aged 35 and below have a higher probability of belonging to Cluster 1

(frequent pirates) whereas their older counterparts have a higher probability of belonging to Cluster 3 (infrequent pirates), indicating a negative relationship between age and piracy.

Result 1: Age is negatively related to software piracy.

This is consistent with the findings of a few studies (Highland, 1984; Shim and Taylor, 1988, 1989) that younger individuals are more likely to commit unethical acts by practicing software piracy. A more recent survey from Pew Internet and Jupiter Research found that the younger respondents (aged 18 to 29) were more likely to share files whereas the percentage of file-sharers dropped steadily with age (Greenspan, 2003). Our result is in contrast to a different study (Browning and Zabriskie, 1983) that claimed the younger age group demonstrates a higher level of ethical standards and yet another (Sims et al, 1996) that found older students tended to pirate more than younger students.

In addition, for those aged 36 and above, job-related software use is the next most important variable, with a p-value of 0.0637. Respondents who use software primarily for their job have a strong association with Cluster 3 (infrequent pirates) (64.71%) and those who do not use software primarily for their job have a strong association with both Cluster 3 (48.00%) as well as Cluster 2 (moderate pirates) (40.00%). However, in relating to the former, the latter demonstrates a relatively weaker association with cluster 3 (i.e., 48.00% vs. 64.71%).

Result 2: Among the older respondents, the use of university software primarily for their jobs is negatively related to software piracy.

This is in contrast to results obtained by Kini et. al (2003) who found no link between the primary purpose of software use and moral intensity or software piracy.

For respondents aged between 26 and 35, student/faculty status is the next most important variable associated with the three clusters (p-value = 0.0707). A relatively greater proportion of respondents who are faculty or staff belong to Cluster 3 (infrequent pirates) (41.49%) whereas a relatively greater proportion of respondents who are students belong to Cluster 1 (frequent pirates) (65.22%). This indicates a positive relationship between students and software piracy, at least for those aged 26-35.

Result 3a: The medium aged students are positively related to software piracy.

Result 3b: The medium aged university staff is negatively related to software piracy.

The positive relationship between students and piracy is consistent with a number of studies that found young students show an inclination to engage in some type of unethical behaviour (Lysonski and Gaidis, 1991) or, have manifested lower ethical standards and have a more pragmatic outlook when compared to practicing managers (Arlow and Ulrich, 1980; DeSalvia and Gemmill, 1971). Others such as Oz (1990), Paradice (1990), Solomon and O'Brien (1990), and Kievit (1991) found similar results when studying student populations.

For respondents aged 25 and below, computer experience is the next most important variable (p-value = 0.0037). In particular, respondents with eight or more years of experience tend to be in Cluster 3 (infrequent pirates) (60.00%), whereas those with four or fewer years of experience tend to be in Cluster 1 (frequent pirates) (53.33%). The remaining respondents tend to be distributed over the three clusters, with the highest proportion in Cluster 1 (40.38%). This result shows that young respondents (< 25 years old) who have less than four years of PC experience tend to be frequent pirates. However, those with more than 10 years of PC experience also

tend to be frequent pirates, demonstrating an ambiguous relationship between PC experience and piracy behavior, at least among those aged 25 and below.

Result 4: Among the younger respondents, computer experience is ambiguously related to software piracy.

Supporting our result, Rahim et al. (1999) found that students with longer computer experience tend to possess better knowledge about software, thus leading to higher frequency and duration of software use. This is likely to enhance the student's need to explore a variety of software packages to perform their tasks – original or pirated (Loch and Conger, 1996). This notion is supported by Wong et al (1990) who found greater software piracy among experienced computing students. In contrast, Kini et al. (2003) found those with advanced computer experience tend to demonstrate higher levels of moral intensity and thus were less likely to pirate software.

For the younger respondents with fewer than four years of computer experience, computer usage is the next most important variable with a p-value of 0.0238. Specifically, respondents with between four to ten hours of daily computer usage are associated with all three clusters, especially Cluster 2 (moderate pirates) (40.00%) while those with low (fewer than four hours) or high (10 hours or more) daily computer usage tend to be in Cluster 1 (frequent pirates) (66.25%). So among the young and less experienced PC users, those with medium PC usage tend to be occasional pirates whereas both the heavy and light PC users tend to be frequent pirates.

Result 5: Among the younger respondents with low PC experience, PC usage is ambiguously related to software piracy.

On one hand, our result is supported by Sims et al (1996) who found heavy PC users were also more likely to pirate software. Further, a recent survey from Jupiter Research and Pew Internet demonstrated that Internet users had little concern for copyright infringement and were more likely to share files (Greenspan, 2003). In contrast, Eining and Christensen (1991) suggested that those who used computers more would tend to pirate software less due to their higher respect for the efforts put in by software developers.

For the younger respondents with fewer than four years of computer experience and daily computer usage of between four to ten hours, the user's ethnic group is the next most important variable (p-value = 0.0561). A relatively higher proportion of Malay respondents is in Cluster 3 (infrequent pirates) (50.00%) and a relatively higher proportion of Chinese and Indian respondents is in Cluster 2 (occasional pirates) (48.72%). Once again, among the very young both in age and PC experience as well as those with medium PC usage, the Malays tend to be less frequent pirates as compared to the Chinese and Indians in Singapore.

Result #6: Among the younger respondents with low PC experience and intermediate PC usage, being a Malay tends to be negatively related to software piracy.

There are not many studies that found any link between ethnic group and software piracy. A recent U.S. survey actually found that file-sharers were equally as likely to be white, black or Hispanic (Greenspan, 2003).

Finally, software use for assignments, personal software use, gender, marital status, income or affiliation/major do not appear to be associated with the cluster membership.

4. Discussion

Some of the main causes of software piracy among the universities have been the absence of a clear software policy and a lack of understanding of the copyright law by students as well as a lack of vigorous law enforcement by academic officials (Im and Epps, 1992; Bird, 1995; Mason, 1990a). According to a study by Im and Koen's (1990), 35.7% of the Business schools at universities surveyed said they did not have formal policies against unauthorized software copying. A more recent survey by Robinson and Reithel (1994) indicated that only 64% of the private institutions and 61% of the public institutions had a software policy designed to discourage software piracy. Today, even when the universities had no knowledge of the infringement, they might still be held liable if they had the ability to control the activity that resulted in infringement and had some financial interest in the act (Hal Roach Studio, Inc. v. Richard Feiner & Co., 1984). Cook (1986, 1987) explained that students tend to pirate software because they were not told what was expected of them with respect to hardware/software use, or did not understand the legal definition of piracy and the consequences of noncompliance. This was further supported by Eining and Christensen (1991) who found that business students lacked an understanding of the laws regarding software copying. All three universities surveyed in Singapore do have explicit software policies for their staff and students and at least two of the local campuses are found to have diligently enforced it. This is evidenced by the recent fines of 20 students each of S$200 by National University of Singapore (NUS) and further fines of at least 5 by Nanyang Technological University (NTU) for illegal file-sharing or downloading of music (*The Straits Times*, 2004b).

Other factors contributing to software piracy in Singapore include the availability of pirated software, cultural differences regarding intellectual property rights, and the strength of copyright laws. The high availability of pirated software in Singapore is evident in frequent news reports regarding sudden official raids on private residences of piracy syndicate members and the confiscation of pirated goods worth S$1 to S$7 millions at the notorious Sim Lim Square (*The Straits Times*, 2003b). Further, as suggested by Swinyard et. al. (1990), as much as copyright and patent protection were inherent values of western culture in which individual freedom and benefits were emphasized over social benefits, they may be firmly against the grain of Asian culture, which supported the concept of sharing over protecting individual creative work.

The Singaporean government has made great efforts lately in combating software piracy by providing a stronger legal framework with higher intellectual property rights protection. This can be witnessed in the recently signed U.S. and Singapore Free Trade Agreement (FTA) and the subsequent passing of several related bills in 2004. Some of these bills were aimed at tightening laws covering items such as trademarks, patents, copyrights, and the manufacture of optical discs. For instance, under the Copyright Act of 2004, effective January 1, 2005, copyright infringement is to be treated as a criminal offence with a maximum of S$20,000 in fines and/or six months' jail, (*The Straits Times*, 2004a).

On the enforcement role played by the Singaporean government, indeed, the Intellectual Property Office of Singapore (IPOS), the official watchdog agency, has joined forces with the Business Software Alliance (BSA) (the major software publisher that represents Microsoft, Adobe, Macromedia and Symantec) and local law

enforcement units to launch several campaigns to educate businesses and the general public regarding software piracy. Piracy control measures taken include: a special hotline for anonymous tip-offs and to help businesses manage software assets properly; the distribution of posters with strong anti-piracy messages for display to businesses and owners of public venue and commercial buildings (Business Software Alliance, 2001); the issuing of stickers with the words "Say No! To Piracy" to software vendors for placement on covers of computer software (Intellectual Property Office of Singapore, 2004b); the screening of an anti-piracy trailer/advertisement in local movie theaters, on television networks, on radio stations and in newspapers (Intellectual Property Office of Singapore, 2004a). Additionally, IPOS has also been holding awareness talks in schools and universities (*The Straits Times*, 2002) along with organizing seminars to teach businesses software management and auditing (*The Straits Times*, 2004a).

It is true that no amount of technological protection devised is completely effective, so more recently software publishers shifted their focus to legal protection against copyright infringement (Mason, 1990a; Shim and Taylor, 1988). Although the legal solutions played a role in controlling software piracy, they were not as effective as other solutions (Malhotra, 1994). A recent study showed that only 17% of online users revealed they had reduced file-sharing activity due to fear of legal consequences (Greenspan, 2003). Further, a number of studies (Cheng et al., 1997; Malhotra, 1994; Noyelle, 1990) found that the high price of legitimate software was the main reason for justifying piracy acts. A study (Moores and Dhaliwal, 2004) that compared piracy behavior of students from Hong Kong and Singapore found that although the piracy level was lower in Singapore, Singapore pirates were less willing to accept cost as a

reason to stop buying. Therefore in terms of pricing, local software publishers can adopt innovative pricing strategies that include negotiated agreements, reasonably priced backups and multiple copies, institutional selling, licensing agreements, and strong customer support. IPOS had recently launched a program to offer SMEs a maximum discount of 40 percent on software products of six software companies: Microsoft, Adobe, Macromedia, Autodesk, Symantec and Borland. (*The Straits Times*, 2004a). It is hoped that these pricing measures would encourage users to buy legal copy and discourage piracy.

5. Conclusion

In order to reduce software piracy, a three-prong effort of prevention and enforcement measures by the universities, software publishers and government should be in place. On the part of the university community, a clearly stated software policy must be posted with students and staff duly informed of the importance of adherence and consequences for non-compliance. The universities can constantly provide the staff with the essential software tools needed to improve their performance and achievements of their goals. In addition, they can step up the monitoring by continuing to work with local software publishers in hiring internal auditors (Mason, 1990b; Clevander et. al, 1988) and conducting more regular software inventory checks. More importantly, the universities can encourage research in software piracy (Athey, 1990) and hold joint-seminars with IPOS/BSA to educate both the staff and students regarding the private and social cost of software piracy (Banerjee, 2003; Sims et. al, 1996). Further, as an effective deterrent, the universities and

organizations should not hesitate to identify individuals and situational characteristics of IT personnel who commit piracy acts (Harrington, 1996; Banerjee et al., 1998) in addition to imposing fines. At the same time, the university should continue to treat copyright infringement as a criminal offence as provided under the recently amended Copyright Act of 2004 and work with government and software publishers to prosecute offenders.

There is an alternative to copyright protection as in countries like Vietnam and to a lesser extent China which have resorted to adopting the open-source software as a solution to software piracy (*The Straits Times*, 2004c). Open-source software refers to software programs such as Linux that depends on sharing computer codes and are downloadable for free, and which can perform tasks similar to those of Microsoft Windows or Office. This open-source solution is challenging the belief in the ownership of ideas as the best way to promote innovation since there are obvious benefits of having input from a free range of ideas. Ironically, while copyright law makes sure that the creators of original work receive fair compensation, excessive copyright protection can ultimately promote a monopoly and hinder further innovations. Finally, discovering the best balance between intellectual property rights protection and ways to encourage the open exchange of ideas will decide how innovative a knowledge-based society such as Singapore becomes.

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Table 1: Factor Analysis Results and Alpha Coefficients

	Factor Loading	Eigenvalue (Percentage Explained)	Cronbach's Alpha Coefficient
Factor 1: Ethics		1.79 (59.55%)	0.805
Unlikely to be caught	0.638		
Minor effects on others	0.761		
Regardless of effects	0.894		
Factor 2: Property rights protection		1.66 (55.28%)	0.787
Copy if unprotected	0.761		
Copy if not for commercial purposes	0.769		
Copy if no penalty	0.699		
Factor 3: Attitude towards software publishers		1.61 (80.24%)	0.754
No worry	0.896		
Copy if don't buy	0.896		
Factor 4: Convenience		1.22 (61.08%)	0.759
Copy than buy	0.782		
Copy makes software popular	0.782		
Factor 5: General acceptance		2.14 (71.45%)	0.800
Copy like most	0.848		
Expensive software	0.848		
No one will be hurt	0.839		
Factor 6: Specific acceptance		2.21 (55.25%)	0.723
Use for assignment at home	0.705		
Personal use at home	0.848		
Use for non-university work	0.797		
Try out if intend to buy	0.599		

Table 2: Cluster Analysis: Mean Score of Clustering Criteria by Cluster

	Cluster 1 (N = 221)	**Cluster 2 (N = 154)**	**Cluster 3 (N = 191)**
Factor:			
Ethics	2.51	3.12	3.94
Rights	2.19	2.80	3.80
Attitude	2.48	3.28	4.06
Convenience	3.70	2.88	2.01
General acceptance	3.73	2.93	2.00
Specific acceptance	3.74	3.26	2.83

Table 3: Cluster Analysis: Multiple Comparison Results by Cluster

	Cluster 1		**Cluster 2**		**Cluster 3**	
	Mean	**Group**	**Mean**	**Group**	**Mean**	**Group**
Factor:						
Ethics	2.51	B	3.12	B	3.94	C/D
Rights	2.19	A	2.80	A	3.80	C
Attitude	2.48	B	3.28	C	4.06	D
Convenience	3.70	C	2.88	A	2.01	A
General acceptance	3.73	C	2.93	A	2.00	A
Specific acceptance	3.74	C	3.26	B/C	2.83	B

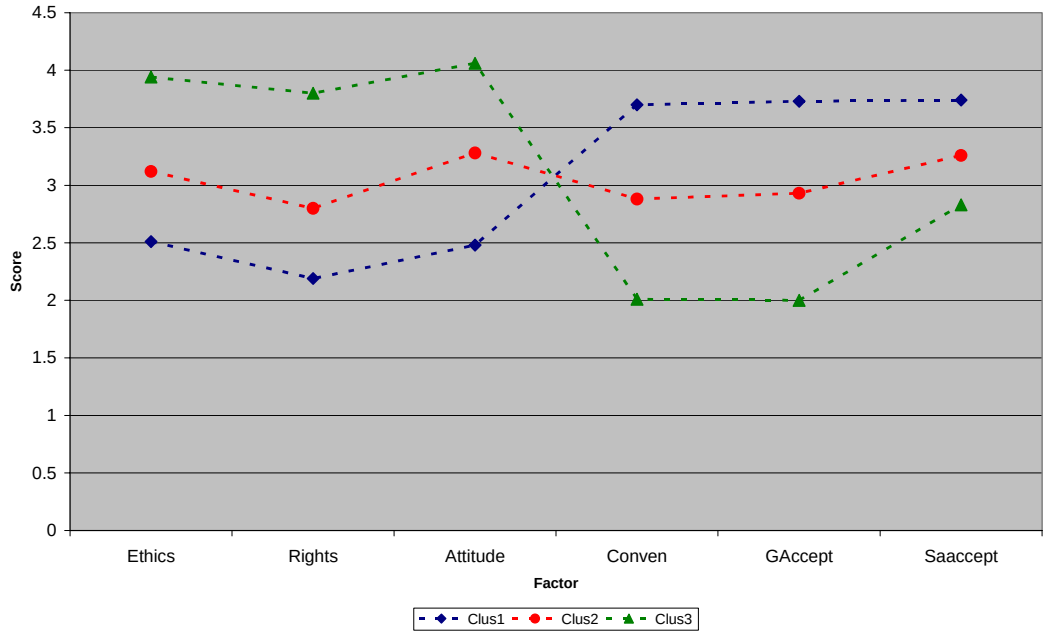
* Groups with the same letter are not significantly different at a 0.05 level.

Table 4: Software Piracy and Demographic Characteristics of the Sample (N = 566)

	Total	%
Part I: Screening Question		
University Status		
Students	348	61.4
Academic Staff	92	16.3
Non Academic Staff	126	22.3
Name of University		
Nanyang Technological University	233	41.2
National University of Singapore	176	31.1
Singapore Management University	157	27.7
Part II: Personal Computers Profile		
PC Ownership		
Yes	518	91.5
No	48	8.5
Number of PC(s) Owned		
0	47	8.3
1	267	47.2
2	168	29.7
3	58	10.2
More than 3	26	4.6
PC Experience		
< 2 years	56	9.9
2 – 4 years	114	20.1
4 – 6 years	140	24.7
6 – 8 years	97	17.1
8 – 10 years	62	11.1
> 10 years	97	17.1
Average hours of PC Usage		
< 2 hours	63	11.1
2 – 4 hours	117	20.7
4 – 6 hours	138	24.4
6 – 8 hours	127	22.4
8 – 10 hours	82	14.5
> 10 hours	39	6.9
Location of PC Access (multiple entries)		
Home	499	88.2
School	528	93.3
Others	65	11.5
Primary Use of Software (multiple entries)		
Completing assignments / projects	319	56.4
For personal use	241	42.6
For the job	199	35.2
Part III: Demographic Profile		
Gender		
Male	316	55.8
Female	250	44.2

Ethnic Group		
Chinese	360	63.6
Malay	103	18.2
Indian	81	14.3
Others	22	3.9
Nationality		
Singaporean / Permanent Resident (PR)	514	90.8
Others	52	9.2
Age Group		
17 – 21 years	130	23.0
22 – 25 years	186	32.9
26 – 35 years	140	24.7
36 – 45 years	75	13.2
46 – 55 years	31	5.5
Above 55 years	4	0.7
Student Status		
Staff	218	38.5
Undergraduate – Year 1	140	24.7
Undergraduate – Year 2	143	25.3
Undergraduate – Year 3	52	9.2
Undergraduate – Year 4	6	1.1
Graduate	7	1.2
Current Major		
Accountancy & Business	210	37.0
Arts & Social Science	49	8.7
Communication	21	3.7
Computer Science	26	4.6
Engineering	103	18.2
Information Technology	40	7.1
Science	26	4.6
Others	91	16.1
Monthly Family (Household) Income		
S$0	17	3.0
< S$1000	7	1.2
S$1,000 – S$2,999	112	19.8
S$3,000 – S$5,999	220	38.9
S$6,000 – S$8,999	126	22.2
S$9,000 – S$11,999	45	8.0
S$12,000 – S$14,999	25	4.4
Above S$14,999	14	2.5
Marital Status		
Married	148	26.1
Divorced	64	11.3
Single	353	62.4
Others	1	0.2

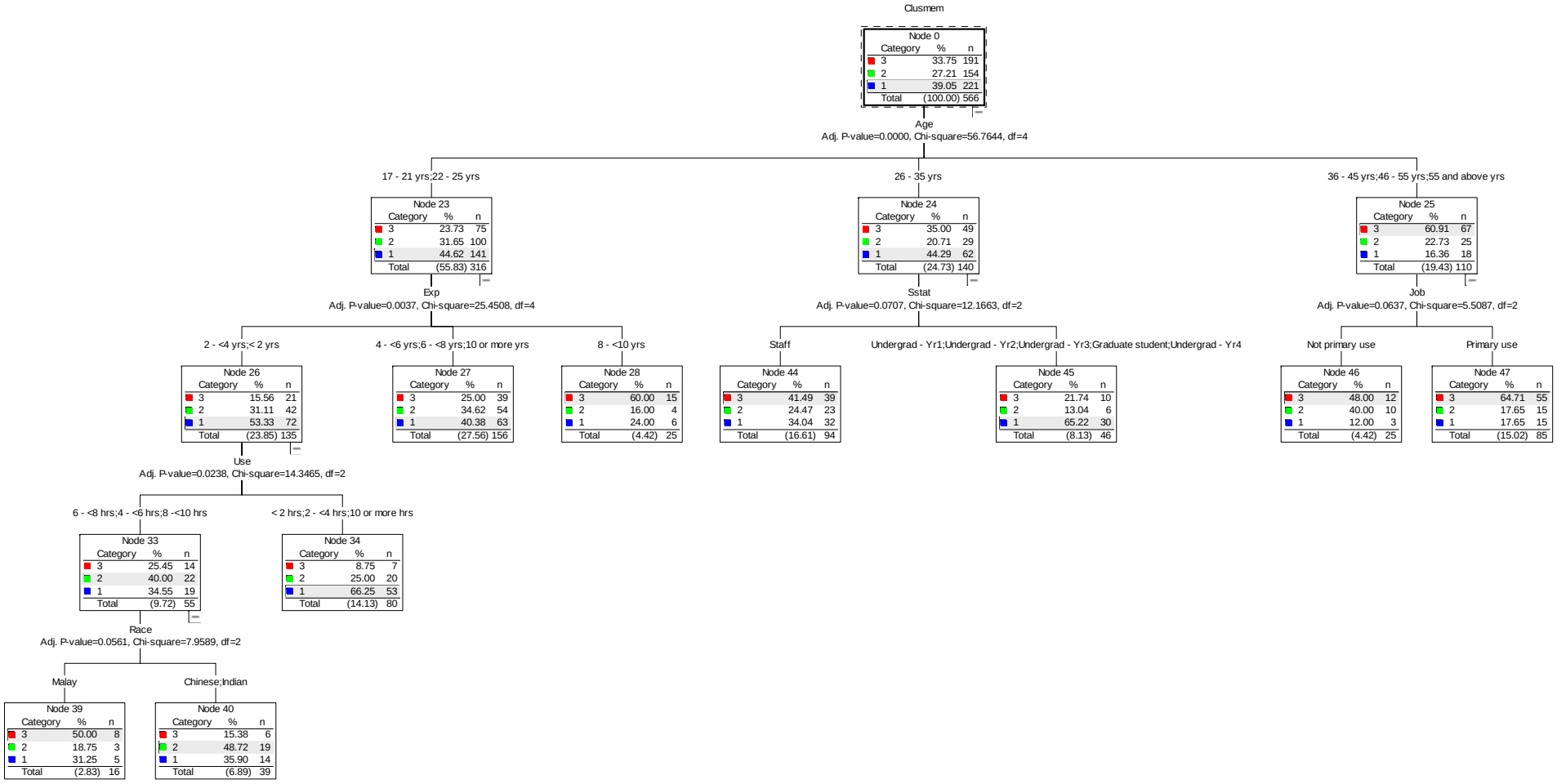
Figure 1: Profile Plot of Clusters



Legend:

Ethics = Ethics
Rights = Property rights protection
Attitude = Attitude towards software publishers
Conven = Convenience
Gaccept = General acceptance
Saccpet = Specific acceptance

Figure 2: Decision Tree Results



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