Association for Information Systems
AIS Electronic Library (AISeL)

PACIS 2005 Proceedings

Pacific Asia Conference on Information Systems (PACIS)

December 2005

Regret Avoidance as a Measure of DSS Success

Shin-Yuan Hung
National Chung Cheng University

Yi-Cheng Ku
National Sun Yat-sen University

Ting-Peng Liang
National Sun Yat-sen University

Chang-Jen Lee
National Chung Cheng University

Follow this and additional works at: http://aisel.aisnet.org/pacis2005

Regret Avoidance as a Measure of DSS Success

Shin-Yuan Hung[a]   Yi-Cheng Ku[b]   Ting-Peng Liang[b]   Chang-Jen Lee[a]

Department of Information Management

National Chung Cheng University[a]

National Sun Yat-sen University[b]

Kaohsiung, Taiwan

Abstract

Assessing the value of decision support systems (DSS) in organizations is an important line of research. Traditionally, researchers adopt user satisfaction and decision performance as two measures of system success. In some cases, however, the use of DSS may not be driven by satisfaction. Instead, avoiding possible decision errors may be the reason for adoption, which indicates that regret avoidance is another useful measure of DSS success. Regret is a post-decision feeling about not choosing a better alternative. Recent behavior research has indicated that, instead of pursuing higher performance and user satisfaction, reducing decision regret is another important consideration for many decision makers. This research extends prior research on DSS evaluation by proposing regret avoidance as an additional measure of effective DSS use. Results from a laboratory experiment that involves using DSS for stock investment show the existence of a significant effect of reducing regret in situations where user satisfaction level is not high. Hence, it is important to include regret reduction in measuring DSS effectiveness.

Keywords: Regret Theory, Decision Support Systems, Information Systems Evaluation, Information Systems Success

1. Introduction

Decision support systems (DSS) are information systems that facilitate decision-making by offering information access, model analysis, and tools support (Alter 1977; Keen and Scott Morton 1978). Previous research on DSS success is mixed. The nature of the system allows many to believe that the system has a positive impact on *decision performance* or *user satisfaction* by reducing the efforts, costs, and decision time in the process (Bharati and Chaudhury 2004; Guimaraes et al. 1992; Henderson and Schilling 1985; Holsapple and Whinston 1991; Kohli and Devaraj 2004). However, opposite research findings also exist. The impacts of the DSS on *decision performance* or *user satisfaction* were found insignificant (Gelderman 1998), or significantly negative (Gelderman 1995). These conflicting results suggest that additional considerations exist when decision makers use DSS.

Recently, there is a line of research that investigates the effect of psychological feeling of not choosing the best alternative (called regret) and how this may affect decision behavior (Bell 1982; Landman 1987; Tsiros 1998). People often feel bad after a decision is made, when they missed or

abandoned a better choice. The theory investigating the phenomena is known as the regret theory (Loomes and Sugden 1982). For example, Inman, et al (1997) proposed a generalized utility model to illustrate the effect of post-choice disappointment and regret. The model considers both chosen and forgone alternatives as the basis for valuation. The results show the exist of post-choice regret whose negative effect could be stronger than the positive impact of rejoicing.

Since regret is so annoying, most people are often willing to pay a cost or do something to avoid it (Bell 1982;Bell 1983). The effect of regret in human decision behavior has been reported in many areas such as negotiation (Larrick and Boles 1995) and consumer behavior research (Simonson 1992). Business practices taking advantage of regret avoidance are common in many countries. Companies allowing sold merchandise to be returned with no charge within a certain period of time in the United States is a good example. This grace period increases the likelihood of purchase because it reduces the potential regret from the customer. The behavior of regret avoidance could affect our decisions in that one may reject a decision if he felt that the decision is likely to cause regret (Gilovich and Medvec 1995), and the anticipation of regret may affect the decision process (Bell 1982; Loomes and Sugden 1982; Simonson 1992).

Given the important effect of regret in decision-making, it is interesting to investigate whether regret avoidance can be used as a new dimension for assessing the value of DSS and how this compares with the traditional measure of user satisfaction. In this research, an experiment was conducted to investigate the effect of DSS on decision regret, which includes DSS use as an independent variable, user responsibility as a moderating variable, and three dependent variables: decision performance, user satisfaction, and user regret. The result shows that the use of DSS could improve decision performance and reduce user regret, but good decision performance does not always guarantee a high level of user satisfaction. Therefore, decision regret should be included in assessing the value of DSS.

The remainder of the paper is organized as follows. Literature relevant to the evaluation of DSS is briefly reviewed. The research framework and experimental design of this study are described in Section 3. Data analyses and research findings are presented in Section 4. Finally, managerial implications and future research issues are discussed.

2. Using Regret to measure DSS Success

Measuring systems success is an important issue in information systems research. In prior literature, two categories of variables are used to measure DSS success: one is process-oriented, such as the frequency or length of system usage, and the other is outcome-oriented, such as decision performance and user satisfaction (Ginzberg 1983; Humphreys et al. 1983; Ives and Olson 1984; Shirani et al. 1998). Since the conceptual "value analysis" proposed by Keen (1981), a number of studies that investigated the effect of DSS using different methodologies, including case studies, field studies, and laboratory experiments, have been published (Alavi and Joachimsthaler 1992; Sharda et al. 1988). However, the results of those studies are inconsistent. Some studies have reported a positive value of using DSS, while others found the relationships between DSS usage and performance to be uncertain (Benbasat and Nault 1990; Eom and Lee 1990; Ives and Olson 1984; Sharda et al. 1988). This implies that there may exist other factors that have not been investigated but can justify DSS use. In this section, we review existing DSS

success measures and the development of regret theory that can be an additional aspect for measuring DSS success.

2.1 Decision performance and user satisfaction

DSS success has been viewed from a variety of perspectives in previous research, including user satisfaction and decision-making satisfaction, level of DSS usage, perceived benefits of DSS, improved decision quality and performance, and business profitability (Alavi and Joachimsthaler 1992; Guimaraes et al. 1992).   For example, Alavi and Joachimsthaler (1992) represented DSS implementation success in terms of system use, decision-making performance, decision-making time, user satisfaction with the system, user confidence in the decisions, and user attitudes toward DSS.   Eierman, Niederman, and Adams (1995) developed a DSS research model that includes eight major constructs (environment, task, implementation strategy, DSS capability, DSS configuration, user, user behavior, and performance) and seventeen relationships.

These success measures generally target at system efficiency or effectiveness (Keen and Scott Morton 1978; Sharda et al. 1988). Efficiency is more process-oriented and is typically measured by decision speed or the number of alternatives under consideration.   For example, Alter (1980) cites increased efficiency of decision making as one potential benefit of a DSS.   Effectiveness is measured by decision outcome, such as the quality or accuracy of decision and user satisfaction. For example, many studies have adopted user satisfaction and/or decision-making satisfaction, decision quality, and business profitability to measure DSS outcomes (Cats-Baril and Huber 1987; Kendall et al. 1987; Mahmood and Sniezek 1989; Sanders and Courtney 1985; Sharda et al. 1988).

Table 1: Survey of DSS success measures

Study	Independent variable	Dependent variable
Sharda, Barr, and McDonnell (1988)	DSS/ non-DSS	Profit performance Variance in profit performance Time Number of alternatives Confidence
Le Blanc and Kozar (1990)	Length of DSS use Other variables ● Lagged accidents rate ● Traffic level ● DSS utilization ● River stage ● weather	DSS usage
Alavi and Joachimsthaler	Cognitive style Personality attributes Demographic variables User-situation variables	Performance ● Cost/profit ● Decision-making time Attitudes/Perceptions ● User satisfaction with DSS ● Confidence in decisions ● Perceived usefulness of system
Todd and Benbasat (1992)	DSS Problem size	Unique units of information referenced Total units of information referenced Number of alternatives analyzed in detail
Davis and Kottemann (1994)	What-if analysis	Performance

Crossland, Wynne, and Perkins (1995)	Problem complexity Presence/ absence of DSS	Decision time Accuracy
Eierman, Niederman, and Adams (1995) *	DSS capability Implementation strategy User behaviour Environment User Task DSS configuration	Performance User behaviour Implementation strategy User

Swink (1995)	User Characteristics
	   ● User experiences
	   ● Cognitive Factors
	Effort
	DSS Characteristic
	Task Characteristics
		Decision performance
		   ● Decision quality
		   ● Perception accuracy
		   ● Solution search efficiency
		   ● Decision time

Montazemi, Wang, Nainar, and Bart (1996)	Suggestive guidance vs. no guidance Informative guidance vs. no guidance Suggestive guidance vs. informative guidance	Task performance
Barr and Sharda (1997)	DSS	Decision performance
González and Kasper (1997)	Animation images Animation transitions Animation navigation	Decision quality
Swink and Robinson (1997)	DSS attributes Problem size Network types Demand dispersion patterns	Decision performances
van Bruggen, Smidts, and Wierenga (1998)	MDSS Support	Performance Decision quality Less susceptible to using the anchoring and adjustment heuristic
Gregor and Benbasat (1999)	KBS Explanations	Accuracy Speed

Swink and Speier (1999)	Task Characteristics
	   ● Problem size
	   ● Data Aggregation
	   ● Data Dispersion
	User Characteristics
	   ● Spatial Orientation
		Decision Performance
		   ● Decision Quality
		   ● Decision Time

Mennecke, Crossland, and Killingsworth (2000)	Problem Complexity SDSS Support Subject Characteristics	Decision Efficiency (Solution Time) Decision Accuracy
Parikh, Fazlollahi, and Verma (2001)	Decisional guidance vs. no guidance Informative vs. suggestive decisional guidance Predefined vs. dynamic decisional guidance	Decision quality User satisfaction User learning Decision-making efficiency
Bharati and Chaudhury (2004)	System quality Information quality Information presentation	Decision-making satisfaction

* This study developed a theoretical framework for DSS research from a review of literature. Eight broad DSS constructs （independent variables, mediator variables, and dependent variables） and 17 relationships among these constructs were examined.

Table 1 shows a survey of 18 studies that used different DSS success measures. As we can see, they focused on decision performance and user satisfaction. *Decision performance* may be measured subjectively or objectively (Liang 1986). Subjective measurements assess the user's perceived value of a system (e.g. perceived economic benefits), whereas objective measures evaluate decision performance based on objectively measurable criteria, such as time required to reach a decision, resulting profit enhancement or cost saving.

User satisfaction is the subjective feeling of users about how the system has performed. For example, According to the expectation theory, user satisfaction is affected by prior expectations of users about the system and its effectiveness (Barkhi et al. 1998). Based on disconfirmation theory, users have a tendency to disproportionately rate the difference between actual performance and expected performance. Therefore, the actual performance can influence user satisfaction (Barkhi et al. 1998). However, the actual result about the relationship between DSS usage and performance or user satisfaction has been conflicting so far (Gelderman 1998; Sharda et al. 1988). Therefore, we believe that there must be post-choice factors that may influence DSS usage but have not been investigated.
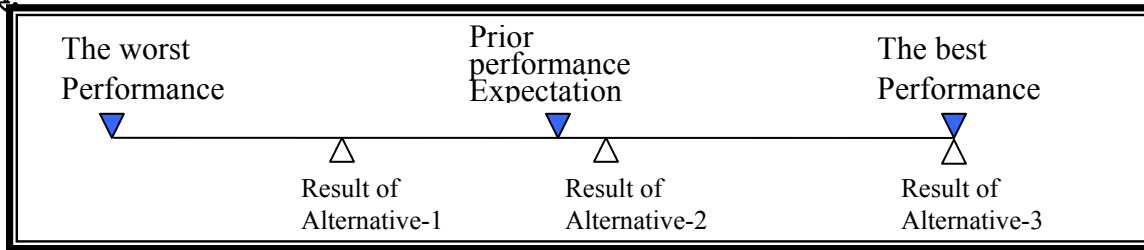
2.2 Regret as a decision outcome

Most of previous works on DSS success target at performance enhancement but none of them has explored the role of regret avoidance. A complete post-choice evaluation, however, needs to also include regret and disappointment because recent behavioral research has found that, in addition to maximizing positive decision outcomes, decision makers often take potential regret into consideration.   For example, Tsiros and Mittal (2000) develops a model of regret and found in empirical tests that regret directly influences the intention of product repurchasing. Regret is experienced even in the absence of information on a better-forgone outcome and consumers may defer their repurchase decision after receiving post-purchase information that may lead to future regret (Cooke et al. 2001).

Regret is a psychological state different from satisfaction. Landman (1993) defines regret as:

> *Regret is a more or less painful cognitive and emotional state of feeling sorry for misfortunes, limitations, losses, transgressions, shortcomings, or mistakes. It is an experience of felt-reason or reasoned-emotion. The regretted matters may be sins of commission as well as sins of omission; they may range from the voluntary to the uncontrollable and accidental; they may be actually executed deeds or entirely mental ones committed by oneself or by another person or group; they may be moral or legal transgressions or morally and legally neutral. (p.36)*

Regret occurs when a foregone option would have yielded a better outcome than the actual one (Bell 1982; Loomes and Sugden 1982). Comparing with satisfaction, regret is a rational and *negative* cognitive response caused by comparing the actual result with a better one that was passed up by the decision maker. Studies found that people are willing to take risks or to acquire more information in a game or investment decision in order to gain a higher monetary return (Zeelenberg et al. 1996). The more information they acquire, the more likely they feel the regret could be avoided (Zeelenberg and Beattie 1997).

錯誤!

	Prior performance Expectation	The best Performance
The worst Performance		

Result of Alternative-1   Result of Alternative-2   Result of Alternative-3

Figure 1: Regret as a measure of DSS effectiveness

In psychology, regret and dissatisfaction are two different concepts; even though both show a certain feeling of displeasure (Tsiros 1998). Their measurements are also different, which can be illustrated by the simple example in Figure 1. Given the outcomes of three alternatives, the user would feel dissatisfied and regret if alternative 1 was chosen, feel satisfied but regret if alternative 2 was chosen, and feel satisfied with no regret if alternative 3 was chosen.

The reference points for satisfaction and regret are different. Satisfaction is compared with the expectation prior to the decision, but regret exists only when the decision maker misses a better choice. For instance, an investor bought a stock with an expectation to earn a 10% return at the beginning of the year and ended up with an actual return of 20% by the end of the year. The investor may be satisfied, but could feel regret after learning that the stock that he had dropped reached a return of 30% at the same time period.

Given that regret measures a post-decision feeling different from satisfaction, it may be used to interpret the conflicting observation between user satisfaction and decision performance. In other words, a decision maker obtaining an acceptable performance from a decision may feel a mixture of satisfaction (as compared with the prior expectation) and regret (as compared with the better performance of dropped alternatives). It is reasonable to use regret as an alternative measure of decision effectiveness with an assumption that the use of DSS can reduce potential decision regret due to the ability to examine potential outcomes of more alternatives.

2.3 Factors Affecting Decision Regret

Several factors have been found to affect people's regret. The first one is *job responsibility* as a sense of duty. People may feel more regret when they assume higher responsibility for the result (Gilovich and Medvec 1994). People might feel more regret on actions they heavily involved (Kahneman and Tversky 1982). However, some researchers found that user responsibility is not a necessary condition for decision regret. For instance, Connolly et al. (1997) argues that, while regret and responsibility are positively correlated, one does not need to feel any responsibility to generate decision regret. Similar observations are reported in Zeelenberg et al. (1998) and Ordóňez and Connolly (2000).

Gender is another factor that has been reported to have effect on decision regret. Males are reported to have a tendency of feeling more regret than females (Landman 1987). Individual's personality is also found significant in feeling regret (Boninger et al. 1994). Among the factors, responsibility has a higher theoretical sense. A user with more responsibility may treat the
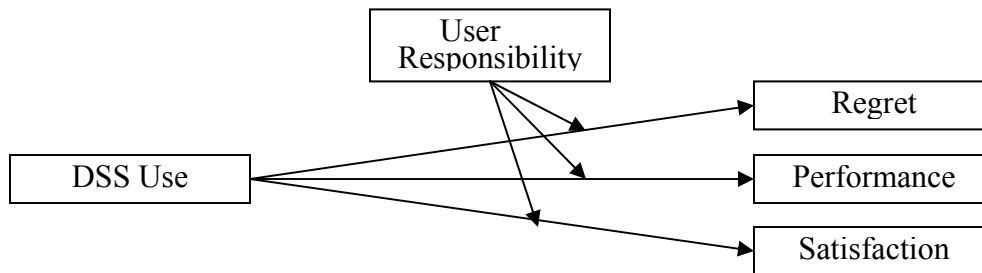
Figure 2: Research model

decision more seriously and hence use DSS more carefully and care more about the results. Therefore, we assume that *the effect of DSS use on performance, satisfaction, and regret is stronger when the user feels more responsible for the outcome (Chen 1992).*

3. Research Model and Experimental Design

3.1 Research Framework and Hypotheses
Based on the literature reviewed in the previous section, we can hypothesize that the use of DSS may increase decision performance, user satisfaction and decrease decision regret and the effects will be moderated by job responsibility of the user. Therefore, our research framework, as shown in Figure 2, includes DSS use as an independent variable, user responsibility as a moderating variable, and decision performance, satisfaction, and regret as three dependent variables. Heavier DSS use implies that the decision maker commit more on the analysis of decision making, including information access, analytical models, and other tools, we assume that DSS use may reduce the likelihood that a good alternative is missed. Hence, the user would have a higher likelihood of choosing the optimal alternative and will be less likely to feel regret. Two sets of hypotheses are formulated below.

H1: DSS use and decision outcome
    H_{1a}: DSS use will increase decision performance.
    H_{1b}: DSS use will increase user satisfaction.
    H_{1c}: DSS use will reduce user regret.
H2. Moderating effect of user responsibility.
    H_{2a}: The effect of DSS use on decision performance will be moderated by user responsibility.
    H_{2b}: The effect of DSS use on user satisfaction will be moderated by user responsibility.
    H_{2c}: The effect of DSS use on user regret will be moderated by user responsibility.

3.2 Research Design
Experimental task and the experimental system
Since our research model includes a main variable and a moderating variable, the experiment uses a two by two factorial design (using DSS or not; high or low responsibility). The task we chose for the experiment was choosing a stock for investment. This decision was chosen because financial investment is a popular but highly uncertain decision. Investors use DSS to support this kind of decisions on a regular basis.

Table 2: Functions of the experimental system

Menu	Function
Market Summary	Detail information of stock market, including stock quotes, change, day's range, volume and so on.
Industry Quotes	Detail information of the specific industry.
Company Information	Information of six companies used for trading in the experiment, including basic information, historical prices, news, and streaming charts are available.
Technical Analysis	Tools for technical analysis, such as the moving average, RSI and KD indicators.
Recent News	Three categories of news: political, international and financial
Calculator	Tool for calculating investment returns and others

Figure 3: Sample screen of the DSS

A web-based DSS for the experiment was designed using Microsoft ASP and Access Data Base. The system includes necessary functions to support the users (summarized in Table 2). These functions are representatives of six basic DSS functions, including selection, aggregation, estimation, simulation, equalization, and optimization (Blanning 1979). For example, the system can show data of daily transactions and sort them by industry, price, and volume. Subjects can also use technical indicators and other analytical tools to predict the trend of a stock, including MACD, MFI, ROC, RSI, Slow-stock, and Fast-stock indicators. Certain information of a company, including news reports and industrial data with different criteria, is also available for examination. Furthermore, the subject can use the system to estimate and simulate their investment performance under different scenarios. Figure 3 shows a sample screen of the DSS. Subjects in the control group did not have the system but were provided with the samedata and information in a paper form. This ensures that the difference in outcome was really due to the use of DSS rather than the content they were allowed to access while making decisions.

This system is a DSS because it is capable of support all phases of Simon's decision process: intelligence, design and choice (Simon 1984; Simon 1960). Market- and industry-related information such as market summary, industrial quotes, company information, and recent news supports intelligence. Technical analysis and certain functions for calculation support the

analysis and selection of candidate stocks support the design and choice stages.

Each subject was given US$150,000 to start with. The decision was to choose six stocks and allocate the available fund. The experimental market simulated the behavior of selected stocks listed on the Taiwan Stock Exchange.

Subjects

Seventy-two volunteers were recruited to participate in the experiment. Each subject was randomly assigned to one of the four settings. Sixty-five of them (40 males and 25 females) eventually completed the whole experiment. All subjects were business students with an average age of 23 years old. Most of them (98.5%) had taken at least one course in finance and 33.8% of them had real-world experience in stock investment. Most subjects (87.7%) use computers everyday. Each participant received a fixed reward of US$3 for participation. Additional US$10 was awarded based on their decision performance.

Variable Manipulation and Measurements

In order to manipulated the feeling of responsibility, the mood induction procedures (MIP) was conducted using a short essay.   Mood induction procedures intends to induce emotional changes in experimental subjects through manipulating variables inside the laboratory in a controlled way (Westermann et al. 1996). The subject asigned to the low responsibility group was given the following short essay to read before the experiment:

You made a trip the day after you made an investment decision.   You were so busy that you didn't keep an eye on the stock market.   After you came back from the trip, you learned that during your trip, a crisis between Taiwan and Mainland China had caused unexpected market downturn.   There is not much you could do to avoid it now.   To make things even worse, you have to sell the stocks now (with a major loss), due to other uses of the money.

The subject's feeling of responsibility was measured after the manipulation. Decision performance was measured by the profit earned from the investment portfolios, which is the difference between the final market value of their chosen stocks and their initial investment. User satisfaction was measured by three questions regarding subject's perception of investment (Ordóñez and Connolly 2000; Swink 1995).   Regret was measured by two questions (Zeelenberg et al. 1998).   All of these questions were measured on the 7-point Likert's scale.

Experimental Procedures

A pretest was conducted to ensure that all questions in the questionnaire were unambiguous, the experimental manipulations were successful, and the experimental system was usable.   After pilot testing with 12 subjects, we decided to move the system from a PC to the server in order to avoid network problems and revised questionnaire Moreover, since we found that the prior mood of the subject has effect on the result, we used a video tape to control the subjects' mood.   A short (5 minute) segment of a funny film was presented to all subjects before the experiment to induce a positive mood before the experiment.   The use of a video tape to induce positive affect was found by Oaksford et al. (1996).

Full experiment was conducted after the pilot test.   The whole experiment includes six steps: (1) Subjects listened to a standard introductory script and then read the background document; (2) Subjects in the DSS use group were then trained to use the systems, and sit in an introduction to stock investment session, whereas those in non-DSS group only received the investment

Table 3: Factor analysis on satisfaction and regret

Dimension / Item	Factor 1 (Satisfaction)	Factor 2 (Regret)
Satisfaction 1	0.961	.
Satisfaction 2	0.981	.
Satisfaction 3	0.955	.
Regret 1	.	0.974
Regret 2	.	0.972

introduction; (3) All subjects were then asked to watch the mood-inducing movie; (3) The subject filled out the background questionnaire; (4) Complete the experimental tasks with or without using DSS; (5) To generate subjects' emotion, their investment performance and reward were announced in public; (6) Subjects in the low responsibility group were treated by asking them to read a short essay to ease their feeling of obligation, whereas those in the high responsibility group was not; (7) All subjects were asked to complete the questionnaire for measuring their satisfaction and regret.

4. Results

4.1 Reliability and Validity
A total of sixty-five subjects completed the experiment. The Cronbach's alpha for measuring reliability is 0.96 for user satisfaction, and 0.95 for regret, respectively, which are highly acceptable (Nunnally 1978). Since most questionnaires were adapted from previously validated instruments the content validity is acceptable. In addition, the results from factor analysis on satisfaction and regret as illustrated in Table 3 show acceptable construct validity.

The treatment effect of user responsibility was effective as subjects receiving the treatment had a higher average responsibility score (Mean = 4.75) than those without the treatment (Mean = 4.09). This implies that subjects with or without the treatment had significantly different feelings of responsibility($p = 0.034$).

4.2 Findings
The means and standard deviations of the resulting data are shown in Table 4. As we can see, decision performance and user satisfaction are both higher but the decision regret is lower for the group that used DSS. For the DSS use group, higher responsibility had resulted in the lower performance, but had higher satisfaction and lower regret. A Pearson correlation analysis indicates that decision performance and user satisfaction have a significant positive correlation, while user satisfaction and regret have a significant negative correlation (see Table 5). It implies that, although satisfaction and regret are defined differently, they do have a strong negative correlation.

In order to test the main effect of independent variables, a multivariate analysis of covariance (MANCOVA) is performed. Z-skewness test and Box's M test are used to test normality and variance homogeneity. The result from the Z-skewness test shows that most values are in the range of −1.96 to 1.96. This implies that most data fit the normality assumption. The value

Table 4: Mean and standard deviation under different treatments

Treatment	Performance	Satisfaction	Regret
DSS Use	4.7060(.318)	4.7843(1.5524)	2.4118(1.5099)
No DSS Use	3.7740(.333)	3.9686(2.0572)	3.9677(2.1367)
DSS with High Responsibility	4.3889(2.0041)	5.0926(1.4811)	2.1389(1.5886)
DSS with Low Responsibility	5.0625(1.4818)	4.4375(1.6042)	2.7188(1.4020)
No DSS with High Responsibility	4.4000(1.6818)	4.4000(2.1052)	3.4333(2.0342)
No DSS with Low Responsibility	3.1875(2.0073)	3.5625(1.9915)	4.4688(2.1715)

Note: Standard deviations are in parenthesis.

Table 5: Pearson correlation matrix

N=65	Performance	Satisfaction	Regret
Performance	1.000	0.607***	-0.702***
Satisfaction		1.000	-0.822***
Regret			1.000

***: Correlation is significant at the 0.01 level (2-tailed).

Table 6: Summary of results

| Hypothesis	Result	Significance
Main Effects-- DSS Use		
H_{1a}: DSS use will increase decision performance.	Supported.	F = 4.096 p =0.047*
H_{1b}: DSS use will increase user satisfaction.	Not supported	F = 3.299 p = 0.074
H_{1c}: DSS use will reduce user regret.	Supported.	F = 11.644 p = 0.001**
Moderating Effects-- User Responsibility		
H_{2a}: Users with high responsibility will have higher decsion performance.	Supported.	F = 4.884 p = 0.031*
H_{2b}: Users with high responsibility will have higher satisfaction.	Not supported	F = 0.067 p = 0.796
H_{2c}: Users with high responsibility will have a higher user regret.	Not supported	F = 0.261 p = 0.611

* p <0.05, ** p <0.01

from the Box's M test is 25.911 (p=0.170), which indicates that differences among the variances of different groups are not statistically significant. The correlation of the dependent measures is tested with Bartlett's test of sphericity. The significance is smaller than 0.001, which satisfies the necessary level of intercorrelation to use MANCOVA (Hair et al. 1995). Hence, a MANCOVA test is appropriate, and the statistic results are summarized in Table 6.

From the data in Tables 3 and 5, we find that DSS use results in a significant higher decision performance. That is, subjects using the DSS were able to choose better stock portfolio during the experiment. Hence, Hypothesis H_{1a} is supported significantly.
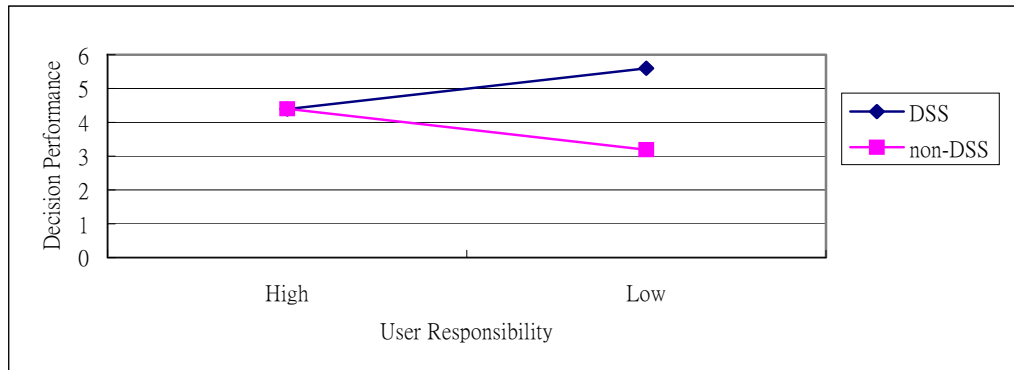
Figure 4: Decision Performance by treatment
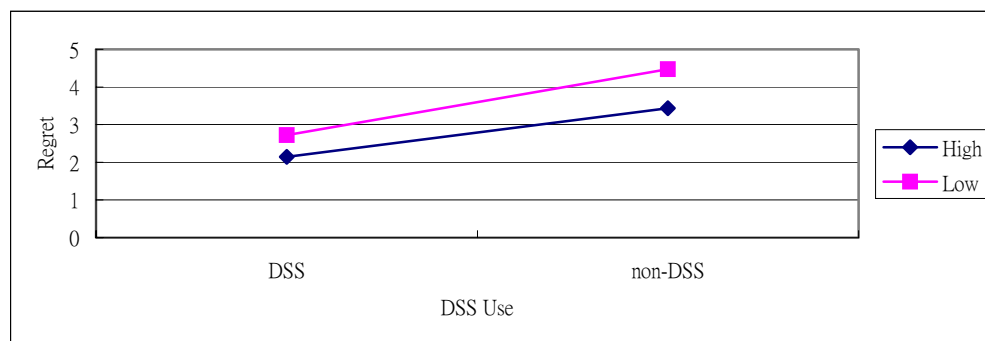
Figure 5: Regret level by treatment

The effect of DSS use on user satisfaction is not statistically significant at the 0.05 level (p = 0.074). Hence, Hypothesis H_{1b} is only marginally supported.   However, the effect of DSS use on decision regret is statistically significant (p<0.01).   Therefore, hypothesis H_{1c} (DSS use reduces decision regret) is supported significantly.   It implies that users adopting DSS are more likely to reduce the feeling of regret than to increase higher satisfaction.

The result shows an interesting phenomenon that sometimes users will not feel satisfied even though their decisions generate positive returns. Instead, they may feel sorry when the decision performance is lower than a better alternative that they could have chosen.

The interaction effect between DSS use and user responsibility exists. As Figure 4 shows, the difference in decision performance is significant mainly in the low responsibility group but not so for the high-responsibility group.   It implies that low-responsibility users may benefit more from using DSS. Hypothesis H_{2a} is supported.   The moderating effects of user responsibility on user satisfaction and user regret are not statistically significant.   Hence, hypothesis H_{2b} and H_{2c} are not supported.

Although the moderating effect of user responsibility on regret is not significant statistically, the high-responsibility group has a higher level of user regret, as compared with the low-responsbility group (see Figure 5). This confirms the observations from prior studies (Zeelenberg et al. 1998; Zeelenberg et al. 1998b; Zeelenberg et al. 1998c):people may feel more regret when they assume a higher responsibility for the result (Gilovich and Medvec 1994),

whereas people will not feel regret when he has no responsibility. Subjects who used DSS felt less regret than those who did not.   This implies that users who feel highly responsible for the decision outcome may regret more, but using DSS during the decision process can ease their regret.

5. Conclusions

In this paper, we have introduced the concept of using regret as a measure of decision outcome and presented findings from an experiment to show how DSS use can affect decision regret. The results indicate that significant correlations exist among decision performance, user satisfaction, and regret, even though they are defined differently.   Higher decision performance often results in higher user satisfaction, and hence lower regret.   However, decision makers sometimes do not feel satisfied when they miss a better alternative even though the actual outcome is better than expected.   In this study, we found that the use of DSS can significantly reduce post-decision regret.   It could be because DSS allows those who use it to support decisions-making to examine more information and hence reduce the likelihood of surprise.

User responsibility has been found to have significant moderating effect between DSS use and decision performance.   In particular, DSS use was more effective in increasing decision performance for subjects with low responsibility than for subjects with higher responsibility. This may be because that subjects who feel highly responsibility for the decision performance will do their best to make decision, no matter whethet a DSS is available.   Users in the high responsibility group may make more effort to ensure the best result even without DSS, as long as the time for analysis is enough.   Subjects with lower responsibility may not spend as much time on analysis as those in the high responsibility group during the decision making process.

The implications of the above findings are mulit-faceted.   First, our research suggests that regret can be a useful alternative for measuring the outcome from decision-making. A decision maker may feel satisfied but regret, if his performance is better than the prior expectation but worse than some forgone choices.   This substantially extends our prior knowledge of DSS success and it may be necessary to include decision regret in the measurement instruments in order to make a complete assessment.   We believe it is an appropriate first step toward developing more suitable models to measure the effectiveness of DSS.   Second, decision regret could be a new dimension for explaining system usage behavior.   It may also be a potentially new measure of information systems success.   Moreover, managers would be interested to know whether using DSS can improve decision performance.   As shown by the experimental results , decision performance is enhanced by using DSS and DSS uses will increase user's decision performance and avoid user regret significantly.

6. References

Alavi, M., and Joachimsthaler, E.A. "Revisiting DSS implementation research: A meta-analysis of the literature and suggestions for researchers," *MIS Quarterly* (16:2), 1992, pp.95-116.

Alter, S. "A taxonomy of decision systems," *Sloan Management Review* 19, 1977, pp.39-56.

Alter, S.L. *Decision Support Systems: Current Practice and Continuing Challenge*, Addison-Wesley, Reading, MA, 1980.

Barkhi, R., Jacob, V.S., Pipino, L., Pirkul, H. "A study of the effect of communication channel and authority on group decision processes and outcomes," *Decision Support Systems* (23:3), 1998, pp. 205-226.

Barr, S.H., and Sharda, R. "Effectiveness of decision support systems: development or reliance effect?" *Decision Support Systems* (21:2), 1997, pp. 133-146.

Bell, D.E. "Regret in decision making under uncertainty," *Operations Research* (30:5), 1982, pp. 961-981.

Bell, D.E. "Risk premiums for decision regret," *Management Science* (29:10), 1983, pp. 1156-1166.

Benbasat, I., and Nault, B. "An evaluation of empirical research in managerial support systems," *Decision Support Systems* (6:2), 1990, pp.203-226.

Bharati, P., and Chaudhury, A. "An empirical investigation of decision-making satisfaction in web-based decision support systems," *Decision Support Systems* 37, 2004, pp. 187-197.

Bhattacherjee, A. "Understanding information systems continuance: an expectation confirmation model," *MIS Quarterly* (25:3), 2001, pp. 351-370.

Blanning, R. "Functions of decision support systems," *Information & Management* (2:3), 1979, pp. 87-93.

Boninger, D.S., Gleicher, F., and Strathman, A. "Counterfactual thinking: from what might have been to what may be," *Journal of Personality and Social Psychology* (67:2), 1994, pp. 297-307.

Cats-Baril, W.L., and Huber, G.P. "Decision support system for ill-structured problems: an empirical study," *Decision Science* 18, 1987, pp. 350-372.

Chen, Z. "User responsibility and exception handling in decision support systems," *Decision Support Systems* (8:6), 1992, pp. 537-540.

Connolly, T., Ordóňez, L.D., and Coughlan, R. "Regret and responsibility in the evaluation of decision outcomes," *Organizational Behavior and Human Decision Processes* (70:1), 1997, pp. 73-85.

Cooke, A., Meyvis, T., and Schwartz, A. "Avoiding future regret in purchase-timing decisions," *Journal of Consumer Research* (27:4), 2001, pp. 447-459.

Crossland, M.D., Wynne, B.E., and Perkins, W.C. "Spatial decision support systems: An overview of technology and a test of efficacy," *Decision Support Systems* (14:3), 1995, pp. 219-235.

Davis, F.D., and Kottemann, J.E. "User perceptions of decision support effectiveness: two production planning experiments," *Decision Sciences* (25:1), 1994, pp. 57-78.

Eierman, M.A., Niederman, F., and Adams, C. "DSS theory: a model of constructs and relationships," *Decision Support Systems* 14, 1995, pp. 1-26.

Eom, H.B., and Lee, S.M. "A survey of decision support systems applications (1971-1988)," *Interfaces* (20:3), 1990, pp.65-79.

Gelderman, M. "Factors affecting the success of management support systems: Analysis and meta-analysis." *Paper presented at the IS/MAS forum of the Annual Conference of the American Accounting Association*, Orlando, FL, August 1995.

Gelderman, M. "The relation between user satisfaction, usage of information Systems and performance," *Information & Management* (34:1), 1998, pp.11-18.

Due to the page limitation, the reference list is incomplete. Please contact the author if you need the complete references.