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Hollywood Stock Exchange Method Applied to Automobile Industry :
Online Trade Platform of Marketing Forecast for Future Automobile Model Sales

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HOLLYWOOD STOCK EXCHANGE METHOD APPLIED TO AUTOMOBILE INDUSTRY

Online Trade Platform of Marketing Forecast for Future Automobile Model Sales

By

Ting Zhai

A thesis submitted in partial fulfillment of the requirements for the degree of

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UNIVERSITY OF OTTAWA

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ABSTRACT

Nowadays artificial trade markets are popular on the Internet. They have had an effect on the traditional marketing in the world, and will have a greater effect on it as the technological era goes. The Hollywood Stock Exchange (HSX) is an online stock platform used as a tool for the market research and movie production in the movie industry. Some HSX commercial researchers have proven the value of the marketing tactics in carefully controlled laboratory studies, in which the HSX helps the film producers in the movie industry succeed in their future movie production. The technology of the HSX in the movie industry gives the author an idea of making an online platform for the automobile industry in its future model making. After a careful study of the characteristics of the HSX, the author has designed an online stock platform, Automobile Stock Exchange (ASE[1]) which enables him to gather extensive profile data about the consumer behaviors for developing an effective marketing strategy on the future model design in the automobile industry. The purpose of the thesis is to make a study of the possibility of simulating an online automobile stock trade platform for the automobile industry in its market research and forecasts about the future auto model sales through insightful data analysis of the

[1] Automobile Stock Exchange Platform's URL, www.cirp.uottawa.ca/ase/

feedback and customer behaviors with the similar approach of the HSX. The author's study shows some rather encouraging results about the applicability of the ASE for the automobile industry forecasts, and the author has come to a conclusion that although there are some differences between the HSX and the ASE, the technology and mechanism of the HSX could be developed for a wider range in its application, and that the HSX could be applicable to the ASE because the ASE can be easily conducted via Internet in terms of organizational and technical aspects, and it seems to work well under different incentive structures and even with a limited number of participants. With the encouraging results, a review of the forecast accuracy of the ASE for automobile industry forecasts has been proposed for further researches.

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The writing of this thesis has been a challenging but most rewarding experiences as well as summary of the knowledge I have learned from both Bemidji State University and the University of Ottawa. This would not have been possible without the support of many professors, classmates, friends and family. First and foremost, I would like to express my deepest gratitude to my thesis advisor Dr. Christian Navarre for his invaluable guidance and advice as my research and thesis progress. His suggestions have enabled constant improvement and high quality of the thesis and encouragement has helped me brave the rough times when things do not seem to go in the right direction. I would also like to thank Dr. Christian Navarre for his generous financial support to help me complete my M.S. degree.

Special thanks go to Isabelle Therrien and supervisor Dr. Jacques Robert who both are working for the CIRANO in the city of Montreal. Isabelle has been a great mentor and friend offering patient advice and guidance throughout my research process. Dr. Jacques Robert has provided me with the research tools I need for the experiment on my research ideas. I also must thank Christopher Waller in Car Internet Research Program for his assistance.

Most of all, I would like to thank my parents, Dr. Liming Zhai and Mrs. Bojing Gao for the freedom, support and love they have given me throughout these years, in good times and difficult times. They have given me the strongest love, strength and courage to mount greater heights and pursue my dreams.

I love you, father and mother.

GLOSSARY

HSX, Hollywood Stock Exchange.

ASE, Automobile Stock Exchange.

Virtual Exchange Market, The application of Internet-based virtual stock markets is an additional approach that can be used to predict short- and medium-term market developments.

Double-sided market, participants from both sides of the market participation in the competitive phases. At the most general level, a double market may be thought of as a forum for executing a trade. It is a market type in which the market is not initiated by a specific order (no reference side). Once the market has been created, the orders sent are placed in a symmetrical way, for both sides of the market (purchase or sale order). Note that in a double-sided market, there will be only one buyer (or seller); as long as the buyer may submit new orders during the competitive phase.

Continuous double market, a new order creates a new round thereby generating an update of the market state. The new order is added to the market according to some priority rules. It is then compared with the book orders as a way to check for possible matches. When an order is completely fulfilled, it is cleared from the market. The process is then repeated. Bids and asks may be submitted to the market continuously over time, and transactions may occur at any time the market is open.

Single-product negotiations, in a lot of markets, many products are negotiated simultaneously. However, the negotiations for one product are often conducted independently of the negotiation for the other products. These markets are simply collections of single-product negotiations.

Multi-product negotiations, the negotiation for one product depends, through specific rules, on what goes on in the negotiations for the other product. In multi-product synchronized auctions, the stopping rules are synchronized, and the negotiations on all items end simultaneously only if there is no bidding activity on any of items. It allows for backup strategies. Another type of multi-product negotiations is the combinatorial auctions and the bundled trading double-market. In these mechanisms, bids are for a list of items or traders with an all-or-nothing condition. Optimization tools based on combinatorial computing are necessary in order to implement these mechanisms.

Trading system, the mechanism which delivers three functions – trade execution, order routing and data dissemination. Order execution is the process whereby orders can be

transformed into trades. This process is an algorithm that performs order matching according to a set of rules governing the priority of submitted bids and offers. Order routing is the act of delivering orders from their originators, negotiators, to the execution mechanism. A data dissemination mechanism transmits pre- and post-trade data, about quotes and trades respectively, to market participants. The market structure of a trading system consists of the set of rules governing its trade execution mechanism and the amount of price and quote data it releases.

Market state, the market state contains all the relevant information for the negotiation following. This information contains the negotiation table, the adjudication table, the round number, the price of the last transaction and the higher and lower price negotiated. There is a market state update at each round.

Round, a round begins with the display of a new quote and new responses, which stand for the market state, and finishes with an update of the market state. The concept of round is not very present in continuous market.

Phase, each phase has its own constant negotiation rules. A negotiation is divided into many phases if the rules change during the negotiation. The different phases can be separated by a time lag and, as a function of some activity rules; a clean up of orders on the market can be accomplished. A continuous market is divided into an initiation phase and a unique competition-adjudication phase.

Participants/user, defined a participant as any human or software that is able to interact with ASE.

Ask, an order to sell a specified number of products at a specified price.

Ask price, the quoted price in an order to sell.

Bid, an order to buy a specified number of products at a specified price.

Bid price, the quoted price in an order to buy.

Order, either a bid or ask.

Purchase order, an order to buy one or more products at the current market price.

Sell order, an order to sell one or more products at the current market price.

Market order, placing a purchase or a sell order.

Limit order, placing a bid or an ask.

1 INTRODUCTION

The purpose of the thesis is to study the possibility of simulating an online automobile stock trade platform. The online platform is similar to the Hollywood Stock Exchange (www.hsx.com) [9] an integrated marketing, research and technology company driven by its patented entertainment stock market. At the HSX.com, users buy and sell their virtual shares of celebrities, movies and music with a currency called Hollywood dollar. The price of the HSX movie stocks provide the author with good forecasts of actual box office returns, and that price of the HSX securities in Oscar, Emmy, and Grammy award outcomes constitute accurate assessments of the actual likelihoods that nominees will win [9].

The concept and methodology of the HSX research helps the author with the idea of making an online platform to assist the automobile industry in its future model making decision. As an online stock exchange platform, the system enables the author to gather extensive profile data of a future vehicle model. This enables its user to evaluate the likelihood of success of a particular auto model and/or an automobile company. The feedback data which this online platform collects can contribute to the understanding of consumer behavior in order to develop an effective marketing strategy on the future model design, or to assist in marketing decisions of the automobile industry.

1.1 Problem definition

The introduction of the HSX says that HSX helps Hollywood movie industry forecast its future movie likelihoods, and it works. The question therefore is, could the HSX be applicable to the automobile industry for its future automobile design? Could the automobile stocks in the real automobile sale market be as profitable as those good selling movie stocks in the HSX? What outcomes or results could be expected to come out?

What correlation would be between each car stocks' price variation in a time interval and its sale records in a time period in the real market?

One of the forecast research works used as a comparison, is the Iowa electronic market (IEM) [10], which supports trading in securities tied to the outcome of political and financial events. Their 1988 market, open only to University of Iowa students and employees, offered securities that paid off proportionally to the percentage of votes received by various candidates in that year's US presidential election. The final prices matched Bush's final percent margin of victory more closely than any of the six major polls. The IEM 2004 US presidential vote share market was a real-money futures market where contract payoffs will be determined by the popular vote cast in the 2004 U.S. presidential election.

Some HSX Commercial researchers have proven the value of many marketing tactics in carefully controlled laboratory studies [1, 6]. According to their research, the HSX has helped many film producers in the movie industry succeed in their future film-making. As movies are different from automobile not only in price, but also in design, cost and value, there must be some differences between movie production and automobiles model design when the HSX applies to the two fields. Consumer behavior is different in buying diverse items, and products that feature emotion arousal as primary benefits such as movies, books and music CDs are the most obvious example [4]. Automobile as well arouse emotions, and despite the fact that vehicles can not be purchased as easily as movie DVDs, the technology and method of the HSX should be developed for a wider range of its application in more markets.

1.2 Research Objectivities

The nature of the study will be exploratory with four components. The structure and functionality of the HSX will be focused on the HSX method analysis component, with the accuracy of the HSX forecast and actual returns being looked at briefly. The similarity between movie and automobile industry component will be discussed and comparisons

drawn between these two industries. The platform design for the simulation of "stock trade" and data flow diagrams will be analyzed in the online trade platform component, and the entity relationships and trade phases will be explored. More complicated skills in data collecting, such as stock bid price, ask price, last price, low price, high price, stock trade volumes, stock information presenting and outcome data analysis for final conclusions will be discussed in the data collection and analysis component.

- HSX method analysis. The mechanism, structure and functionality of the HSX platform that helps movie producers to make correct decision will be deeply explored.

- Similarity between movie and automobile industry. The movie industry and the automobile industry will be compared and their similarities examined. The HSX works in the movie industry and the reasons why it should work in the automobile industry will be put forward.

- Online trade platform. The HSX platform is a non-open source simulator for a commercial purpose, and an online platform similar to the HSX will be built to gather the research data generated during the stock trade period through a database. That platform is designed to collect data accurately.

- Data Collection and Analysis. The online platform's outcome and the collected data will be analyzed with the software such as Microsoft Excel, Minitab, etc. Certain statistical procedures on the data will be taken with the variables of interest in a dataset searched. Frequencies or summary statistics of key variables to determine what further analyses will be appropriate reviewed and brief summary statistics will be produced for a final report. Some useful information will be provided for drawing a conclusion about whether the HSX method could be applied to the automobile industry successfully.

1.3 Expected outcome of the research

By using the same method as that in the HSX, the online platform in the research is designed to foster small scale group activities of all sorts, from competing in games, to trading in markets for automobile future models. The online platform will show signs of efficiency manifested as price coherence and forecast accuracy for making decision on future automobile model design. The online platform will provide informative automobile model producer forecasts, while the platform will also provide accurate assessments of future event. The interesting parties can mine existing market simulation for information, with some reassurance as to accuracy. Alternatively, they can open new artificial markets, with relatively few impediments, as a mechanism for gathering information in areas of personal concern or interest. The automobile model producer may initiate market games in order to carry out experiment that would otherwise be too costly or too difficult.

1.4 Methodology

Qualitative and analyses will be applied to the ideas of selected books and research papers. Through these processes, similarities and differences between movie and automobile industries will be identified. The methodological approach regarding the selection of cars' brands and stocks was justified and was developed on sound literature. This is an exploratory study with a small sample of 45 students who played on an online trade platform as a testing ground. On the basis of these analyses; conclusions are going to be drawn for the helpful forecasting method of the HSX in future economical activity.

2 HOLLYWOOD STOCK EXCHANGE METHOD ANALYSIS

The HSX is an online research tool as well as a VSM (Virtual Stock Market) [8] which would make it possible for people to invest play money on their favorite movies, movie stars and music artists. It is based on the financial markets of the real world. One of the goals of the HSX is to use the data collected from the exchange as a market research instrument. Just like the real financial markets, the user would like to buy low and sell high. When the user is a confident investor, he or she can buy and sell stocks on movies. (Figure 2-1)

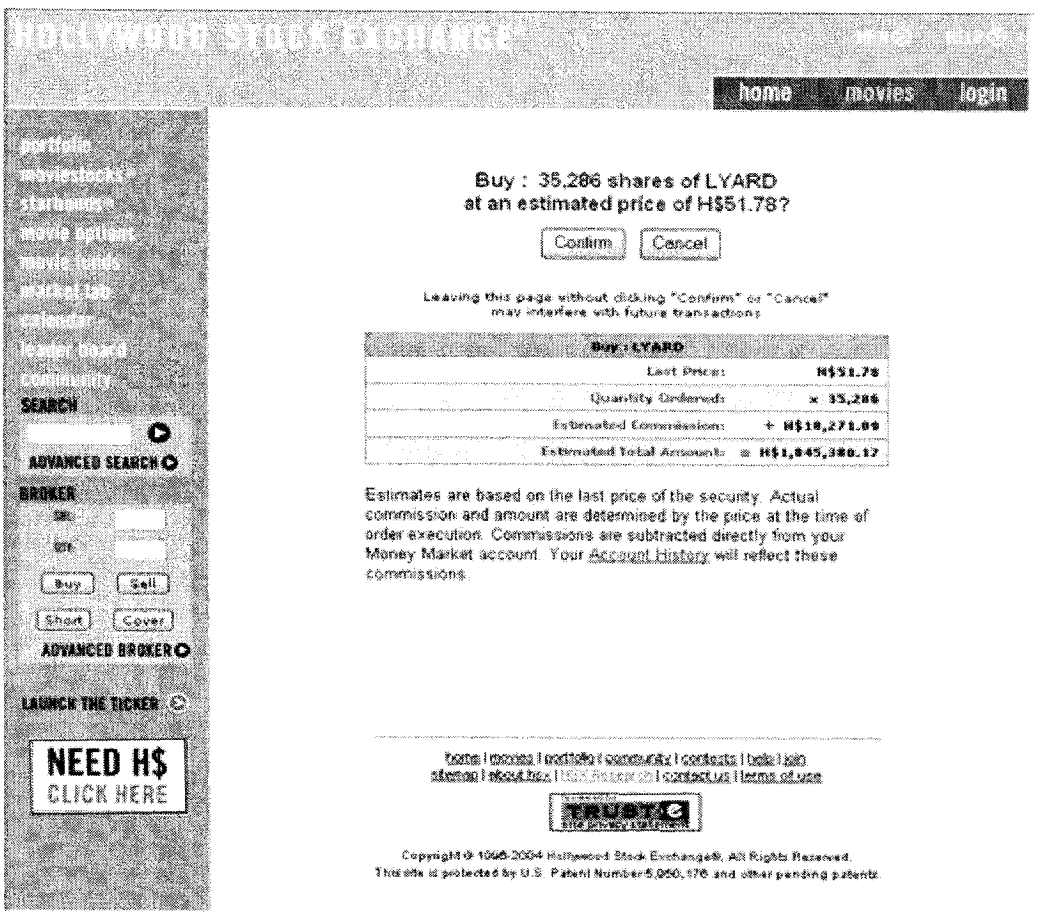


Figure 2-1: Buy and Sell movie stocks in HSX

2.1 The Overview of HSX's Research Purpose

Hollywood Stock Exchange uses an advanced methodology (Vitual Specialist Exchange) for data capture – a predictive artificial market.

The HSX research is based on capturing real-time consumer "opinions" while monitoring trading activity on the Hollywood Stock Exchange website. The HSX researchers collect data unobtrusively without the surveyor bias found in traditional research methodologies. Similar to the NYSE or NASDAQ, the HSX's IPO (Initial Public Offereing) stocks of pre-release movies (typically when the film is in concept or development), which allows traders to purchase these securities for their virtual portfolios. As an artificial market, this enables the HSX to gather extensive profile data of a movie audience. It also enables the HSX and its clients to evaluate the likelihood of success of a particular film and/or a studio. The HSX deliver historical data through www.hsxresearch.com. The HSX also offer a series of reports, and query tools, including:

Market insight – detailed market analysis tools including stock gainers, losers, and marketcap reports and future release movie listings.

Audience insight - audience demographic profiles of specific films, audience tracking and intent measures, awareness and similarity analyses.

Box office insight - projections of opening weekend box office receipts for a film, and future-release estimates for movies starting from 8-weeks prior to release.

As well as these services, HSX offers custom research tailored to its client's specific needs. For example, the HSX data warehouse contains over 1,200 films, with associated sale and release date information. The HSX may cross-tabulate any set of variables and return to customer a custom "cut" or view of HSX's data. The HSX also develops reports and analysis tools for specific applications. For example, it provides similarity analyses where it correlates the profile of a viewing audience (e.g. a cable network viewer profile such as A&E, USA or History Channel) or a day-part viewer profile (e.g. evening

vs. daytime) or an overall viewer profile (e.g. males 18-24) against pre-released and released films. It then provides a listing showing which films best match that viewer profile. The objective in this example is to provide excellent long-lead information for acquisition efforts.

The HSX's data can also be applied to the financial and investment area. Its price statistics on shares and aggregated custom facilitate investment decisions and provides an excellent data source for financial analysis or recommendation reports.

2.2 The Design Description of the Hollywood Stock Exchange

The HSX has had no distinct end of trading since stock trade started in 1996. New stocks are continuously issued called IPO, which adds the brand-spanking new security to the exchange and stocks are constantly cashed out with payoffs. The HSX has more than 200,000 registered participants with an average of more than 30-40 thousand unique participants actively trading everyday. See Table 2-1 for details on the design of the Hollywood Stock Exchange research study.

Step	Decisions
Choice of forecasting goal	☑ Forecasting of movie gross box-office revenues in the United States ☑ Payoff function: Gross box-office revenues in the first four weeks of release in the United States ☑ Price adjustment according to the box-office revenues of the opening weekend ☑ No downtime since start of HSX in 1996—new stocks are continuously issued and stocks are constantly cashed out ☑ Open to the public, participants can join at any time
Incentives for participation and information revelation	☑ Composition of Initial Portfolios/Endowment Endowment of two million "Hollywood Dollars (H$)" per participant ☑ Alternative investment opportunities: Unspent cash pays annual interest rate of 6% ☑ Remuneration/Incentive Mechanism No monetary rewards during certain periods (e.g., May 2000 to January 2001) ☑ Rank-order tournament: During reward periods rewards for participants with highest increase of (virtual) portfolio value during specific interval ☑ Time intervals: Weekly, monthly, per season to date, year to date, 1996 to date ☑ Incentives not based on performance: Additional sweepstakes (e.g., quizzes) not directly related to VSM
Financial market design	☑ Trading mechanism: Market maker ☑ Choice of initial quotes: "IPO Prices" ☑ Quote adjustment to order flow: "Virtual Specialist" ☑ Trading times: 24 hours a day, 7 days a week ☑ Long and short trading ☑ Order types: Limit and market; with temporal restrictions possible ☑ Position limits: Maximum of 50,000 shares per type of movie stock ☑ One percent trading fee on the total value of a trade

Table 2-1: Design of the Research Study on Hollywood Stock Exchange (Source: Martin Spann, Bernd Skiera, "Internet Based Virtual Stock Markets for Business Forecasting", October 2003)

2.3 The Way to Play

After signing up for free, a user receives an HSX account with H$2 million in electronic scrip and is urged to start trading. As in real life, the goal is to buy low (before the films are released) and to sell high. Commissions, deducted from the account, reflect the industry standard of 1 percent. There is even a Hollywood reserve bank, with the power to adjust interest rates, and more Hollywood dollars [9].

The prices of the securities are driven largely by actual ticket sales. But just as Wall Street reacts to breaking news, movies tocks and star bonds are affected by Hollywood events. A share of "Terminator 4", for example, dropped 10 percent on the announcement that Arnold Schwarzenegger had been elected California's governor. Below is a brief explanation of some of the features of the Hollywood Stock Exchange.

2.4 The Movie Stocks

This is the main body (Figure 2-2) of the Hollywood movie stock exchange. What the user is ultimately trying to do with movie stocks is to guess how much money the movie will make at the box office over the first four weeks in theatres. Each movie stock will "cash out" after the four weeks at the amount that the movie made during that time period (H$1 for every real $1,000,000). The user can invest in different movies in various stages of development - from the concept stage all the way to release in the theatres.

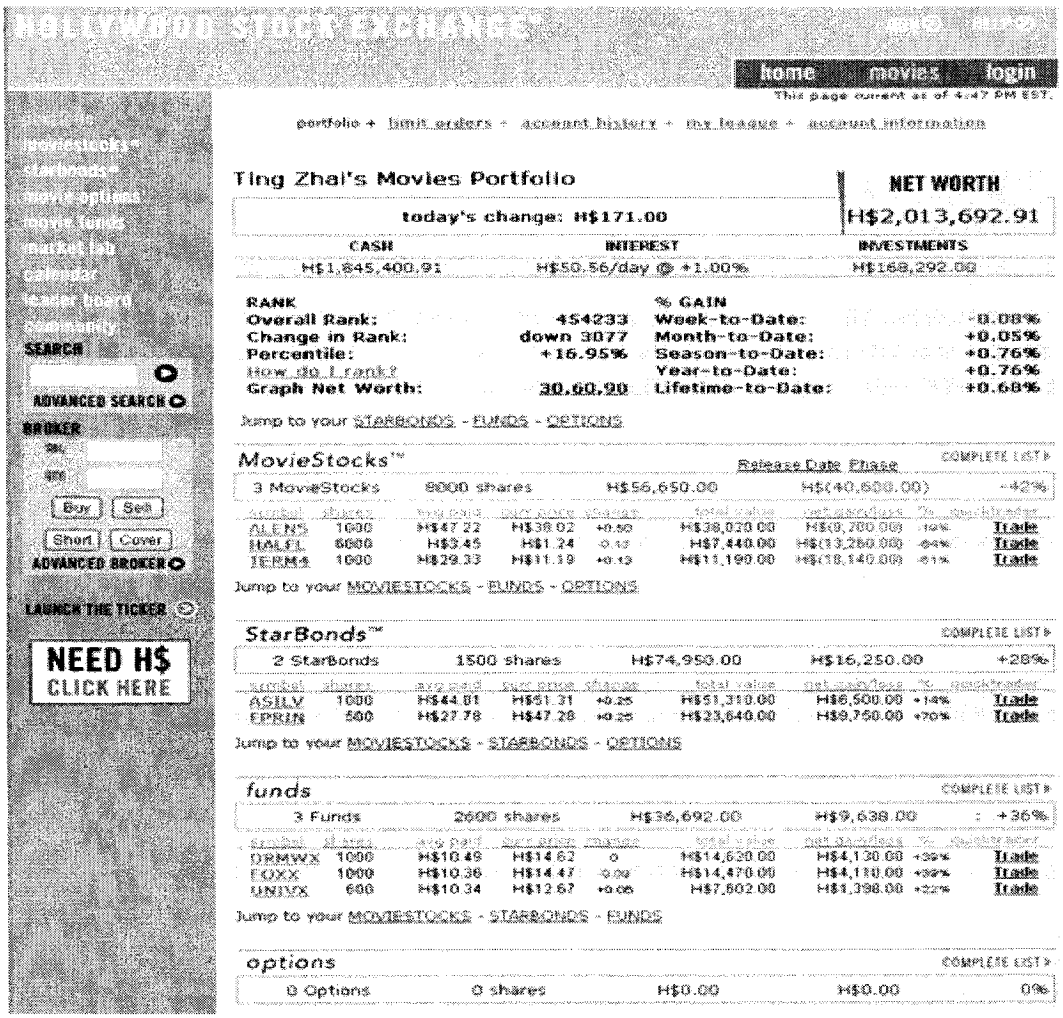


Figure 2-2: Movie Portfolio of HSX

This is where the user can invest in his or her favorite actor/singer or director. The price of a star bond reflects overall star power as determined by supply and demand, as well as how much money each of their films make at the box office.

The options are short-term investment opportunities that are based around a specific event. The typical options are released opening weekend of a particular movie stock. This type of speculation takes the form of "calls" and "puts" and lasts only for the opening weekend. Other special options are released around such events as the Oscars. Each

option has a "strike price" that is set according to what the market expects the film to be evaluated in its opening weekend.

2.5 The Payoff Method

The payoff structure of the HSX movie options is analogous to a so-called European option in the financial markets [5]. A movie stock is cashed out and removed from exchange four weeks after the respective movie is released on more than 650 screens at the HSX. The payoff function is equal to the movie's domestic box office revenue total during those first four weeks of release, paying one "H$" for every million of box office revenue:

The formula is below:

$$D_{m,T_1} = \frac{Z_{m,T_1}}{1{,}000{,}000} \; (m \in \mathrm{M}), \quad (1)$$

Where

Z_{m,T_1} = the domestic box office total during the first four weeks of release of the m*th* movie (T_1 = first four weeks of release),

M = the index set of movies.

The release day of the movie is Friday and the trading on the respective movie stock is stopped. The price of the movie stock is adjusted and trading commences on Sunday evening of the opening weekend. The price is adjusted according to the Sunday evening estimation of the actual box office of the opening weekend multiplied by a specific factor α (formula 2). The purpose is to adjust the price according to a simple prediction for the cash out price. The reason for this adjustment is to incorporate the information of the box office revenues of the opening weekend in the quotes provided by the market maker "Virtual Specialist" [9] at the HSX. This factor of 2.9 for regular opening weekend is publicly known.

$$a_{m,T_1} = \frac{Z_{m,T_1}}{1{,}000{,}000} \cdot \alpha \quad (m \in \mathrm{M}), \quad (2)$$

Where

a_{m,T_1} = the adjusted price of the m*th* movie after the opening weekend (T_1 = first four weeks of release),

α = the adjustment factor (2.9 for a regular three-day opening weekend).

The prediction of the opening weekend box-office of the opening weekend box office receipts formula is below: 1% trading fee on the total value of a trade is charged. The participants with the highest increase of portfolio value during specific tournament are ranked and showed on the web.

$$a_{m,T_1,t} = p_{m,T_1,t} \Rightarrow Z_{m,T_1,t} = \frac{p_{m,T_1,t}}{\alpha} \cdot 1{,}000{,}000 \quad (m \in \mathrm{M},\ t \le T_1), \quad (3)$$

Where

$a_{m,T_1,t}$ = the expected adjusted price at the t*th* point in time for m*th* movie after the opening weekend (T_1 =opening weekend),

$p_{m,T_1,t}$ = the price of a share a the t*th* point in time for the m*th* movie stock (T_1 = opening weekend),

$Z_{m,T_1,t}$ = the expectation at the t*th* point in time on the estimated opening weekend box office receipts for the m*th* movie T_1 = opening weekend)

2.6 The Rational Expectation Equilibrium Method

The theory of rational expectation equilibrium accounts for expert-level forecast accuracy for the HSX research work [5]. In rational expectation equilibrium, the probability distribution used by researcher to make decisions is restricted to be the actual one. This is usually motivated with a heuristic learning argument: if this was not the case, a researcher would make systematic forecast errors, detect them and revise his representation of the stochastic environment. This motivation makes strong assumptions on the information

and the computing abilities of economic researchers since it implies that they can detect any specification error in their model.

2.7 The Daily Summary

There is a daily summary created by a movie fan to indicate stock indices for the Hollywood Stock Exchange online. Every morning, an XSLT (eXtensible style sheet language: transformations) script extracts the stock data for each security type. This also calculates index values, and saves them in a master XML file that records the stock index history over time. The data information is added by using a short ASP script.

Two future XSLT scripts transform the master XML file into two XHTML tables. One of these tables records a daily summary (see Table 2-2), and the other records the historical daily index values. Both tables are formatted using CSS (cascading style sheets), and included in these pages using Apache SSI (server side includes).

	No. of Movies	*Movie Index*	*No. of Bonds*	*Bonds Index*	*No. of Funds*	*Funds Index*	*No. of Options*	*Options Index*
All Time Minimum	1415	10.76	1010	37.57	35	41.34	14	5.2
All Time Maximum	1459	11.19	1031	43.96	38	44.34	144	10.17
All Time Mean	1441	11.05	1021	41.17	37	42.52	53	7.07
Today	1457	11.09	1026	39.13	38	44.28	27	7.18

Table 2-2: Summary of Data from 16 Jan 2004 to 6 May 2004

2.8 The Forecast Accuracy of HSX [David M. Pennock, 2001]

The HSX researchers use a simultaneous equations model to study forecast accuracy, analyst following, and trading volume. The result supports the idea that an analyst's private information complements, rather than substitutes for, the factors that increase certainty about the HSX's prospects. Some research papers made for the HSX research purposes examine whether the artificial market efficiency can hold in HSX method, by

assessing the forecast accuracy of the HSX stock and options markets, the HSX payoff method (Section 2.5).

2.8.1 The Box Office Forecasts

For the forecast of box office, before a movie stock on the HSX adjusts, the stock price constitutes an estimate of 2.9 times the movie's opening weekend proceeds. Pennock, Lawrence and Giles [5] gathered the halt or (closing) prices s_h and adjust s_a (2.9 times the actual return) for the movies opening the during the period from March 3, 2000 to September 1, 2000. Figure 2-3 shows that the actual box office return $s_a/2.9$ versus the HSX estimates s_h for each movie. The correlation between actual and estimate is 0.940. The slope of the best-fit line to the data (the solid line in the figure 2-3) is 1.16, the mean absolute error 3.57, and the mean percent error 31.5%.

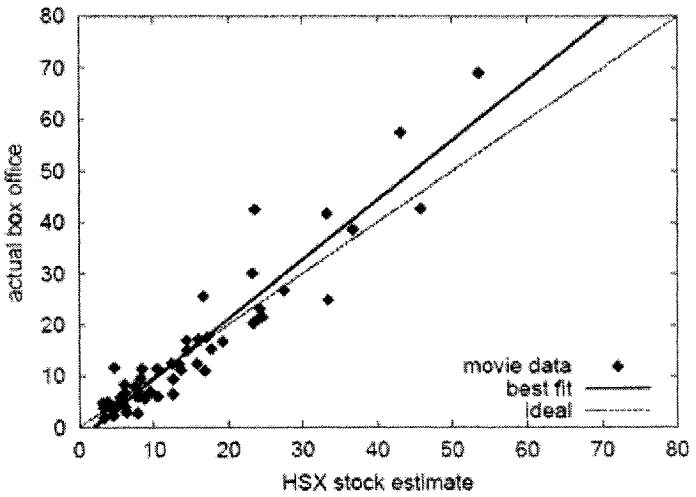


Figure 2-3: The Accuracy of the HSX movie stock forecasts for the opening weekend box office returns. The dashed line corresponds to ideal accuracy; the solid line is the best liner fit. (Sources: Pennock, NEC Research Institute, Princeton, U.S.A)

The HSX option market provides an alternative forecast for the opening weekend returns. The quantity $k + c_h - p_h$, where k is strike price, c_h and p_h are the call (bid) and the put halt (closing) prices, should coincide with s_h, due to put call parity. When actual returns are plotted against this options estimate, the correlation is 0.931, with the best-fit

line's slope 1.12, the mean absolute error 3.38, and the mean absolute percent error 47.0% (section 2.8.2).

After a movie stock adjusts, its price is a forecast of the movie's four week total box office return r_4, Pennock, Lawrence and Giles gathered the cashed out prices r_4 and prices three weeks before for 109 movies from March 3, 2000 to September 1, 2000. Figure 2-4 shows r_4 versus s_4 for each movie. The correlation is 0.978, the best fit line's slope is 1.04, and the mean error is 4.01.

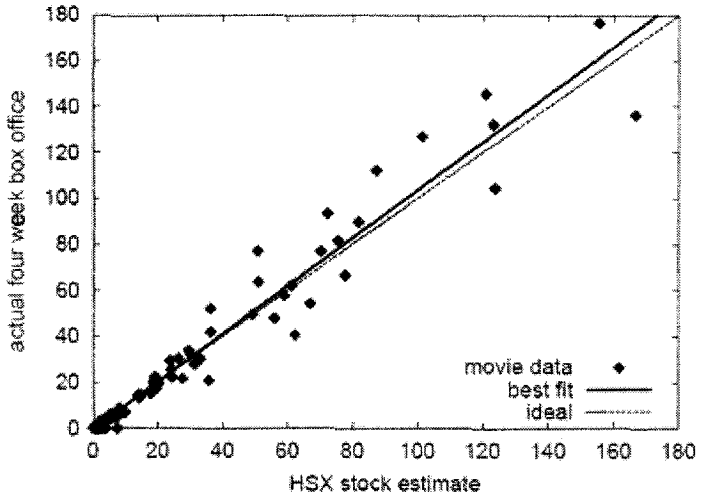


Figure 2-4: Accuracy of HSX movie stock forecasts for four weeks total box returns. The dashed line corresponds to ideal accuracy; the solid line is the best liner fit. (Sources: Pennock, NEC Research Institute, Princeton, U.S.A)

2.8.2 The Mean Absolute Percentage Error (MAPE)

Another way to test the HSX's forecast accuracy is to use MAPE to evaluate the actual box office revenue and historical data collected from HSX [8]. The closing price is compared before trading is stopped on Friday of the opening weekend, with the price adjustment according to the expected opening weekend box office receipts on Sunday evening. This result is compared, with MAPE of 71.1% for the prediction of the total box-office revenues for 10 movies without the HSX data; that is, before the movie release:

$$\text{MAPE} = \frac{\sum_{m \in M} \left(\left| P_{m, T_i, t} - a_{m, T_1} \right| / a_{m, T_1} \right)}{|M|}, \quad (4)$$

Where

MAPE = The mean absolute percentage error of the deviation between the Friday closing price and Sunday evening price adjustment of the M movies stocks (t = Friday close),

$|M|$ = the number of different types of movie stocks in index set M .

$$a_{m, T_1} = \beta_0 + \beta_1 \cdot \hat{a}_{m, T_1, HSX} + \beta_2 \cdot TS_m + \beta_3 \cdot DVActThr_m + \beta_4 \cdot DVDraRo_m + \beta_5 \cdot DVCom_m + \mu_m \quad (m \in M)$$

Where

$\hat{a}_{m, T_1, HSX}$ = the HSX forecast of the Sunday evening price adjustment of the m*th* movie according to its Friday closing price (T_1=opening weekend),

TS_m= the number of movie screens of m*th* movie on opening weekend (in thousands),

$DVActThr_m$ = the dummy variable: "1' if movie is in genre "action" or "thriller",

$DVDraRo_m$ = the dummy variable: "1' if movie is in genre "drama" or "romance",

$DVCom_m$ = the dummy variable: "1' if movie is in genre "comedy",

μ_m = the residual of the m*th* movie.

Martin Spann and Bernd Skiera (2003) assume that the HSX forecasts are unbiased if the constant (β_0) of the regression is equal to 0 and the parameter for the HSX forecasts (β_1) is equal to 1. The joint hypothesis test (H1: $\beta_0 = 0$, $\beta_1 = 1$) is accomplished by testing the restriction H1 through the application of restricted least squares. Further, the

HSX forecasts incorporate the additional information if movie-specific factors cannot significantly reduce the sum of squared errors. Thus, the corresponding hypothesis (H2: $\beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$) can be analogously tested through the application of restricted least squares.

Table 2-3 displays the results of a direct comparison of all different HSX's prediction methods.

Instrument	Hits*	MAPE (%)	HSX (%) improvement [a]
HSX	14	40.62	-
HSX enhance Model 1[b]	14	36.48	11.35
HSX enhance model 2[c]	14	36.81	10.35

[a] Percentage of improvement of alternative instrument over HSX = [[MAPE HSX – MAPE instrument]/MAPE instrument.
[b] Model estimate on movies 1- 152.
[c] Model estimated on movies 1-76..
* Number of movies. Method with lowest absolute percentage error for a specific movie.

Table 2-3: The predictions of Hollywood Stock Exchange, Box Office Report (Sources: Martin Spann, Bernd Skiera, School of Business and Economics, Walfgang Goethe-University, Frankfurt am Main, Germany)

A "hit" is defined as a case where a specific forecasting instrument (HSX or an Artificial Trade Market) has the lowest absolute percentage error of all considered forecasting instruments for the same movie. The enhanced predictions of the HSX according to models 1 and 2 lead to an increase in forecast accuracy relative to the ones directly derived from the Friday closing prices at the HSX. (Table 2-4) shows that the HSX performance (71 versus 69 hits and an insignificant difference of the MAPE). The enhanced model 1 of the HSX significantly increases the forecast accuracy of the HSX.

Instrument	Sample	Hits *	MAPE (%)	HSX (%) improvement [a]
HSX	140 movies	69	31.11	-
HSX enhanced model 1[b]	140 movies	75	28.40	9.54
HSX	60 movies	36	34.76	-
HSX enhanced model 1[c]	60 movies	36	32.71	6.27

[a] Percentage of improvement of alternative instrument over HSX = [MAPE HSX−MAPE instrument]/MAPE instrument.
[b] Model estimated on movies 1–152.
[c] Model estimated on movies 1–76.
* Number of movies. Method with lowest absolute percentage error for a specific movie.

Table 2-4: The predictions of Hollywood Stock Exchange (Sources: Martin Spann, Bernd Skiera, School of Business and Economics, Walfgang Goethe-University, Frankfurt am Main, Germany)

The author's empirical studies show rather encouraging results for applicability of the HSX for business forecasting purposes. From the above tables and data comparison, the HSX shows signs of efficiency, manifested as price coherence and forecast accuracy. In absolute of terms, HSX provides informative box office forecasts, while HSX provides prescient likelihood assessments of uncertain events of movie industry.

3 A COMPARISON OF THE MOVIE (HOLLYWOOD) AND THE AUTOMOBILE INDUSTRY

It is not difficult to find a research topic related to the HSX method for the automobile industry and movie industry. The HSX commercial researchers have proven the value of many marketing tactics in carefully controlled laboratory studies [5, 9]. According to the researches, the HSX has helped some film producers in the movie industry succeed in their movie production. However, there are not many differences between movie forecasting and automobiles model sale forecasting when the HSX method is employed to simulate the outcome.

Consumers' behaviors are different for buying various goods because many products feature emotional arousal as primary benefit. Movies, books and music CDs are the most obvious examples [4]. The emotional arousal does not apply to automobiles often such that customers do not purchase a car as easily as they buy a DVD movie. Because all purchases involve some element of risk if the product's price is high, the risk is perceived to be high also. Consequently, consumers often experience cognitive dissonance, which is an individual's unsettled state of mind that results from an action taken by an individual. Its presence suggests a lack of confidence in the decision. In this research study, the author used a virtual stock market which is a totally dependent on all kinds of products or services for its virtual stocks. Both HSX and IEM are examples that where mentioned in previous chapters.

In a virtual stock market - an online simulation of a stock market, it is completely free and it is a convenient means to test users trading strategies and a learning exercise on how to invest. It allows users to trade virtual stocks freely without risking their money. In the ASE, all stocks are virtual stocks which present a bet on the outcome of future automobile market sales situation. Their value depends on the realization of these market situations,

making the stock prices a predictor of these market situations. Thus bidding on the ASE virtual sock is different of buying a real car.

It is the same concept as HSX, the virtual stocks in HSX present films traded on the movie market. These can be films that are both in the process of being made and that are currently in theaters. The price of a virtual stock of HSX reflects how much money traders thinks the film will make domestically in its first four weeks of wide release at the box office. Trade in the HSX has nothing to do with buying a real ticket for a real movie.

3.1 Overview of the Automobile and Movie (Hollywood) industry

Both society and our daily lives have changed dramatically with the birth of the automobile. As a product, an automobile is required to have multiple functions. The most basic function of it is to move freely from point A to B. However, in many cases, the consumer today is not simply being satisfied with this. For instance, it has a symbolic function as a method of self-expression.

Further, the automobile can be seen as an individual's "toy," especially by the younger generation. In a way, the automobile can be considered as the greatest "toy" of the 20th century. At times, it can even function as a one's shelter or home. So, the automobile is required to function in various ways simultaneously. Car manufacturers have applied fine segmentation strategies to appeal to the greatest number of people, understandably using different messages. In the other words, technological innovations are necessary, but the most important point in producing marketable cars is the consistency of the different message delivered to the car consumer's desire.

The automobile industry may compare to another major entertainment business – the movie. Since the 1940s, the movie has become a major entertainment in people's life. Historically, movies have played a key role in distributing world's myths, dreams, legends, and ideals, serving as significant reinforcement for dominate social norms, values, and ideology. But with its strong and extensive links to the American public and to the world, the movie industry has also provided the foundation for many of today's multinational,

diversified communications conglomerates. So despite the continuous introduction of new forms of entertainment and communication technology, American movies and the movie industry remain as important components of the information/entertainment sector in the United States and aboard.

3.1.1 The Automobile Industry

About a hundred years have passed since automobiles came into being at the end of the 19th century. Indeed, the 20th century could be described as the age of automobiles. As a revolutionary product for travel and transportation, the automobile transformed society, and grew into a giant industry that pulled up the economy and lead technological innovations. It was also the automobile industry that provided representative business models of the 21st century, such as mass production and the multi-divisional form of a corporate organization. Table 3-1 shows the U.S. passenger car production by selected company, between years of 1999-2003. The reason why author does not use Canadian passenger car production data is because the most of the major vehicle and movie producers are located in the U.S.

	1999	2000	2001	2002	2003	2002/03
AutoAlliance	165,143	107,431	71,723	65,924	83,422	26.45%
BMW	48,394	38,665	34,169	23,188	56,589	144.0%
Dailmler	431,827	432,933	438,141	420,064	363,027	-13.6%
Chrysler						
Ford	1,225,117	1,247,333	989,868	1,072,389	821,680	-23.4%
General	2,093,345	1,989,031	1,656,172	1,672,987	1,385,081	-17.2%
Motors						
Honda	686,367	677,090	692,377	641,109	593,110	-7.5%
Mitsubishi	159,702	222,036	193,435	202,352	126,243	-37.6%
Nissan	167,742	150,129	157,876	235,473	322,047	36.8%
NUMMI	210,726	197,737	5,526,635	5,691,677	5,469,594	13.7%
Subaru-Isuzu	93,070	107,955	103,010	93,125	89,243	-4.2%
Toyota	356,840	371,877	353,381	386,860	435,853	12.7%
Total	**5,637,949**	**5,542,217**	**4,879,119**	**5,018,777**	**4,509,812**	**-10.1%**
Passenger						
Cars						

Table 3-1: U.S. Passenger Car Production – 1999 to 2003
(Source: DesRosiers Automotive Consultant Inc. and Ward's Automotive Reports News Market Data Book 2004)

Automobile manufacturing is the world's largest manufacturing activity, with just over 50 million new vehicles produced each year. The indirect aspect of it is due to the need for a retail distribution network and the generation of demand for intermediate inputs (in the form of components and raw materials like steel and rubber). Governments have therefore looked to the automobile industry as a major opportunity for national economic development, international trade and foreign direct investment. The automobile is also the second largest expenditure item for households after housing. Many own a car, visit dealers, and are aware of the variety that exists in car models and options that reflect consumer preferences and lifestyles. This factor would be the major difference between an automobile and a movie when a consumer purchase occurs.

3.1.2 The Movie (Hollywood) Industry

Currently, the American movie industry dominates the cinema all over the world. Although it does not make most feature movies, it is the only one that reaches every market in the world. For example, the market share of the American motion pictures in the European Union was about 70% in 1996. In Canada, 96% of all movies shown in the theaters are foreign, primarily American [2].

By 1998, the average film budget was almost $53 million. Many films cost over $100 million to produce, and some of the most expensive blockbusters were even more. In the early 1990s, box-office revenues had dipped considerably; due in part to the American economic recession of 1991, but then picked up again by 1993 and continued to increase. The average ticket price for a film varied from about $4.25 at the start of the decade to around $5 by the close of the decade [2].

The production of filmed entertainment in the United States of America is dominated by some large companies. These companies act as a "three-tier society". At the top are big studios, or the majors – Paramount Pictures, Twentieth Century Fox, Miramax Films, Warner Brothers, Universal Pictures, Columbia and Dream Works. The second tier includes the smaller or less production companies, including MGM, Lions Gate Films, Dimension Films and Sony Pictures. At the bottom are the much smaller and often struggling "independent" distributor and production companies, which regularly receive over 90% of the revenues from the domestic theatrical market [2].

Table 3-2 shows the data which the author found in the reference site for each studio with five or more movie of year of 2003. Note that in some cases movies are listed as being released by a studio that is a division of a larger movie production company.

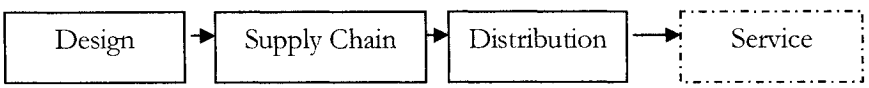
	Released Movies (2003)	*Number of Release on DVD*	*Revenue of Year 2003 (millions $) proximately.*
20th Century Fox	25	20	$1,600
Columbia Picture	27	23	$1,566
Dimension Films	7	7	$140
Dream Works	9	9	$639
Lions Gate Films	9	7	$81
MGM	19	15	$475
Miramax Films	23	21	$483
Paramount Pictures	24	21	$1,152
Sony Pictures	7	6	$210
Touchstone Pictures	12	12	$744
Universal Pictures	18	14	$1,368
Warner Bros	37	30	$2109

Table 3-2 : Statistics for each studio with five or more movie in year of 2003 (Source: Based on Form 10K report from the corporations, as reported by Disclosure 2004, and Moody's Industry Manual, New York: Moody's Investor s Service, 2004)

3.2 The Value Chain for the Automobile and Movie Industry

To better understand the activities through which an industry develops a competitive advantage, it is useful to separate the business system into a series of value-generating activities referred to as the value chain. Both of automobile and movie industry has its own value chain. The author identified automobile industry's primary activities as shown in the following diagram:

Automobile Industry Value Chain

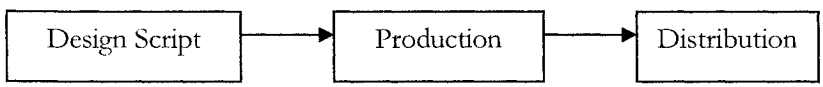


The primary value chain activities for automobile industry are:

- Design: the receiving and warehousing of raw materials, and their distribution to manufacturing as they are required.
- Supply Chain: tighter coordination of supply chains for ordering, inventory, and shipping.
- Distribution: sales channels including the traditional dealer franchise system, but also including new alternative retail outlets such as Internet dealers.
- Service: the various dealer and third-party outlets that provide warranty and out-of-warranty automotive service.

The movie industry, or the motion-picture industry, is divided into three sectors: design, production, distribution. The production sector includes those movie producers who produce movies. Once the product is made, producers use distributors to introduce the movie into the theatrical market. Distributors also run theaters and place movies on their screens to attract the audience that will generate box office revenue. Movie industry's primary activities are identified and shown in the following diagram:

Movie Industry Value Chain



The primary value chain activities for automobile industry are:

- Design Script: writing dialog or text to be used in the films.
- Production: the processes of transforming inputs into finished films.
- Distribution: the identification of customer needs and the generation of movie ticket sales

3.3 Designing Activities

3.3.1 Designing Vehicles

The design process begins with the product designers and engineers in the vehicle manufacturer firm, whose task is to master the complex and increasingly modular nature of the modern automobile. One of a vehicle designer's challenge is to tune the essential systems such as power, brake, protection, lighting, suspension to work together harmoniously, with each taking account of the other's need. As the interactions among many systems are increasingly complex, harmony would be difficult to achieve in each new model even if the technology of the systems has never changed. A key objective for the designer to achieve is to change the very nature of the individual systems to improve the overall vehicle. Because the development of new technologies for the automobile's various systems proceeds at different speeds and in different directions, creating overlaps and conflicts, the maintenance of harmony at a time of technical change is a true art relying on much accumulated know-how and experimentation.

The first step for a vehicle designer to take is to respect a long time scale. It will take 3-4 years on average to incorporate a new component system after it is fully completed in prototype form, into a new model. During the period, the designer needs to design and install production tools. Typically, this occurs halfway through the vehicle pre-production cycle and involves trying the new system out on test beds and then in prototype and pre-production vehicles to see what happens to the performance of the whole when something is added. Since the results are often a mixture of good and bad, several time-consuming iterations using forecast tool such as online or persona survey are used to provide timely feedback to the engineers in order to bring the vehicle up to a standard the consumer will accept.

Getting the stage of a fully developed prototype from a concept on paper to an actual prototype that really works is a very time-consuming process. It has taken a decade or more to have some new technologies. There are many risks throughout this process and sometimes the journey is never completed or is indefinitely delayed by technical obstacles or shifts in market conditions.

3.3.2 Designing Movie Script

Same as a vehicle design, marketing research often takes place to estimate audience interest in a film idea before a Hollywood film script is written. As in other consumer markets, computerized market surveys are used more frequently these days in Hollywood to make decisions about the viability of film projects.

Computers play a role in script preparation, as screen writers employ various software programs, such as Power Scriptor, Movie Master, or Final Draft to assist in formatting scripts. Software for the preparation of story boards also is available, as are computerized story boards witch makes it possible to visualize a scene while writing a script or before shooting begins.

HSX is a good example for forecasting on future movie sales and likelihood of a pre-filmed movie. Its "virtual specialist" as the core of the HSX's forecasting technology tool that enables the HSX's commercial researchers to offer movie fans a fully customized and managed for entertainment stock exchange service, and use result to provide good feedbacks from movie fans' to movie producer for future movie script designing.

3.4 Supply Chain and Production Activities

3.4.1 Supply Chain of the Automobile Industry - The Lean Production System

The superior efficiency of lean production over mass production is reflected in automobile product development performance. According to Clark and Fujimoto [5], it took forty-seven months worth of engineering time for Japanese producers to design a new vehicle, compared with sixty months in the US and Europe. A major reason for this difference lay in the over-lapping product development phases and the effective use of suppliers as part of the development team.

The world automobile industry faced at least two distinct transformations in the twentieth century, first from craft production to mass production originating in the US, and second from mass production to lean production originating in Japan. These transformations have had an enormous impact on production efficiency and work organization. Benchmarking and learning between plants have led to some similar

production principles being adopted in different parts of the world.

3.4.1.1 Toyota System

An example of lean production system for automobile industry is the Toyota system. The production, development, and supplier system of the currently production system for most auto producers are suing often refer to as the Toyota system, or the lean production system - an "ideal type" based on the Toyota-style production system, though considerably simplified. The Japanese system was a key factor for Japan that helped it to establish its position as a top-class auto industry in the world.

The following competitive capabilities are the characteristics of the Lean Production System.

- Overcoming trade-offs: In manufacturing it has achieved competitive advantage simultaneously in production process productivity, manufacturing quality, production lead time; in product development it has achieved competitive advantage simultaneously in development productivity, design quality (product strength), and development lead time.
- Flexibility: It offers flexibility to deal with changes in products and the variety of products (variety in product mix, some fluctuations in total production volume, model change) with minimal increase in costs.
- Organizational learning and improvement: It has built-in organizational learning mechanisms that enhance productivity, improve quality, as well as solve other problems in manufacturing, continuously and on a company-wide scale.

3.4.2 The Movie Production

The nexus of the movie production processes are in the editing room. This is the place where the film is assembled by cutting and mixing the physical location video and audio recording. Once rough cuts of these shots are available, additional aspects such as computer generated special effects and music and sound synthesis are added by outside

parties. In all cases, the enhanced content is returned to the editing room, possibly for further cutting, modification, and enhancement. As with most of the other parts of the production process, post- production may be outsourced to other companies.

3.5 Distribution Activities

3.5.1 The Major Role of Distribution in Automobile Value Chain

Once the vehicle manufacturer produces cars of the specifications that match the demand it expects it sends the cars to its franchised dealers. Car dealers in turn stock cars in massive parking lots.

Automotive marketing, distribution, and retailing represent approximately 20 to 30 percent of the value of a new car, depending on company, dealer type, and the level of sales incentives applied to the product line. Automotive markets generate more than $1.5 trillion in revenue world-wide every year, of which approximately $500 billion is generated in the North American region. Almost one-third of this value is directly created by retailing of new and used vehicles, service and repair, and related distribution activities.

Many of the keys for a successful manufacturing company are held by players in the distribution activities. Retailers, customer researchers, forecasters, distributors, financial sources, and others define what the manufacturing activities should make and how and when it should make it, because they have direct contact with the wishes of the ultimate customer. Manufacturing organizations that do not heed the information embedded in the complex distribution networks suffer poor sales, high inventories, and tarnished reputations with customers. In the past, with less competitive markets, auto companies could afford the often hidden costs of high retail inventories. Now, all car manufacturers are trying to find new ways to limit these costs by understanding customer needs and by listening carefully through the various layers of retailing and distribution.

The distribution activities of the auto industry has always been important but has received little attention from auto production executives. However, distribution has become so

critical to overall strategy that the activity is receiving much more attention than ever before. The activity is extremely diverse and is not necessarily amenable to the same tight coordination that auto manufacturers are building into their distribution supply chains. However, linking the distribution activities to the production activities is the key to attaining better responsiveness to customers and to achieving competitive advantage.

3.5.2 The Process Activities of Movie Distribution

Finally, after production stage, the post-production stage which the visual and audio elements of a movie are fine-tuned. As with most of the other parts of the production process, post-production may be outsourced to other movie-making companies. Parallel to the development of the content itself are related business activities, marketing departments develop advertisements to promote the movie, often long before the content is actually completed. Trailers and posters are created to raise awareness of the movie. The marketing department also gauges audience reaction to early cuts of the movie shown in private focus group screenings. The film is altered in response to audience reaction and surveys. The final version to be shown in theaters is completed when the editors, directors, producers, and marketing department are satisfied.

Prior to theater release, the final version may be distributed to many parties. Critics and awards judges may receive copies. This process serves an essential function in the movie industry: to publicize and draw (hopefully positive) commentary about the movie. However, the sheer number of people involved at this stage considerably complicates content security. Many studio employees have access to the final version: marketing and executives continue to view the content and build and execute strategies for its promotion.

Several months after theater release, movies are replicated on DVDs at DVD pressing plants. DVDs are then distributed to stores and movie rental companies. It is not unusual for U.S. DVD distribution to begin a month or more before the official DVD release date. (Typically, overseas DVD distribution of American movies does not begin until after the U.S. release date.)

3.6 Comparison Summary

From an industry perspective:

- Similarities: Both the automobile and movie can be seen as an individual's entertainment tool, for instance – a car model collection, a movie (DVD) collection by young generation. The two industries have somewhat similar value chain activities for their products, from designing activity to distribution activity. Each of their own industry value chain provides useful information about technical specifications, performance, long-term industry trends, market supply and industry cost structures during the production producing processes.
- Differences: Automobile manufacturing is the world's largest manufacturing activity, with just over 50 million new vehicles produced each year. Governments have, therefore, looked to the automobile industry as a major opportunity for their national economic development, international trade and foreign direct investment. The automobile is also the second largest expenditure item for households after housing. This factor would be the major difference between an automobile and a movie (DVD) when a consumer purchases a car or a movie ticket (DVD).

From a researcher perspective: each of the industries reviewed in this chapter has excellent features in some areas while lacking them in other areas. As the two products – movie and automobile keep leapfrogging over one another in the features race, there is never a clear reason that the automobile can't be applied into the HSX method. The important thing to do when applying automobile is to determine researcher's own set of requirements clearly, assign weights of importance to it, and compare the different products with respect to those requirements. It is important to have a clear and precise definition of researcher's own requirements when use automobile model as virtual stock.

In developing the Automotive Stock Exchange these points must be kept in mind:

- Test the model on an experienced group of people. The group should be comprised of automobile enthusiasts and industry experts that have specific knowledge such as car dealers.

- A selection of vehicle characteristics as supplied by this group and attached to each virtual vehicle in the game would provide helpful information for each auto exchange game player.

4 AN ONLINE AUTOMOBILE STOCK EXCHANGE PLATFORM

4.1 System Requirements

The core of this research is to design an online trade platform to forecast future automobile model sales. This chapter explains how an artificial market system similar to the HSX is designed.

This online trade system will be designed for (1) the researcher or system administrator who will manage the system and do research work, and for (2) the user who plays with this platform as an activity player. The project deliverables will consist of (1) system data flow, and (2) documentation: system specification, design, tests, and a user menu. Currently the system is hosted by CIRANO's (CEX) [12] Server. The system is generated by J2EE application which contains all the API used for messaging middleware (JMS), database access (JDBC), persistence mechanism (EJB), presentation (JSP), etc.

4.1.1 Server Requirements

Server hardware and operating system. Intel(R) Pentium(R) III CPU family 1133MHz, memory: 1G SDRAM, Linux version 2.4.20-19.9 (gcc version 3.2.2 20030222 (Red Hat Linux 3.2.2-5), and application server: Jboss 3.2 with Tomcat 4.1.

Internet software: Java web server and Netscape Navigator or Microsoft Internet Explorer 5.0 above.

System language environment: HTML, CSS, JSP, Servlet, PostgreSQL, and Java. Database: Relational SQL database is selected, and JDBC.

4.1.2 Client Requirements

Client hardware and operating system: a personal computer with the current operating system.

Internet software: Netscape Navigator or Microsoft Internet Explorer 5.0 above, session cookie and Javascript enabled.

Input and Output Requirements. The input is made through either a keyboard or mouse via a user interface, which is accessed from a client part computer (user or a server part computer (system administrator). The output is the HTML and JSP, which is displayed on the screen as a response to the user's trading request.

4.2 Database Design and Entity Relationship Diagram (ERD)

One of the goals for this thesis is to record historical stock price and to compare it against actual auto model sales data. With an artificial market platform, users can only communicate with the database through an interface. It is imperative to have a well designed and optimized database as it will have a direct effect on the quality of the system.

The conceptual modeling is an important phase in designing a successful database application. The author's design followed the traditional approach of concentrating on the database structures and constraints. Because of the limited time to complete all thesis objectives, author did not implement the whole platform. Having consulted with the staff in the CIRANO research group about the system requirements and research purpose needed, the author came up the ASE platform design which is a sub-model of an existing platform which is running by CIRANO.

The platform was designed by author with an entity relation diagram (ERD, Figure 4-1). There are six entities: user, e-stock manager, stock, trade, adjudications and marketing material, which are represented by rectangles. Each entity has its own attributes, listed in an entity block; the key attribute is marked by samples "pk, fk1, fk2" in terms of primary key, and foreign key. The primary key is a filed that has a unique value for each record in the file or table. For instance, stock ID would serve as a good primary key for a stock table if every stock record in the table will contain a unique value in the stock field. A Foreign Key is the primary key field(s) from one table that is repeated in another table to provide a common field between the two tables. For example, if there are two tables called stock and order that are related to each other, the primary key field can be included from stock

(stock ID) in the order table as well. Those entity attributes are indispensable information that is necessary to manage the system. There are some relations between entities, which are defined inside Microsoft Visio with this ERD. There are two kinds of relations in the ERD; one-to-many and many to many.

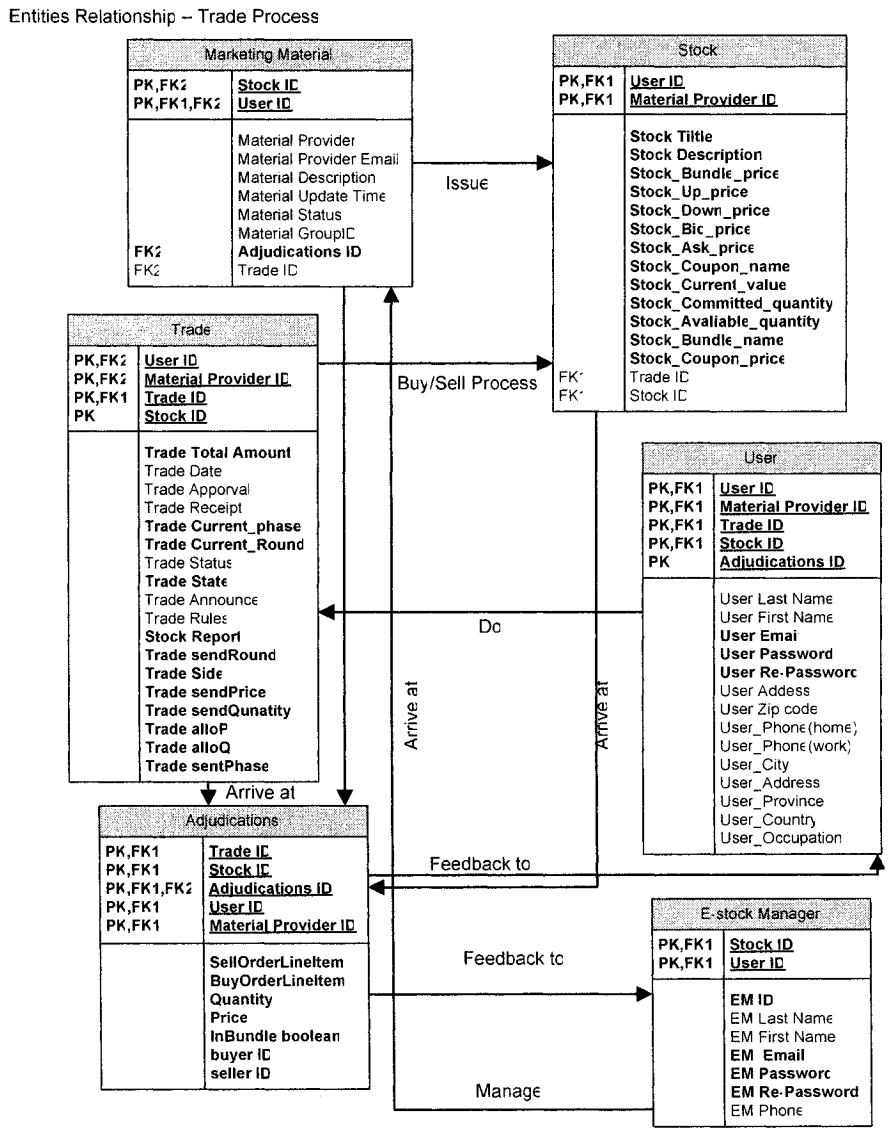


Figure 4-1: Entities Relationship Diagram – Trade Process

Once the ERD has been drawn, the conceptual design of the database is finished and the conceptual schema is created. The next step is the actual implementation of the database by using PostgreSQL. The conceptual schema is then translated from the high-level data model into the implementation data model. This step is called logical design, which will be explained in a later section, and its result is a database schema in the implementation data model of the JDBC.

4.2.1 Trade Table

The table in this section is a trade table; it is the core entity in the ERD where it connects the other entities to relate each other before the database is created.

There is a market state update at each round (as this platform is a price discovers mechanism, producing 'temporary' equilibrium prices at fixed points). It keeps all the relevant information for the negotiation following. After round r, the market state contains these elements:

$$E_r = (r, AI), \qquad (5)$$

Where:

(a) r = the round number

(b) AI = the temporary allocation table until negotiation ends. In this case it becomes the final adjudication.

This table is contained in the negotiation document under the name "trade table". The trade table takes the form of a list of inputs. Each line corresponds to an order and each column to an indexed classified variable (See 4-1 table's column description). The number of lines is thus dependent of the number of order received and of the order's management rules.

Table's column description (actual version):

Column Name	*Description*
Trade ID	Trade ID (PK, FK2)
Stock ID	Stock ID (PK)
User ID	User ID (PK, FK2)
Material Provider ID	Material Provider ID (PK, FK2)
Trade Total Amount	Total Amount trade in process
Trade Date	Trade date, time
Trade Approval	Trade approval status
Trade Receipt	Trade receipt, automatically send from system
Trade Current _phases	Trade Current phase
Trade Current_round	Trade Current round "r"
Trade Status	Trade Status
Trade State	Where state the current Trade process at
Trade Announce	Announcement from system, such as error messages
Trade Rules	Trade Rules
Stock Report	Stock Report generated by system
Trade sendRound	Round during which the order was sent.
Trade side	Order's market side (buy or sell)
Trade sendPrice	Asking price (limit price)
Trade sendQunatity	Asking quantity
Trade alloP	Allocation price (obtain price)
Trade alloQ	Allocation quantity (obtain quantity)
Trade sentPhase	Phase during which the order was sent.

Table 4-1: Trade Table in Database

An input can take two forms. It can be either a limit order from a seller or from a buyer. As an order arrives, it is systematically added to the allocation table by some priority rules. At every market state update, an allocation procedure classifies orders (a purchase order that fits with a sale order according to some market rules). This will be explained later in the market procedure section.

4.3 Data Flow Diagrams (DFD)

The system requirements are described in the data flow diagrams of relationship between each service function, each system component and the external user. The system structure is demonstrated in a context diagram in Figure 4-2. The entity relationship diagram between the system service and user is described in Figure 4-1, and the data flow diagram (DFD) about levels is described in later sections.

Context Diagram

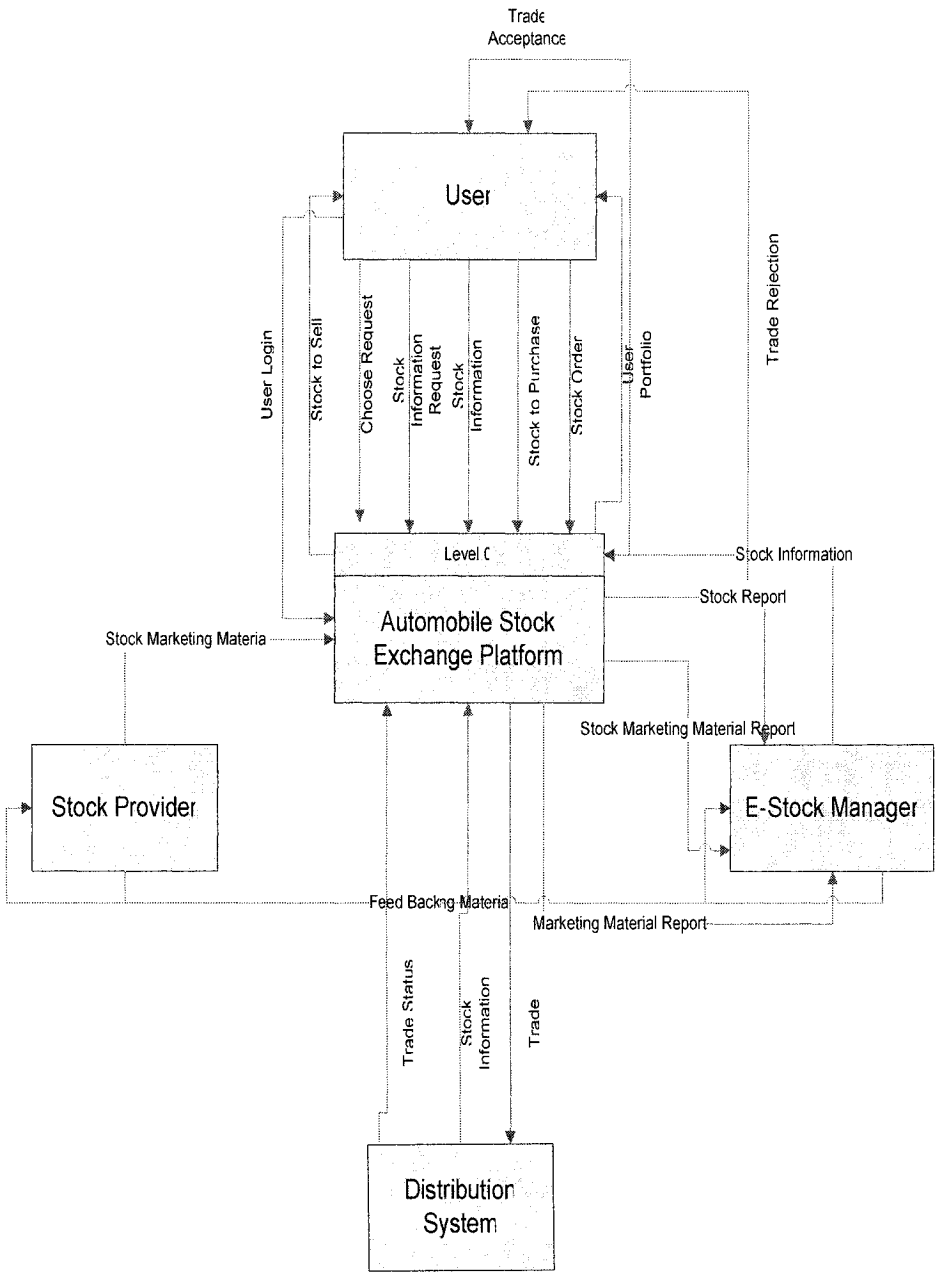


Figure 4-2: Context Diagram for Online Stock Trade Platform
(Level 0 DFD)

Creating the Context Diagram - the author's online trade platform system starts with a context diagram. Figure 4-2 shows the platform's context diagram. There are four purpose use cases in the context diagram: maintain stock information, maintain stock materials, user trade stock and trade with distribution system. The four entities are 2 internal entities and 2 external entities. Maintain stock information is the first use case and it works as the core of the trading system for inputs: stock information from different sources. Clearly, the distribution system is an external entity. The stock information is the data store that holds information within the "ASE platform". The information is owned by the "ASE platform". However, it is not quite clear if the electronic stock manager is the part of the stock system. In this case, as the e-stock manager makes decisions independently about the system on the basis of the information both inside and outside the system (e.g., deciding what information needs to be changed within the system), the e-stock manager is considered to be an external entity. At this point, the context diagram will have two external entities (distribution system and e-stock manager) that have the dataflow called "stock information" into the trade platform. The stock file is internal to the trade platform and therefore is not documented. The output data flow from the trade platform to the e-stock manager called "stock report" (see Figure 4-2).

The second use case is built in the same fashion. There is a new external entity "stock provider" (who provides 'stock materials') that has an input data flow into the system called "stock materials". The e-stock manager also has this same data flow into the system. The stock materials file is internal, and so it is not included on the context diagram. The only output is the stock materials reports to the e-stock manager. The third use case is more complex but is again done in the same way. The list of other input join the system, with one of the outputs of the system goes to a new destination, the order file. Since the order file is internal to the platform, it and the corresponding data flow are not shown on the context diagram. Last use case describes how stock orders move from the online stock trade platform into the distribution system and how status information is updated from the distribution system. It is fairly straightforward with four entities.

This context diagram is designed around the customer external entity. Some analysts might at this point try to bundle together some of these data flows into higher-level data flows. For example, the two inputs "choose request" and "information request" data flows might be bundled into one "request". The output to these requests "stock information" and "stock materials" might be bundled into one data flow called "search response". Using bundles makes the context diagram simpler. However, it then requires the level 0 data flow diagram to use these same bundles and ultimately will require some level- 1 data flow diagram or lower-level data flow diagram to use splits and joins, as these bundles are shown as inputs to the data flow diagram. But the specific elements within them are used by the processes on the data flow diagram. Such a use of splits and joins will increase complexity at the lower levels.

4.3.1 Creating Data Flow Diagram Fragments

Unlike the context diagram, the data flow diagram fragment includes data flows to external entities and to both internal and external data stores. Figure 4-3 shows the data flow diagram fragment for the first use case. The data flow diagram fragment for the second use case is equally straightforward. The author tried to position the two external entities to similar places on this data flow diagram fragment as they are on the context diagram in Figure 4-2. The reason author tries to do this because it makes it simpler to put data flow diagram fragments together later and because it helps make the level 0 data flow diagram look similar to the context diagram. Despite the number of inputs and outputs for use case three, they are relatively straightforward in design.

4.3.2 Creating the Level 0 Data Flow Diagram

The next step is to create the level 0 data flow diagram by integrating the data flow diagram fragments. Basically it is the context diagram; Figure 4-2 shows the level 0 data flow diagram, give an overall view of the data flow.

4.3.3 Creating the Level 1 Data Flow Diagram

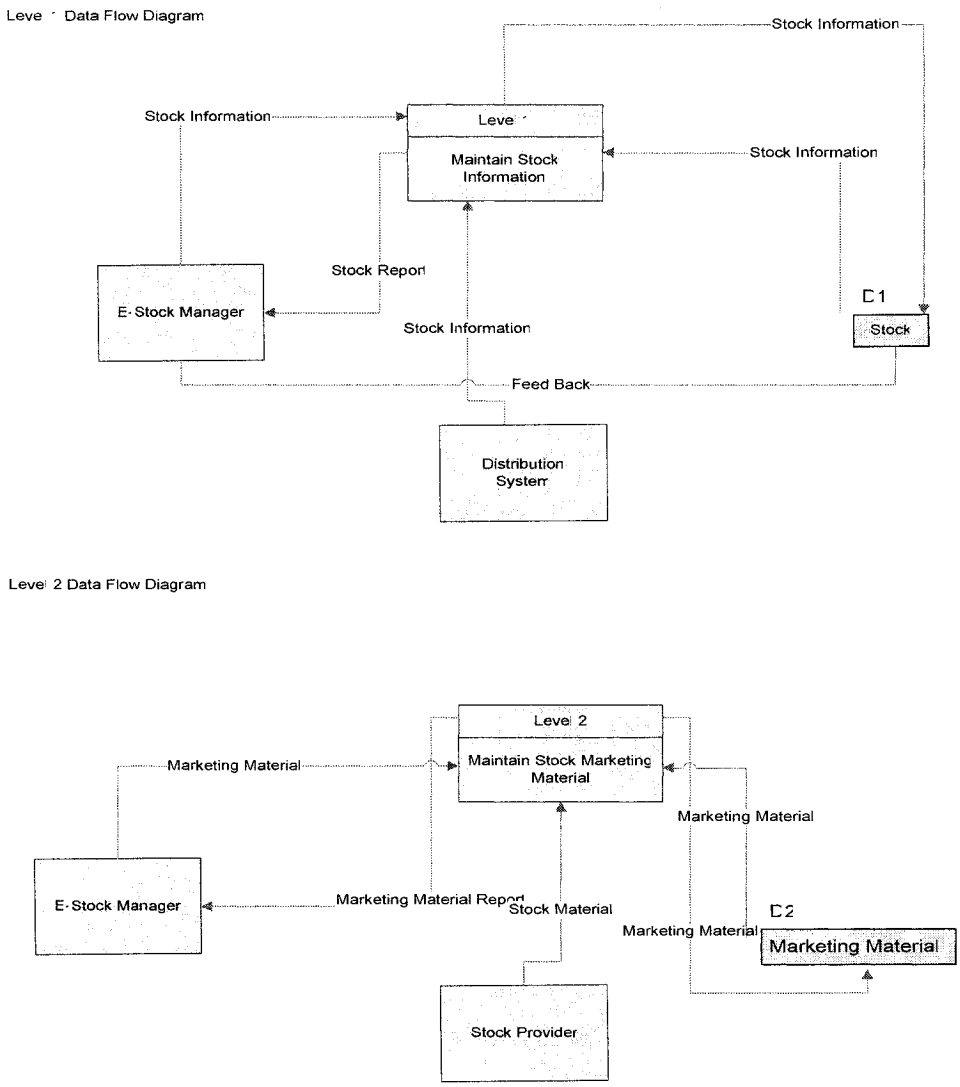


Figure 4-3: Online Stock Trade Platform System (Level 1 and 2 DFD)

The process for creating the level 1 data flow diagram s is to take steps and to convert them from a use case into a data flow diagram in much the same way as for the level 0 data flow diagram. However, unlike the level 0 data flow diagram, no external entities are listed on the level 1 data flow diagram and no destinations are shown for the data flows that

connect outside the use case, unless they connect to a data store. The gray color block "stock" contains all the required information for stock entity, such as stock information which includes stock id, stock name, etc. It connects the other 2 entities through the process of "maintain stock information", the entities are "e-stock manager" and "distribution system"; it also connects to other processes for other use cases. The author had to choose different names and numbers for the processes in the data flow diagram than what the use case called for as mentioned in the previous section. It is a relatively straightforward process. Sometimes additional data flows or steps are discovered, but if the objectives of the system are well defined, this happens only rarely. The level 1 and 2 data flow diagrams are shown in Figure 4-3.

4.3.4 Creating the Level 2 Data Flow Diagram

The author has broken down several of processes on the level 1 data flow diagram into more detail on a level 2 data flow diagram which comes from the second use case. The gray color block "stock material" contains all the information of stock materials such as trade quality, type of trade for each stock during the trading process; it connects to process of "trade stock".

4.3.5 Creating the Level 3 Data Flow Diagram

Level 3 data flow diagram is the "trade stock" process that combines the level 1 & 2 data flow diagrams to generate the third use case. The only entity "user" has inputs and outputs from/to "trade stock" process. Figure 4-4 shows the Level 3 & 4 data flow diagrams.

4.3.6 Creating the Level 4 Data Flow Diagram

The last use case is presented by level 4 data flow diagram, which connects to the level 3 data flow diagram by using the input of trade information. This process maintains the trade activity, there are three entities "distribution system", "e-stock manager" and "user" is linking to this use case process.

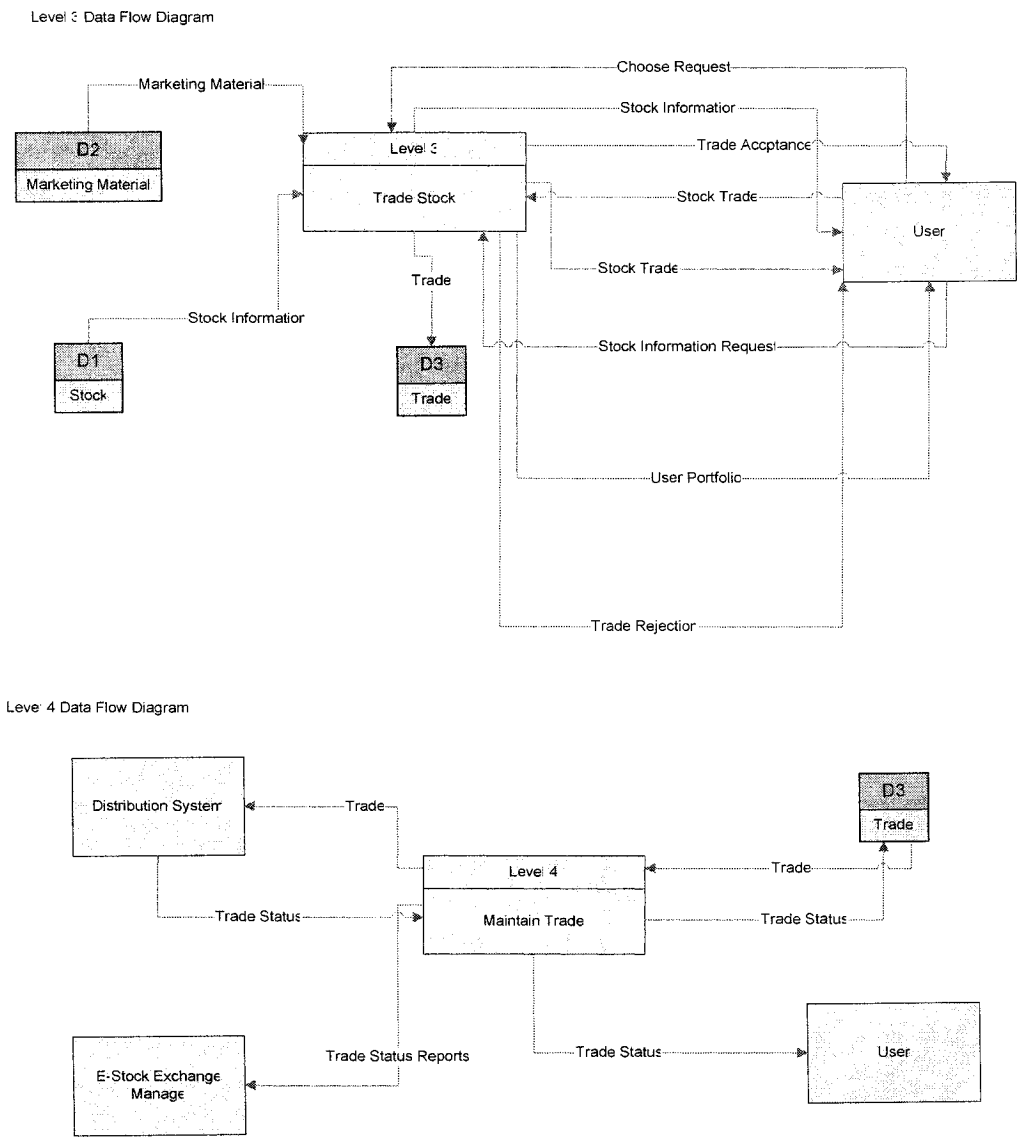


Figure 4-4: Online Stock Trade Platform System (Level 3 and 4 DFD)

4.3.7 DFD-Overview and Validating

The last step is to integrate these use cases to a complex system by connecting each data flow diagram. The final set of data flow diagram was validated by the author and then by author's advisor. A few minor changes were identified, such process names and additional

functionalities. Figure 4-5 shows the automobile stock exchange platform Data Flow Diagram – Scenarios Integrated.

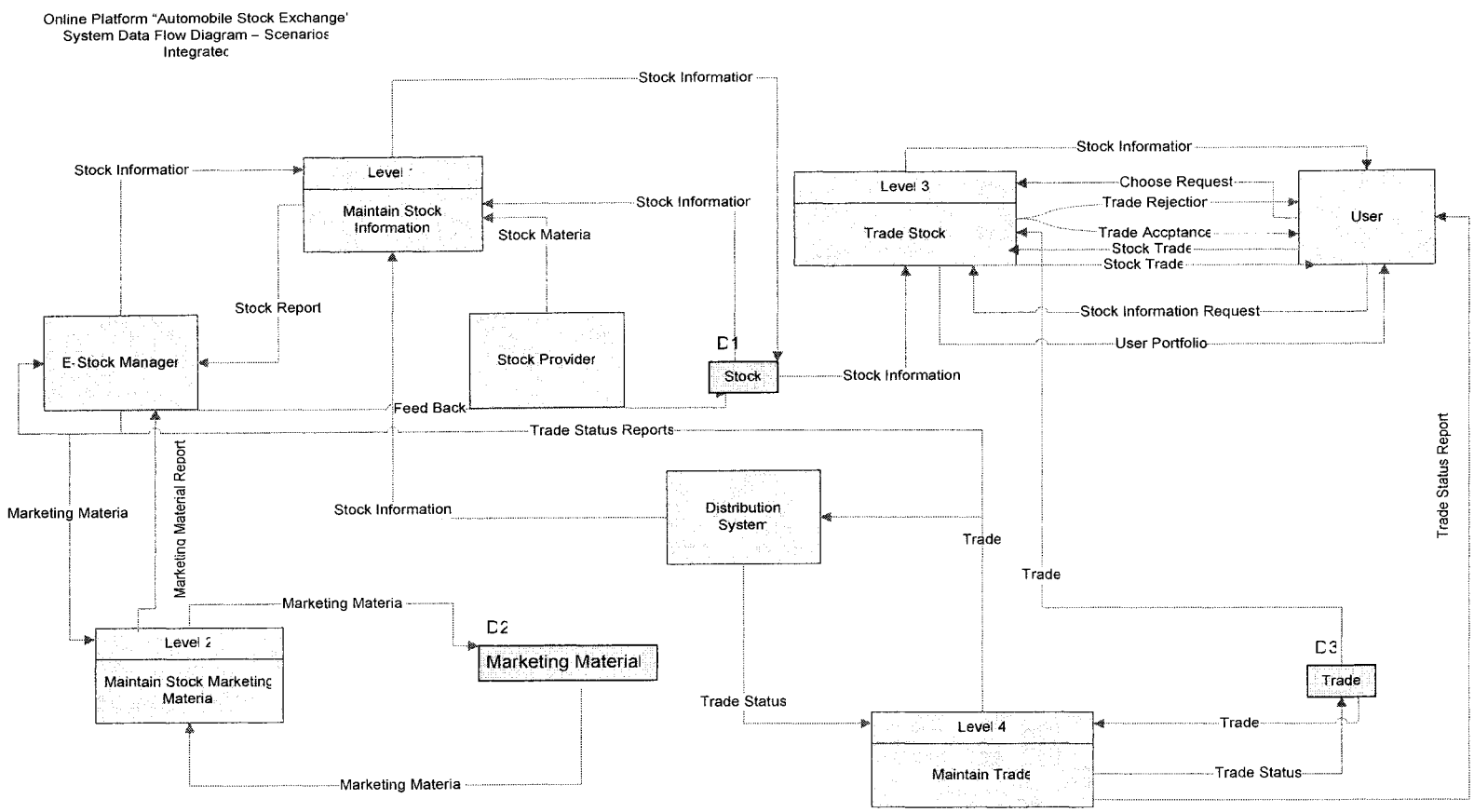


Figure 4-5: Online Stock Trade Platform System – Scenarios Integrated

4.3.8 Moving from Logical to Physical Models

Above is the Logical Data Flow design. Once design strategy and actual design have been developed, the next step is to move from the logical process and data models to the physical ones. Author has defined the processes supporting the online stock trade platform system by designing logical data flow diagrams and the data is used by those processes by developing logical models. Figure 4-6 gives a good example on logical data flow for use case "maintain trade". These models do not contain any indication of how the system will actually be implemented when the information system is built; they simply state what the new system will do. The physical process models (DFDs) and physical data models (ERDs) are created to show implementation details and to explain how the final system will work. These details can include references to actual technology, the format of information moving through processes, and the human (user) interaction that is involved. These models are considered models because they describe the characteristics of the system that will be created, and the diagrams can be thought of as containing the "programmer view' of the system.

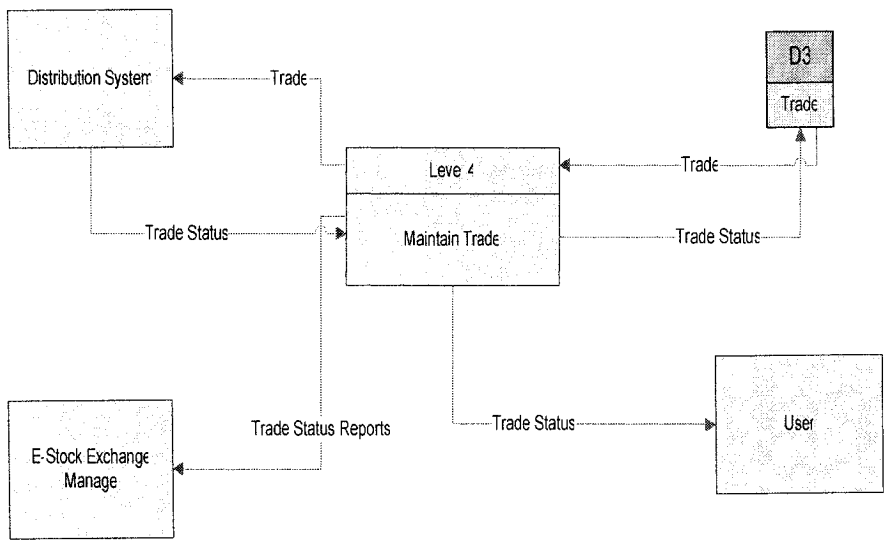


Figure 4-6: Logical Data Flow Diagram

4.3.9 The Physical Data Flow Diagram

There are four steps to make the transition to the physical data flow diagram.

The first step is creating a physical data flow diagram with the existing logical data flow diagram and then adds references to the ways in which the stock data stores, stock data flows, and processes will be implemented. Stock data stores on physical data flow diagrams will refer to database tables; processes, to programs or human (user) actions; and stock data flows, to the physical medium for the data, such as stock reports. The name for the various components on the physical data flow diagram should contain references to these implementation details in parentheses. By definition of a system design, external entities on the data flow diagram are outside of the scope of the system and therefore

remain unchanged in the physical diagram. Figure 4-6 shows that how the logical data store called "trade" that will store stock data in the order table of PostgreSQL database has renamed "trade (PostgreSQL: trade table)" and logical data flow "trade" includes "PostgreSQL: trade record" to show that this information will be in the form of a record from the trade table.

The second step is to add human-machine boundary. Physical data flow diagrams also are different from their logical counterparts because they differentiate human and computer interaction using a human-machine boundary, which is a line drawn on the model to separate human action from automated process. For example, the "maintain trade" requires the user to interact with the web using an interface driven by trade platform and processes, and it allows the e-stock manager to request portfolio or stock information from the automated system. The physical model, therefore, contains a line separating the user and e-stock manager from the rest of the process to show exactly what is done by a person as opposed to a "machine" (see Figure 4-7).

In the third step, author added to the data flow diagram additional process, stores, or flows that are specific to the implementation of the trade platform and have little to do with the business process itself. These additions can be due to technical limitations or to the need for audits, controls, or exception handling. Technical limitations occur when technology cannot support the way in which the system is modeled logically. For instance, suppose a data store exists on the logical DFD to hold all stock's information, but the database technology that will be used to build the system cannot handle the large volume of stocks data in separate report. A physical data flow diagram may need to have few different reports, one for activity; one for order and one for quote – so that the technology will work properly. Audits, controls, or exception handling refers to putting deposit and balances in place in the platform in case something goes wrong. For example, a user might cancel an order that he placed. Instead of just having the system get rid of the information about the order, a process maybe included for control purposes that records the deleted orders along with the reasons for the cancellations.

The fourth step is to update the elements in the data flows. The data flows will appear to be identical in both the logical and physical data flow diagrams, but the physical data flows may contain additional system related data for reasons similar to those described in the previous section.

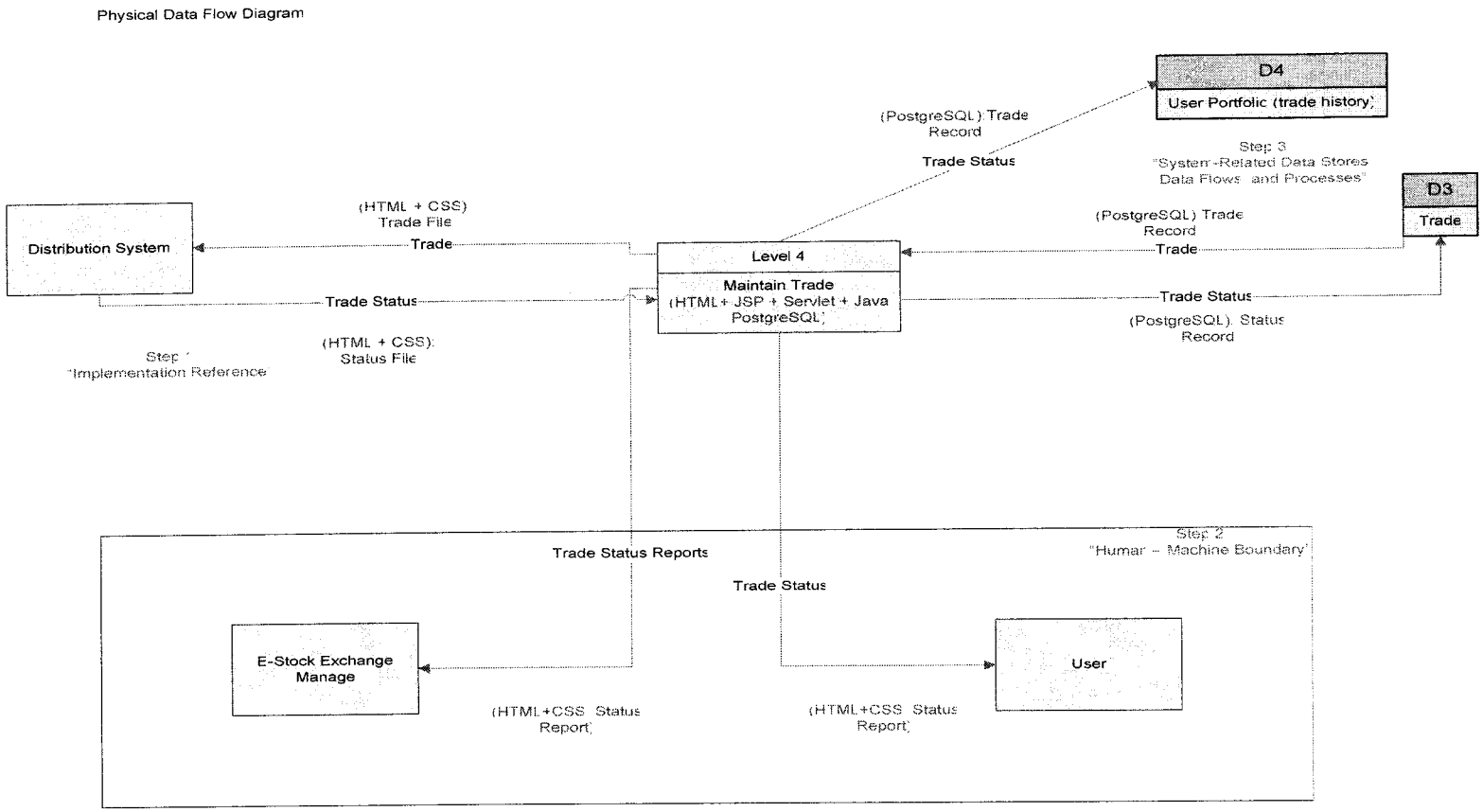


Figure 4-7 Physical Data Flow Diagram (applies to Maintain Trade example)

4.3.10 Applying the Concepts in the "Maintain Trade" Use Case

The author's case is based on the "maintain trade" process. Figure 4-6 shows the logical data flow diagram; which is designed to create the physical model, by using the logical model as the starting point. The author identifies how the data flows, how the data is stored, and how the processes are implemented and added. The implementation references are added on the data flow diagram. As first discussed in section 4.3, (1) the trade order from users usually comes as input data or data type selection, (2) the e-stock manager receives trade reports via the administration site, (3) the trade information will be received as records from a PostgreSQL table, and (4) the distribution system gives feedback through the trade status and receive the trade order information. On the physical data flow diagram, each of the data flows is modified by placing the identified media in parentheses as shown in Figure 4-7. The data store (i.e., trade) refers to the tables called "trade" contained in PostgreSQL database; therefore, the store is then updated with this information to indicate its physical qualities. Also, the web interface is placed in parentheses after the "trade" process to show that the process is conducted.

As a second step, a dotted line is drawn to represent the human-machine boundary and to communicate how much (and what parts) of the process is automated. The system-related components are added to the mode. The system-related date elements are added to the data flow entries. A system-related data element called "trade date" is added, which is added to the data flow that goes from "trade" process to the "stock" data store. This field will capture the last time in which a piece of trade was created or updated in the platform.

4.4 Trade Platform Phases

Given a well designed trade platform structure and physical data-flow, trade platform phases are required. These are explained in this section [7].

4.4.1 Initiation Phase

The trade platform system waits for the "market initiator" to provide some basic information (trade rules) necessary to proceed in the creation of the market. The trade necessarily begins with an initiation phase.

4.4.2 Competition Phase

The competition phase is the one during which the trade platform system waits and processes trade orders (purchase or sale) by the competitive participant (user) of the market trade. During the phase, more than one use is allowed to communicate with the trade platform system. In its course trade orders are submitted, the trade documents are modified accordingly, and information about the state of the market is provided to users. A competition phase consists of a succession of rounds. A round is defined as a period after which the information provided to some or all participants is changed. The information provided by the participants is changed according to the evolution of the state of the negotiation. Basically, a round is structured as follows: (i) users obtain some stock information from the market, (ii) they are asked to submit an order, (iii) at one point, the trade platform system uses the orders submitted by the users in order to update the state of the trade or trade documents, (iv) users are then informed (selectively) about the new state of the market. In fact, a precision has to be made about the market update. A refresh delay has to be determined according to the data processing. The process continues until a phase end condition is met.

The rules of the trade stocks must specify the following: (i) the nature of the orders that users are asked to submit; (ii) what triggers the market update, i.e. the end of the round; (iii) how the trade state is modified by the new orders submitted during the round; (iv) what information is sent to users at the end of the round; (v) what triggers the end of the phase. Different activity rules can lead the end of the phase. In the case of a "call market", a timer (clearing time) will call the end of the competition phase. Every order is accepted by the market during a certain time but is not cleared one at a time as they arrive. Rather, they are entered directly into order queue and held there until a pre-specified clearing time. Concerning information that is sent to users, the output document will be explained in next chapter.

4.4.3 Adjudication Phase

The stock trade necessarily ends with a distinct adjudication phase. At the end of the trade process, the current market state becomes final. Bids and asks eligible for a match at the

system-calculated price are processed into trades with the market maker, which is the mediation agent between the two sides of the market (the counterparty of each trade). Specially, all buy orders (bids) with prices as high as or higher than the clearing price and all selling orders (asks) with prices as low or lower than the clearing price are filled.

4.5 Trade Market Procedures

4.5.1 Competition Phase

Priority procedure - This procedure inserts new orders into the list and places them following their priority order. The priority rules determine the place of a bid or offer in the queue awaiting execution. Each new order is placed in a priority order that is related to its limit price. When two bid orders have the same limit price, the one first inserted first into the list has the priority. This gives the user an advantage to the previous round orders. However, it is the opposite for two ask orders. For the same limit price, the previous sale order is placed behind. Finally, for the same limit price, a purchase order has a priority over a sale order as a way of encouraging trades [7]. Table 4-2, 4-3 and 4-4 provide examples for trading process during the competition phase.

Example: Trade table at the end of round 4:

Trade ID	*sentRound*	*sentPhase*	*side*	*sentPrice*	*sentQuantity*	*AlloP*	*AlloQ*	*partyKey*	*qualityNote*	x	*Stock ID*
867675	4	2	sell	9	5	0	0	3	X	x	12345
746585	3	2	sell	9	8	0	0	2	X	x	12345
986756	2	2	buy	8	10	0	0	1	X	x	12345

Table 4-2: Trade table at the end of round 4

Arrival of a new order:

Trade ID	*sentRound*	*sentPhase*	*side*	*sentPrice*	*sentQuantity*	*AlloP*	*AlloQ*	*partyKey*	*qualityNote*	x	*Stock ID*
786756	5	2	buy	9	8	0	0	4	X	x	12345

Table 4-3: Trade table arrives at new order

New state of the market (AI):

Trade ID	*sentRound*	*sentPhase*	*side*	*sentPrice*	*sentQuantity*	*Allo*	*Allo*	*partyKey*	*qualityNote*	x	*Stock ID*
786756	5	2	buy	9	8	0	0	4	X	x	12345
867675	4	2	sell	9	5	0	0	3	X	x	12345
746585	3	2	sell	9	8	0	0	2	X	x	12345
986756	2	2	buy	8	10	0	0	1	X	x	12345

Table 4-4: Trade table at new state of market

4.5.1.1 Allocation Procedure

The allocation procedure is inside of competition phase, it performs a functionality called "offer quantity".

Quantity offered on the market:

$$Q = \Sigma\ (\mathbf{1}_{sell})\ (sentQuantity), \qquad (6)$$

Where

$\mathbf{1}_{sell} = 1$ if *side* = "sell"
$= 0$ if *side* = "buy"

Example: Quantity offered in case of Table 4-4.

Trade ID	side	Qantity offered on the market	sentQuantity	$\mathbf{1}_{sell}$
786756	buy	Q=0	8	0
867675	sell	Q=5	5	1
746585	sell	Q=5+8=13	8	1
986756	buy	Q=13	10	0

Table 4-5: Quantity offered example

4.5.2 Adjudication Phase

$$\begin{aligned} Trade &= alloQ && \text{if } side = \text{"buy"}, \\ &= (alloQ\text{-}sentQ) && \text{if } side = \text{"sell"} \end{aligned} \qquad (7)$$

The system compares what the participant receives (alloQ) to its initial endowment (sentQ). In the case of a seller if alloQ is less than sentQ, then it means that the seller

entered a trade. For both case, there is an adjudication if trade ≠ 0. Table 4-6 shows an example of the case.

Adjudication table:

buyer ID	seller ID	Quantity	Price
786756	736756 (market maker)	8	9
736756(market maker)	746585	8	9

Table 4-6: Adjudication Table

5 PLATFORM DATA COLLECTION AND ANALYSIS

Whether it is quantitative or qualitative research, it will require (1) understanding a variety of experiment data analysis methods, (2) planning experiment data analysis early in a research project and making revisions in the plan as the research work develops; (3) understanding which methods will best answer the research study questions posed, given the experiment data that have been collected; and (4) once the analysis is finished, recognizing its data accuracy and how the analysis affect the conclusions that can properly be drawn. The research questions govern the overall analysis.

This online stock platform is for a small group of people (approximately 45 users were registered in the system, with most of them being students in Dr. Navarre's class). As an artificial market, the online stock platform lets users trade stock just as seriously as they trade stocks in the HSX, since both platforms' currency for trading stocks is play money. The data records of this platform will be similar to those of the HSX, in historical stock bid prices, ask prices, last price, high price, low price and trade volume. One of the marketing efficiency methodologies was used to test the author's hypotheses, for assessing the magnitude, direction, timing, and significance of stock price reactions to automobile stock listings.

The evidence of the measurable market price reactions to the announcements of automobile stock listings, the trade platform's efficiency in such reactions will be examined in the later sections.

5.1 Designing the Study

The author's examination of online trade platform's forecasting accuracy begins with the stock (automobile model) collection, in which various stock names, type, sale prices and

scale price are created and combined into the complete stock market. The author then examines the historical stock prices, which includes the sample data in the quote log file, such as trade date, round, Product GPK, bid, ask, last, low, high price and trade volume. The next step is that author uses the collected data of each car stock's various prices to analyze and compare with that car's real sales' records. A conclusion will be drawn about the possibility of applying the HSX method to automobile industry.

5.2 Stock Collection

Stock Name	**Type**	**Sale Price (Canada) In Year 2003**	**Scale Price (bundle price)**	**Starting Price (up) ***
BMW 320	Sports	$34,950	$1	$0.71
Chevrolet Equinox LT	SUV	$28,565	$1	$0.14
Chrysler PT Cruiser	Convertible	$26,995	$1	$0.68
Dodge Carvan	Van	$27,825	$10	$5.16
Ford Focus ZX4 SE	Sedan	$18,565	$5	$2.98
Ford F150 XL	Pickup	$27,135	$10	$5.70
Honda Civic SiR	Small	$25,500	$1	$0.11
Honda Element	Truck	$23,900	$5	$1.15
Hyundai Tiburon	Sport	$22,895	$1	$0.32
Kia Rio RS	Sedan	$13,550	$5	$1.00
Pontiac Vibe	Hatchback	$21,150	$1	$0.62
BMW Mini Cooper	Convertible	$31,500	$1	$0.23
Mitsubishi Eclipse GS	Sport	$27,988	$1	$0.12
Nissan Altima S	Sedan	$23,798	$5	$0.43
Saturn VUE Red Line	SUV	$32,135	$1	$0.47
Toyota Scion X (U.S	Truck	$19,995	$1	$0.58
Suzuki Vitara	Small SUV	$21,995	$1	$0.08
Toyota Matrix XR	Hatchback	$21,185	$5	$1.45
Toyota Prius	Hybird	$29,990	$1	$0.01
Volkswagen GTI	Hatchback	$26,550	$1	$0.10

Table 5-1: The car stock selection and each stock's detail information. (Source: DesRosiers Automotive Consultant Inc. and Ward's Automotive Reports News Market Data Book 2004)

$$\text{Note: * The starting price} = \frac{\left(\frac{year\ 2003\ car\ sales}{1{,}000}\right)}{12\ month}, \qquad (8)$$

$$\text{Scale price} = \text{Max}\ \{\text{starting price} \in (1, 5, 10)\}, \qquad (9)$$

The car stocks were selected by one of the members of the CIRP research group experienced in car research. There are total 20 cars currently for sale on the stock market. Figure 5-1 shows the shares of each car's sale in the market.

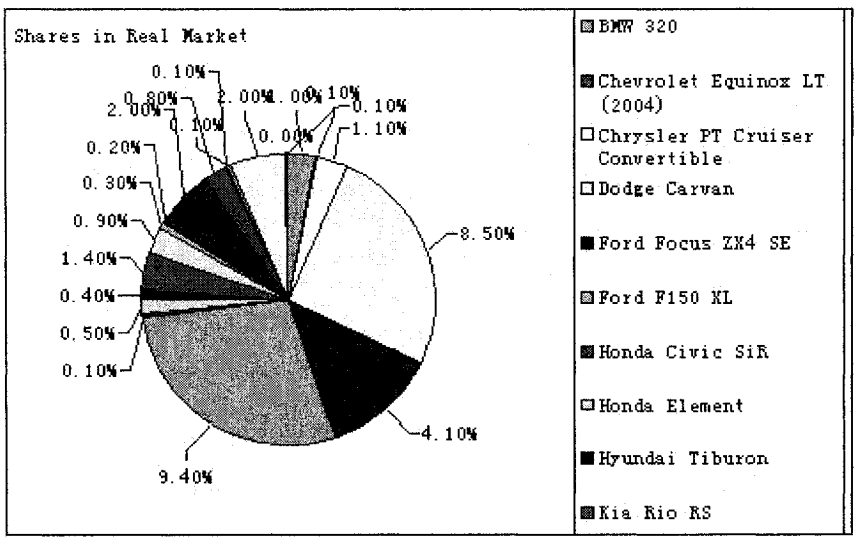


Figure 5-1: The Pie Chart shows the shares of every car are in real market. (Source: DesRosiers Automotive Consultant Inc. and Ward's Automotive Reports News Market Data Book 2004)

5.3 Stock Price Data Collection and Sample

A definition of an online stock trade market can be found in the relevant literature (HSX); this study has chosen a broadly accepted definition defined by the ASE platform for sampling process. A stock of 20 cars by the Car Internet Research Program selection has been considered for the sampling process. At this point it is important to stress that an analysis of the value-relevance of a historical stock price is feasible for a stock sample due to the nature of trade operations. The historical stock data was collected for the period

from July 5, 2004 11:15:48 A.M. EDT, to October 31, 2004 12:00:00 A.M. EDT, due to the restrictions in availability of such measures.

The information for this study has come from some car consulting reports and an online stock trade platform. The data for the cars of 50 brands was collected in accordance with an actual sale derived from consulting company. The data covered total sales, quarterly sales, marketing expenses and research and development expenses. The daily trade stock data was collected in a quota file by a server at Montreal about trade date, round, stock id, bid price, ask price, trade volume, last price, low price, high price.

Output Quota file as below: an example of BMW 320 stock

Quote Log

File Created on : Sep 29, 2004 2:53:57 PM
Negotiation GPK : -1
Negotiation Name : n.nego.BMW_320

Date	Round	ProductGPK	bid	ask	volume	last	low	high
Oct 1, 2004 11:52:28 AM	29	5505228	0.5	0	0	0	0	0
Oct 1, 2004 11:52:28 AM	29	5505227	0.75	0.77	20	0.77	0.75	0.77
Oct 4, 2004 11:52:27 AM	30	5505227	0.75	0	21	0.77	0.75	0.77
Oct 4, 2004 11:52:27 AM	30	5505228	0.5	0	0	0	0	0

5.4 Stock Price Data Analysis

For the market experiment, trade and quote data was collected. For analysis, the quote data about the time series of trading prices and quantities was focused on. The potential market units of automobile model were focused on to make an analogous study of HSX research by David M. Pennock (2001) [5]. Specifically, the author has proposed that an automobile model sale in units can be predicted by its relative stock market capitalization. The market capitalization of an automobile model, or the total value of its stocks, equals to the product of market price and number of outstanding shares. The relative market

capitalization is defined as the ratio of an automobile model's capitalization to the capitalization of the entire market (all models). Since all the models have the same number of outstanding shares, the market capitalization is proportional to the market prices. The market closing price is a nature candidate for the valuation of the automobile model sale in units. However, the study has observed that the closing price is not a particular robust measure for stock valuation. Because the trader's portfolios are valued at the closing price, prices tend to become more volatile towards market close. This is especially true for the low-volume stocks. Hence, in addition to the closing price, all transactions during the trade process: the high, low and last price. The high, low and last prices are calculated from the time series $p_{1,i}$, $p_{2,i}$, ...$p_{T,i}$; where i is the index for the i^{th} stock and T_i is the total number of the cleared trades for i^{th} stock. The high, low and last prices are sensitive to outliers – a small number of transactions that occur at extreme prices. Volume can be regarded as a measure of the amount of information in a transaction. A trade with higher volume will be more informative than one with lower volume, since traders are risking more when they trade larger quantities of a stock. In the stock trade market of the study, volume is also related to how confident the traders are at the corresponding transaction price. Figure 5-2 shows the trade volume for every stock during the experiment period.

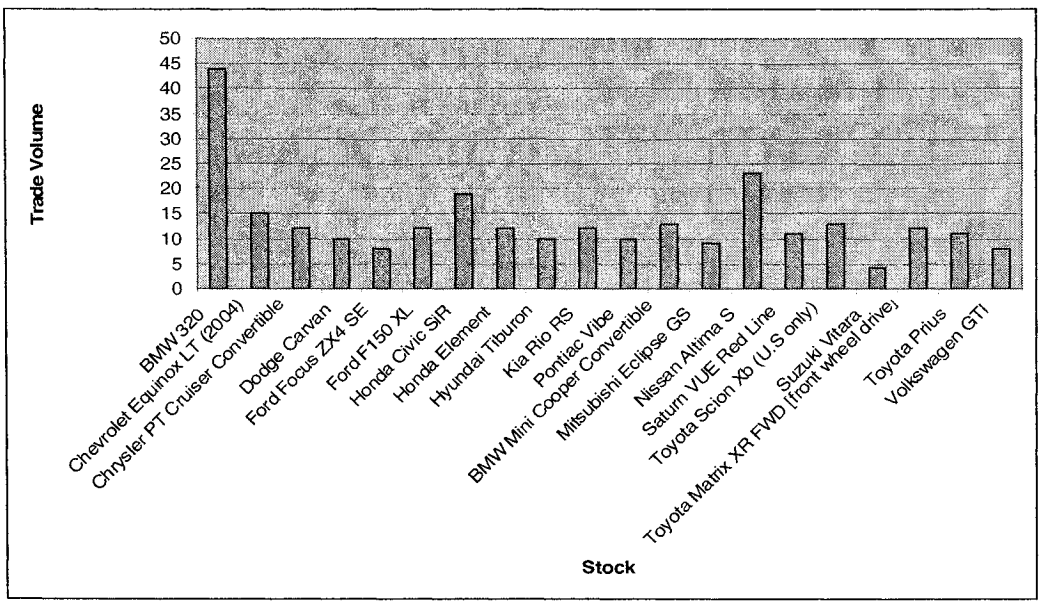


Figure 5-2: Trade volume for each stock

Now given an ASE stock price statistic $\tilde{p}_i$, which can be high, low, closing or last prices, it can arbitrarily compute predicted monthly actual sale (AS) in units as the relative market capitalization.

$$AS \approx \tilde{p}_i * 1{,}000, \qquad (10)$$

Table 5-2 presents the predicted 20 models' actual sales (in Canada) based on the ASE experiments.

Model Name	**Actual Sales (in Units) in September of 2004**	**Predict September of 2004 Sales (in Units) $\tilde{p}$ =Closing Bid Price**
BMW 320	538	740
Chevrolet Equinox LT (2004)	643	140
Chrysler PT Cruiser	469	590
Dodge Carvan	3,991	5,000
Ford Focus ZX4 SE	1,773	2,980
Ford F150 XL	6,104	5,200
Honda Civic SiR	102	500
Honda Element	197	1,150
Hyundai Tiburon	336	300
Kia Rio RS	939	1,000
Pontiac Vibe	901	510
BMW Mini Cooper	275	230
Mitsubishi Eclipse GS	93	110
Nissan Altima S	1,694	1,450
Saturn VUE Red Line	626	580
Toyota Scion Xb	562	450
Suzuki Vitara	23	80
Toyota Matrix XR FWD	1,762	1,350
Toyota Prius	0	10
Volkswagen GTI	62	100

Table 5-2: Predicted 20 model sale units by ASE platform; actual sale data. (Source: desrosier automotive reports volume18 issue 18, October 30th, 2004)

Figure 5-3 compares five closing prices information gathered in the ASE platform. The closing ask price has the highest correlation value compare with other closing prices. Obviously closing high price can't be considered as predicting price $\tilde{p}$ since its correlation value is very low.

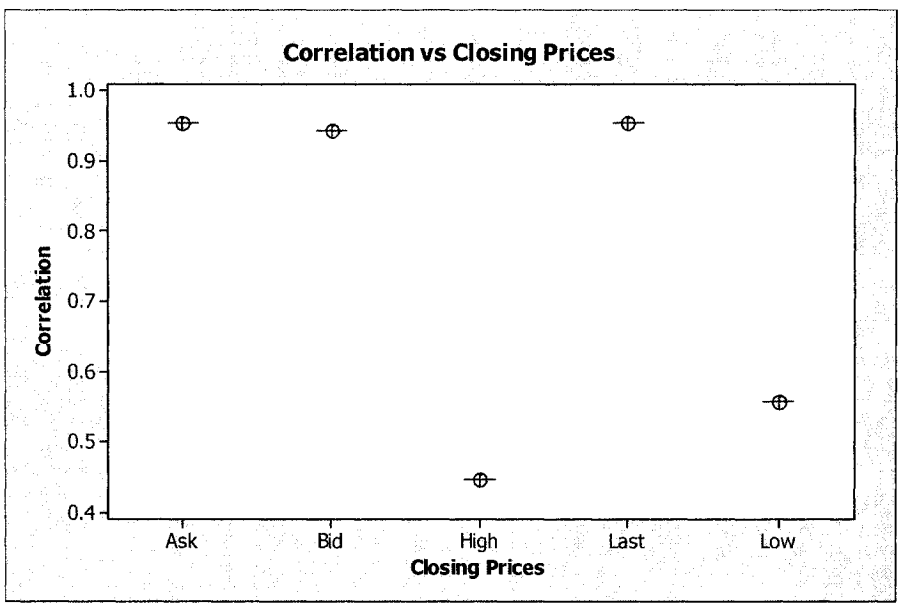


Figure 5-3: Five closing prices Correlations, Correlations between each closing price & actual sales

Figure 5-4 reveals the traders who have won the ASE trade game by having the highest portfolio valued based on closing market prices, and those determined exclusively by fellow traders; do not necessarily win if their portfolio value is calculated based on the "true", underlying value of the stock. However, there does appear to be some correlation between the performance in the market and ability to predict "truth", even at the individual level.

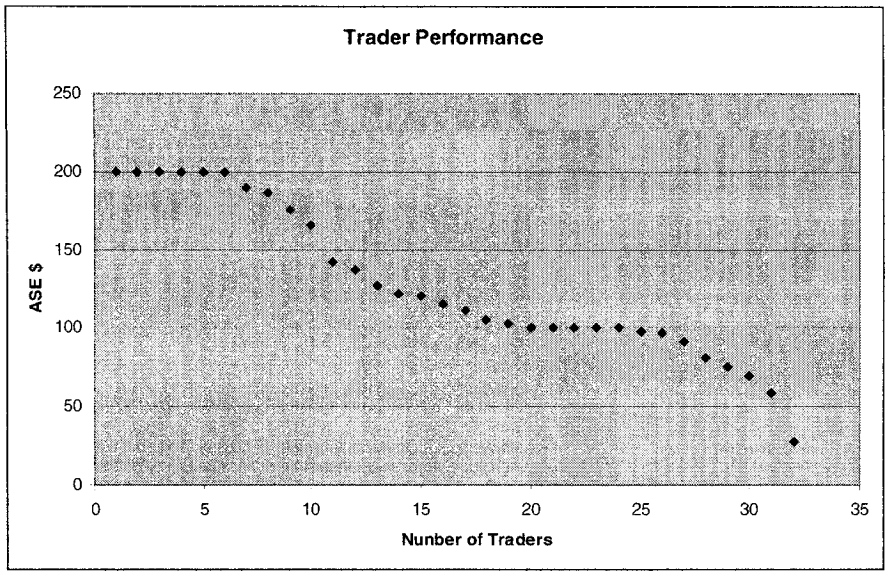


Figure 5-4: Trader Performance

This suggests that the ASE provides a means of identifying individuals who are "in tune" with the preferences of others for the product category being studies. The more empathetic respondents could be recruited for further ASE testing of other concepts in the category or interviewed in greater depth by using other market research methods.

5.5 Forecast Accuracy of ASE

The accuracy of the online stock trade platform's forecasting has been examined. The variables in Figure 5-5 on the horizontal axis represent the prediction of September's model sales (unit in 1,000), and the variables graphed on the vertical axis repents the actual model sales data (unit in1,000)(see Table 5-2). The correlation coefficient of correlation has been calculated by Minitab software, with r=0.945. Thus, the predicting stock price and actual model sales are very highly correlated – in the month of September, 2004. The implication is that a strong positive linear relationship exists between these variables (see Figure 5-5).

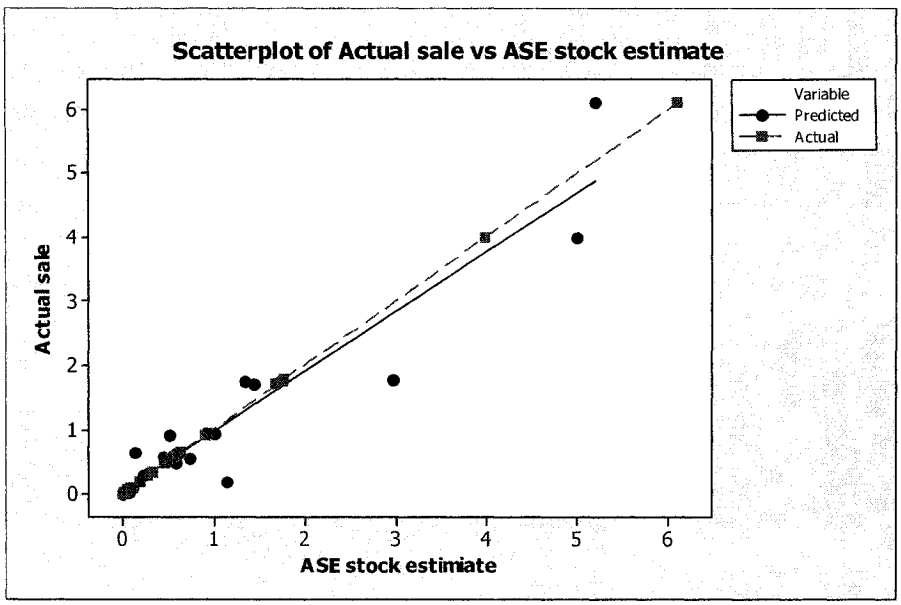


Figure 5-5: Accuracy of ASE automobile stock forecasts for actual model sale returns. The solid line corresponds to ideal accuracy; the dashed line is the best linear fit.

The data analysis results above show that the author's idea proposed in the beginning chapter has been tested to predict actual sales for automobile product prototypes. The results from this online trade experiment show high consistency among themselves and significant correlation with an independent survey study. The results are accurate for describing what happens in the ASE in the short run. After all, over the long run stock prices depend not only on trader's subjective beliefs or expectations, but also on other objective information such as a model concept design, the company's earning potential and the valuation of reputation. On the other hand, the trading experiment presented in this thesis is precisely "beauty contests", since the value of the virtual stocks are derived endogenously from the expectations of the market participants, which are largely subjective.

6 CONCLUSION, LIMITATION AND FUTURE RESEARCH

The study has shown some rather encouraging results about the applicability of the ASE for automobile industry forecasting purposes. It conforms that a program such as the ASE can be easily conducted via the Internet in terms of organizational and technical aspects. In additional, the ASE seems to work well under different incentive structures and even with a limited number of participants. With the encouraged results of the studies, a review of the forecast accuracy of the ASE for automobile industry forecasting purposes has been proposed for future studies.

Having car consumers as its participants, the ASE platform can be a tool for an automobile company to detect knowledgeable car consumers for the purposes of testing new concepts. And if experts or knowledgeable car consumers (such as car dealers or car sales representative) are identified, their willingness to participate in the ASE can show their confidence in the forecasting task and thus be used as a predictor for the ASE's performance.

6.1. Shortcoming and Improvement

Although informational efficiency may hold true in the long term, market imperfections may exist in the short term [8]. However, as the stock trade at the ASE is actually the stock whose terminal values are contingent upon the outcome of an event in short or medium term future, these short term market imperfections appear less of a problem at the end ASE trade process, by using the closing prices of the ASE for deriving forecasts. An analysis of such market imperfections and their effects recorded in behavioral decision research can be made in detail with future experimental research of the ASE.

Although representative samples are not required for obtaining good results, future studies to analyze whether improvements in forecast accuracy could be achieved if participants form a representative sample. Further, the informational structure is an important prerequisite of the ASE, and participants could be actively informed before trading in the ASE. Thereby, the specific information provided can be experimentally controlled and its effects on the forecast accuracy in separated ASE can be analyzed.

Another improvement would be to perform initial interviews, allow trading on the ASE, and finally, finish with another round of interviews. The objective of this design would be to encourage more involvement by ASE participants with the goal that they might think more carefully about future developments. The analysis of such a combination of methods could yield interesting results concerning the interaction between the two forecasting techniques and the possible elicitation of further information. All in all, the ASE could be used to open the doors to other areas of research and therefore be a focus of additional studies in the future.

6.2 Limitation

The limitation of this research study is the limits of the sample population of users. There were 45 participants were participating the platform, all of them were students. Sampling an older population in addition to a student population would provide for further accuracy in the study. A profound analysis of the effects of providing groups of participants with more information or better tools to exploit information, for example, via the use of decision-support systems, on the resulting performance of individual participants would certainly contribute to the author's overall understanding of the usefulness of management science tools under different circumstances. An attractive analysis could be made for the possibilities of combining the ASE with other new data gathering methods – possibly create some sort of hybrid system. For example, the ASE could be combined with an expert group such as car selling dealers, parts suppliers, and manufactory producers to test the platform with regular participants. Such an approach would probably differ from the approach of combining the results of different forecasting techniques. Two possible designs of such an approach would be the

following: In the first design, a group of participants could initially trade on the ASE. After the trading is done, an individual interview could be conducted, followed by another round of trading process in the ASE. The participants then might be sensitized by the ASE which allowing researcher to quantify the outcome and estimate the sensitivity of the results.

6.3 Further Research

A fully functional prototype of an online platform of automobile stock exchange environment exists and is being used. With the ASE trade platform running, the information technology provides a stable and accurate database and web server for further research.

A rich field for future research is the analysis of different design alternatives for the ASE. Future research projects could look at analyzing the different possibilities of the ASE design in detail, such as the appropriate design of the incentives, the initial portfolio structure, and the inclusion of possible financial losses. Additionally, the analysis of the real-time effects of particular events on the topic to be predicted (i.e., on the corresponding stock prices) can be of interest.

Any continuation and expansion of the system into new content areas, and further research of the system development will require more time for system maintenance, upgrading, statistical analysis and reporting.

In conclusion, further research can assist automobile producers in making major marketing decisions contingent not just on the opinions of a few and random people, but by the continuous and accurate data from hundreds of thousands of respondents through an automobile stock exchange platform. Deployed correctly, an ASE can help automobile producers make the right decisions for their future model investment.

APPENDIX I

User Manual

Initialization

An e-stock manager will be the first person to uses the system. First he or she will log in by using a username "admin" and a password "admrox365". This is the initial user created by the system developer. Then the e-stock manager should add him/herself into the administration database.

Once a new user wants to join the trade activity, he or she must register first and the user's information will be overviewed by the e-stock manager. For simplicity, no upper case letters are needed.

Home WebPages

Once the stock trade platform starts, the address www.cirp.uottawa.ca/ase/ is typed in Internet Explorer or Netscape Navigator. The trade platform home page is shown in Figure 1. After the user has read the sections, he/she will enter the trade center by clicking icon "enter" on the right top as it is shown in Figure 2.

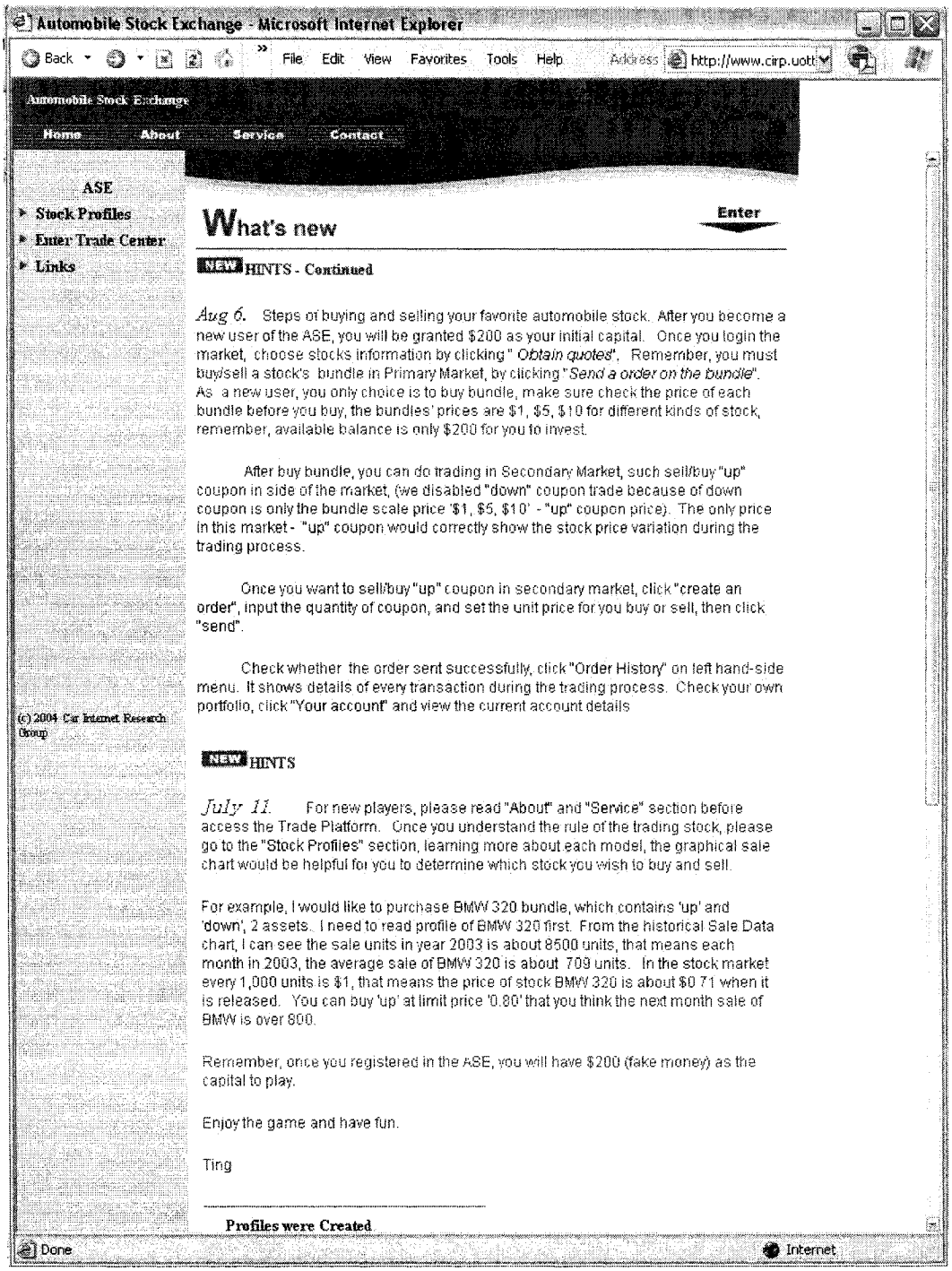


Figure 1, ASE web homepage.

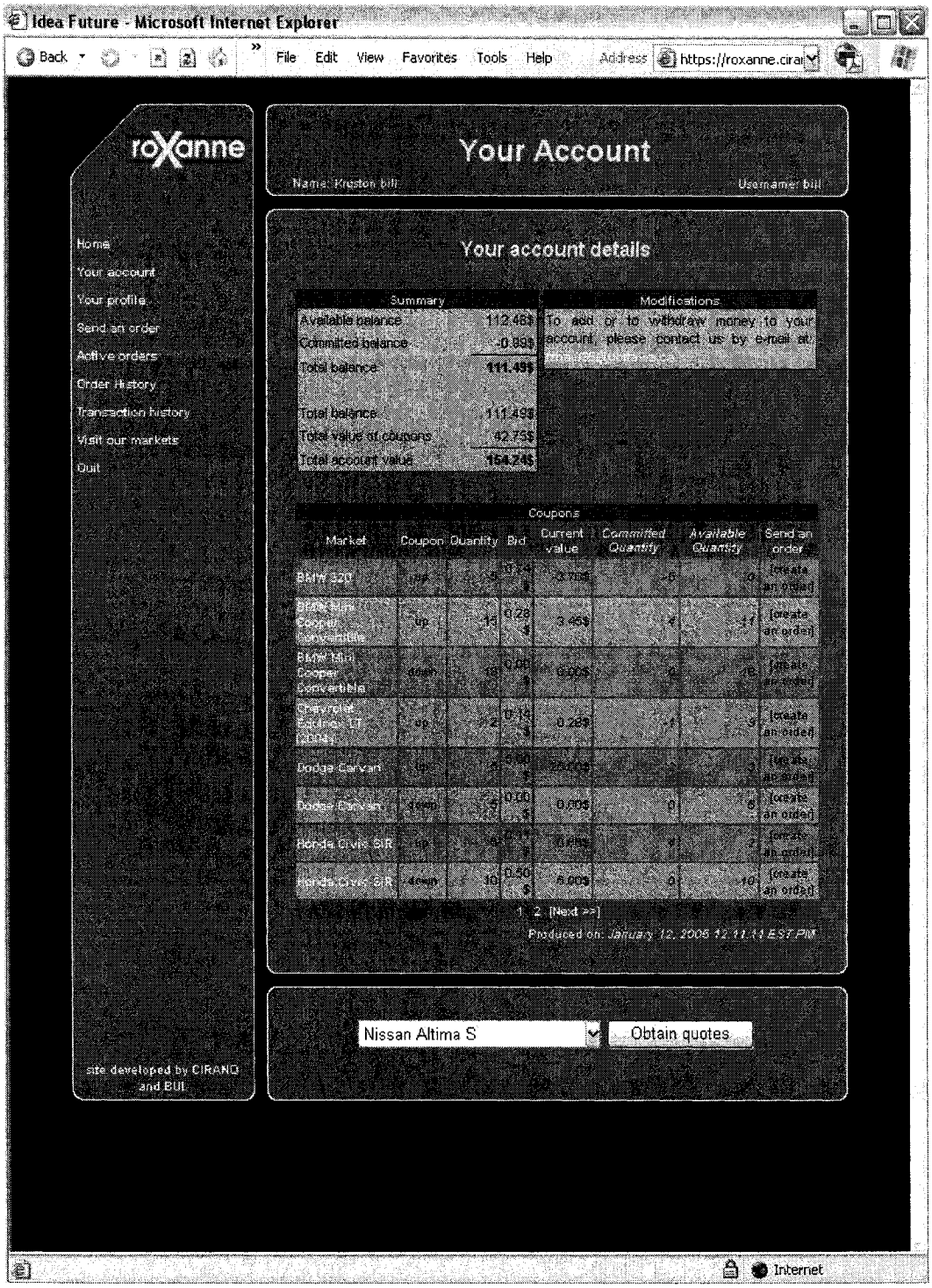


Figure 2, ASE Trade Center.

Trade Process

After a participant becomes a new user of the ASE, he or she will be granted $200 as his/her initial capital. After the user has logged in the market (Figure 3), he or she can choose stock information by clicking "obtain quotes". He or she must buy or sell a stock's bundle in primary market, by clicking "send an order on the bundle". As a new user, the only choice he or she will have is to buy a bundle; the user will make sure that he or she has checked the price of each bundle before he/she trades different kinds of stocks with the bundles' prices of $1, $5, $10. The available balance is only $200 for the user to invest.

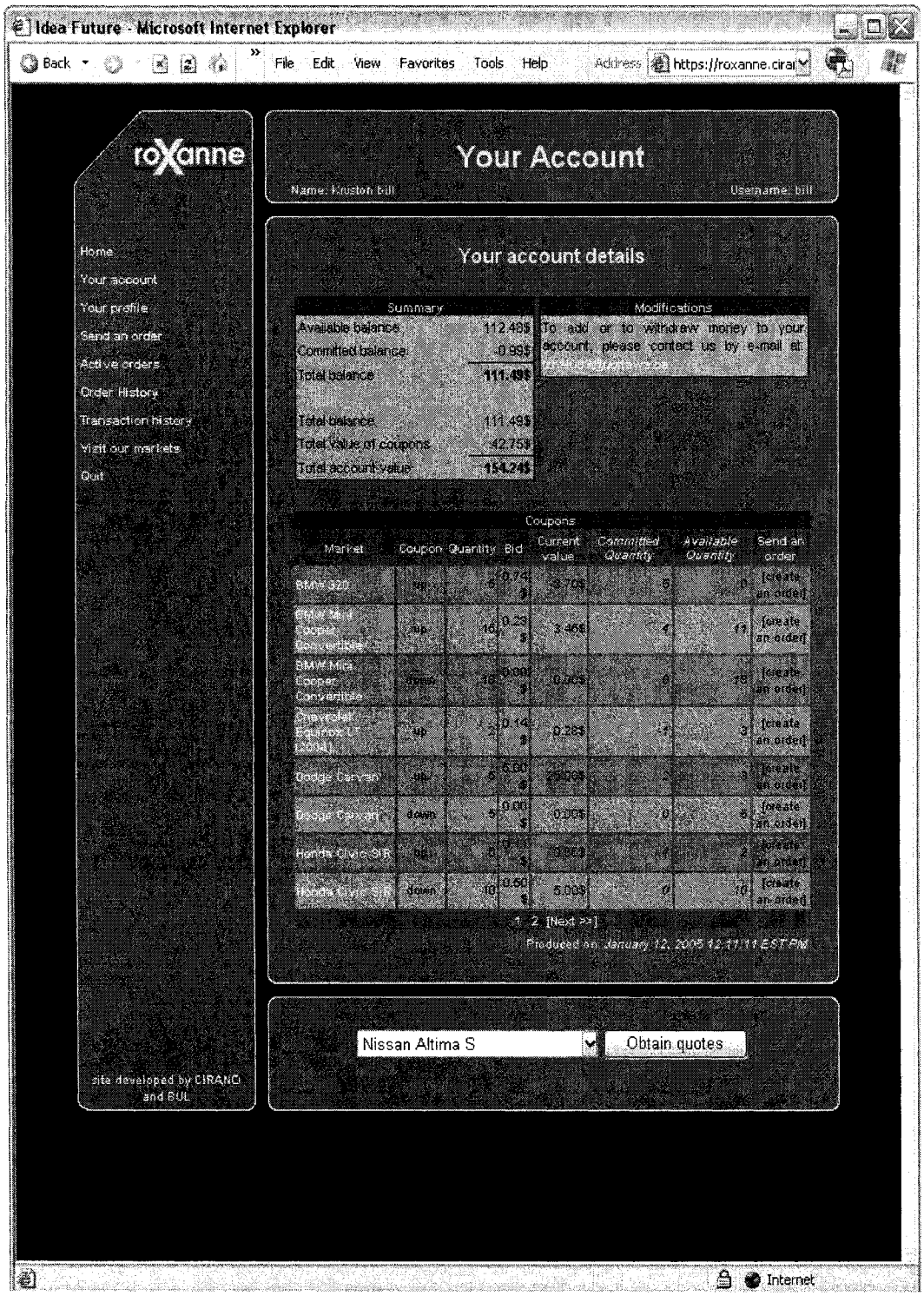


Figure 2, Inside of the ASE trade platform.

After having bought a bundle, the user can do trade in the secondary market, with sell/buy "up" coupon in side of the market. The "down" coupon trade has been disabled because down coupon has only the bundle with scale price of $1, $5, $10 minus "up" coupon price). The only price in this market - "up" coupon would correctly show the stock price variation during the trading process.

If the user wants to sell or buy the "up" coupon in the secondary market, he or she would click "create an order" to input the quantity of the coupon, and set the buying or selling unit price, and then click "send".

To check whether the order has been sent successfully; just click "order history" on the left hand-side menu. It will show the details of every transaction during the trading process. Click "your account" to check the user's own portfolio by viewing the current account details.

If the user would like to purchase a "BMW 320" bundle, which contains "up" and "down", 2 assets, he or she will need to read the profile of the "BMW 320" first. From the historical sale data chart, he or she can find the sale units of about 8,500 units in the year of 2003. That means that the average sale of the BMW 320 was about 709 units in each month in 2003. In the stock market, every 1,000 units is $1, and the price of the stock "BMW 320" was about $0.71 when it is released. The user can buy "up" at a limit price "0.80" when he or she thinks the sale of BMW 320 in next month will be over 800.

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