

TO: Prof. Ben Cohen
FROM: Arun Venkateswaran, Rahman Rahim, Xuan Chen
DATE: May 9, 2013
SUBJECT: Final Memo and Annotated Bibliography

Introductory Remarks:

The use of digital computing has had a dramatic impact on the finance industry throughout the world. Since the invention of digital computing, people have changed the way they invest and their views on stock markets. Due to the importance of digital computing and financial markets on the world, it was an attractive area of study. To adequately analyze the relationship between digital computing and stock markets we had the following guiding question:

“Stock exchanges have been influenced by particular historical, economic, and legislative contexts over the past several decades. Considering those primary contexts, our project asks: what is the relationship between digital computing and the functioning of stock markets, specifically the New York Stock Exchange (NYSE), in the recent past, present and, possibly, future?”

We chose NYSE because it is the largest stock exchange in the world by the market capitalization of its listed companies. This project can also serve as a case study to show how often legislation lags behind technology and what the consequences are. We narrowed the scope of this project, and make it relevant to the Lafayette community. So, NYSE has exposure to Lafayette Alumni and most students graduating from Lafayette work in banks and institutions in New York. Hence, NYSE became the subject of study for our project.

Contexts:

To study the relationship between digital computing and stock markets, we looked into the multiple contexts mentioned in the guiding question above. It allowed us to have a holistic approach that takes into account different perspectives. The main contexts we studied are listed and explained below:

- **Historical:** The historical context is particularly important in seeing how technologies developed and where they are going. In addition, comparing pre and post-computerized money markets will provide us with valuable insights into our driving question. Looking at this perspective will show how certain events led to the use of technology in finance. For example, we analyzed how recession of 2008 affected the stock market and vice versa. The Flash Crash of 2010 is another significant event that we looked at. This event shows the potential dangers of the digital computing and stock market relationship.
- **Economic:** The use of computers has dramatically changed economics. The cost of transactions in trading has dramatically decreased and due to this the over-the-counter trading has blossomed to a seven hundred trillion dollar market, which is basically the use of digital computers to trade from home rather than trading on the exchange floor.

Anyone with computer access can now be an investor and enter the finance industry. People are now able to trade in a global setting. An investor in the United States can buy shares of a stock in China with a click of a button. This has helped foster a global market. It has even changed the way economics is taught in the classroom. For example, in EGRS 261's portfolio project, students bought and sold stock using computers.

- **Legislative:** In the United States, Securities and Exchange Commission (S.E.C.) is the federal agency that is responsible for regulating the securities industry. However, the information technology advancements and the vast applications of the technology in the financial market have increased the difficulty for SEC to monitor the market. SEC, like other financial firms, also started to use information technology in order to regulate rapid traders. Instead of having a company of their own, SEC cooperated with a high frequency company. Besides the efforts SEC put to regulate the market, regulators still found themselves not prepared for technology innovations. More and more new information technologies, for example, cloud computing, will be implemented in the financial market. SEC is facing a problem that needs different solutions at different times. Furthermore, almost all the financial regulation systems have certain intrinsic drawbacks, for example, the boundary problems. It is important to keep these disadvantages in mind when developing and enforcing the federal securities laws.

End Product:

The ultimate goal of this project is to inform the audience of the relationship between digital computing and industry. In other words, it will be an education tool. As a case study, it can show the relationship between technology and policy. Using our driving question and contexts as a guide we will create a website. By using a website we hope that distribution of our final product will be as easy as having computer access. The pages of the website will roughly correspond with contexts. Additionally, there will be pages for our analysis of where the relationship between digital computing and financial markets is headed.

The audiences we hope to reach are engineering studies majors, economics majors, and those at the IDEAL center. For example, for an engineering studies class, the website can be used as a case study to relate technology and society. Many of the topics in EGRS classes, such as contexts, are included in this website. This project can also be beneficial for economics majors. It can provide them with insights on how the technologies they will use affect the world around them. This project is an example of the collaboration of two disciplines. Thus it would be appropriate for the new IDEAL center which stresses interdisciplinary work.

Tasks Completed:

We have met with Professor Kelly of the Economics Department at Lafayette. He gained his bachelor's degree from Harvard University and worked for JP Morgan for nearly a decade. During the meeting, we engaged in the history of the finance sector and how it has changed since he was a trader for JP Morgan. We also went over how

technology has evolved and its influences on the finance sector. He spoke a lot about the convenience digital computing has brought to the financial market, by both reducing the transaction cost for retail or individual investors and increasing the rate of information transmission.

Besides meeting with Professor Kelly, we researched on how digital computing influenced the stock markets, NYSE in particular. Through reading academic and non-academic sources, we analyzed the three major contexts and discovered that digital computing and the stock markets have influenced each other. Moreover, we also found that digital computing has boosted the borrowing power and helped the economic growth. The regulation of stock market remains a difficult task for the legislators. Additionally, we also gathered a wealth of information documenting other related contexts. Using this information, we created a Lafayette site for this project.

The work for each context was divided up and written by members of our group. The most difficult task was answering the question of where this relationship between digital computing and financial markets is headed. We will be able to create a list of questions that need to be addressed as the relationship between digital computing and stock markets continues. These questions addressed ethical, legislative, and technological issues. The website is currently in its final stages and will be completed by May 14th.

Recommendations/Next step:

Since this EGRS project was started from scratch, we still have a long way to go. Furthermore, for future research on this topic, we have numerous recommendations to give. Firstly, there needs to be revision on how current legislative acts passed, has affected future stock market performance and how we could extrapolate these effects. We also suggest that there could be other contexts that could be looked at such as educational, professional and cultural. These are not very critical but can give a comprehensive picture, when studying this topic. Another, big improvement to this project would be to create a course outline for a potential minor in Lafayette College about the topic of Financial Engineering. This idea could be a major breakthrough for our initiated capstone project. We also recommend looking into the following questions which could set up for a bigger level of thinking in this project:

We heard a lot of information about how marginal cost of trading transactions are decreasing and how investors could trade more and often. Yet if stock trading does not necessarily benefit investors and may even harm them, what are the likely consequences for investors?

With digital computing, firms are getting access to information even faster. How should the regulators treat these profits generated from market timing? Should the regulators treat it as the regular profits generated from creating and manufacturing?

Historically, stock market is for traders to gather and to trade. Digital computing allows people to trade with a computer and internet. If this is the trend, will stock market physically exist in the future? Will a future stock market be a virtual stock market?

After financial recession occurs, the regulators put up new financial regulations to stable the market. However, is there a way for the regulators to react before the financial recession? Do the regulators have talent people to put up such provisions?

Is there a need for human intervention as circuit breakers, algorithms are put in place and are getting advanced?

How will the SEC cope up with the regulations placed as technology both hardware and software gets more complicated and as the relationship between technology and stock markets increases?

Digital computing continues to increase the liquidity of the financial market. However, large institutions benefit from illiquid asset. Will digital computing shrink the profits of large institutions and diminishing the components of the system?

Signatures:

Arun Venkateswaran

Rahman Rahim

Xuan Chen

*Attached is the Appendix which only includes the updated Annotated Bibliography

Appendix:

Annotated Bibliography:

Angel, J., Harris, L., Spatt, C. (2011). Equity trading in the 21th century. *Quarterly Journal of Finance*, 1, 1-53.

The Research paper looks into the automation and the increasing number of trading platforms in the equity market. The authors are all established professors in reputed business schools in the country and have written many papers within the field of finance. This has tended to decrease transaction costs and made trading more accessible for the common man. We can see how people have reacted to this platform and how communities changed due to reach ability of trading in stock exchange. The paper talks more about equity than other forms of trading, which might be a limitation, as derivatives are a huge part of trading.

Beder, T., & Marshall, C. (2011). *Financial engineering: The evolution of a profession*. (1 ed., Vol. 2). John Wiley & Sons.

Beder, a Chairman of SBCC in New York, and Marshall, a professor of the City University of New York wrote this book to help everyone understand financial engineering. This book is composed of five parts. Part one is a review of history of financial engineering. The second part is the discussion about the evolution of financial engineering in major markets, such as fixed income and derivatives. The third part is an examination of a number of recent innovative applications of financial engineering such as the highly quantitative trading strategies and securitization. This part also has comments about risk management lessons learned from the recent financial crisis. The fourth part contains lots of case studies for active practitioners and academics. The last part talks about the substantial demand for specific and enterprise risk managers who can think outside the box. This part also presents new ways to be successful in the future that needs innovation. This book details the fundamentals of financial engineering, the newest financial products and cutting-edge research. It is a comprehensive source on financial engineering.

Brown, C. (2007). Financial engineering, consumer credit, and the stability of effective demand. *Journal of Post Keynesian Economics*, 29(3), 427-453.

Financial engineering is growing at a fast pace, especially of the post-1987 period when the markets was growing backed by credit card, installment, student loan and home equity receivables. This paper finds three linkages of financial engineering to effective demand. The here linkages are: funding effects, liquidity preference effects, and balance sheet effects. Data from the Survey of Consumer Finances are used to show that financial engineering has boosted borrowing power at all income level, and the expanded borrowing opportunities has fueled the growth of consumption. Brown is a professor of Economics of Arkansas State University. This paper shows that financial engineering has a macroeconomic context. We can discuss the relationship between macroeconomics and financial engineering in the project.

Brynjolfsson, E., & Saunders, A. (2009). *Wired for innovation: How information technology is reshaping the economy. the United States of America: The MIT Press.*

This book examines the real sources of value in the emerging information economy, including intangible inputs and outputs that have defied traditional metrics. The book provides lots of examples that the companies with the highest level of returns to their technology investment invested in organizational capital to become digital organizations. The authors are Saunders, a PhD candidate at MIT, and Brynjolfsson, a Professor at MIT. The book also show how to better measure the value of technology as they treat technology not just as a type of ordinary capital investment but also a measure of complementary investments. This book offers a comprehensive historical background about how information technology is transforming the economy and where information technology will create value in the future.

Cartea, A., Penalva, J. (2012). *Where is the value in high frequency trading? Quarterly Journal of Finance, 2, 1-46.*

This looks into algorithmic trading and how algorithms are taking over humans and how it is almost impossible for an individual to win an arbitrage because algorithms see any mispricing in a split second. Both the authors are well-known in the field of finance and contribute frequently to the journal. This is useful because algorithmic trading is an integral part of financial engineering. The lack of community outlook might be the only limitation in this paper.

Coates, J., Gurnell, M., Rustichini, A. (2008). *Second-to-fourth digit ratio predicts success among high-frequency financial traders. Proceedings of the National Academy of Sciences. 1-6.*

This article is a research on how gut feeling and constant active lifestyle of traders affect the finance industry and how their performance increases as they work in an ultra rapid environment. This article brings the humanistic context to the project by looking at the neural activity of traders and the internal pressures that a trader faces in his/her workplace. This will give further understanding into how traders rely more on technology and innovation within the field to get their job done. The authors Coates, Gurnell and Rustichini are professors in University of Cambridge from departments such as neuroscience, psychology and economics. The article might be too scientific so we will rely less on the data of the article and more on the results from the study of trader's brain works.

**Donohue, J., Hooker, M., Lewis, C., & Pryor, W. (2010). *Vision. Boston, MA: State Street*
Retrieved from
<http://www.statestreet.com/vision/technology/pdf/TheEvolvingRoleTech.pdf>**

The industry has struggled to fully leverage the power and promise of technology, with market participants eager for solutions that are not only faster and cheaper, but also offer greater security and efficiency. This booklet, written by Donohue, Hooker, Lewis and Pryor, professionals in the financial service industry, provides an overview of the current state of financial technology as

well as background information in regulation such as the Dodd-Frank Act and MiFID 2. This booklet also indicates that the contest of financial technology for now and future is in portfolio allocation and modeling. At the end of this booklet, vision for the future financial technology is depicted. This booklet offers us the perspectives from the professionals rather than the academia on the issues of financial technology.

Fan, M., Stallaert, J., & Whinston, A. B. (2000). The Internet and the Future of Financial Markets. *Communications of the ACM*, 43(11), 82-88.

Digital computing has had a profound impact on how financial markets function. This article argues that advances in telecommunications and computing, specifically the internet, have changed the way in which financial markets function. For example, these technologies play a critical role in efficiency or the degree that market prices accurately reflect all information shown. New technologies, such as the internet have the potential to increase market efficiency. In addition, the authors explain how market competition has increased due to these technologies. The authors are Jan Stallert, a professor of business, and Andrew Whinston, a professor of information systems, computer science, and economics. Both authors appeared to have no bias in this article. This article is from 2000, therefore the information may not be as up to date and accurate as more recent publications. However, this source can still be used to describe the historical and technical contexts of how the internet has influenced financial markets.

Farmer, R. A. (2012). The Stock Market Crash of 2008 Caused the Great Recession: Theory and Evidence. *Journal Of Economic Dynamics And Control*, 36(5), 693-707

Gross-Klussmann, A., & Hautsch, N. (2010). When machines read the news: Using automated text analytics to quantify high frequency news-implied market reactions. *Journal Of Empirical Finance*, 18(2), 321-340.

This article by Klussmann and Hautsch looks at how high-frequency markets react to stock-specific news. The authors are from the Humboldt University in Germany and appear to have no bias. This article looked at the reaction of London Stock Exchange to 29,497 news headlines from 01/03/07 to 06/01/08. The data showed that automated stock specific news changed the stock volatility, trading volumes, and bid-ask spreads. This article is relevant to this project because it shows how technology affects the stock market. It helps explain the technological aspect of computers that can read texts. By showing how this technology affects trading, it can provide insights into the economic contexts. In addition, in terms of the ethical contexts, it will aid in the discussion of the ethical questions that rise with automated trading.

Greenwood, J., & Jovanovic, B. (1999). The information-technology revolution and the stock market. *The American Economic Review*, 89(2), 116-122.

This article studies the post-war behavior of the U.S. stock market and argues that the major technological innovation causes the stock market to be temporarily undervalued until the claims to future dividends enter the stock market via initial public offerings. Greenwood and Jovanovic, both professors of economics, provide many evidences and precludes other explanations for the

stock market undervaluation. This paper offers an insight that IT revolution destroys old firms by making workers and managers obsolete. The entry of new capitals and new firms and the entry of their stock market take time, in the meantime, the stock market declines. This paper offers our project an insight on the relationship of information technology and the stock market.

Goodhart, C. (2008). The boundary problem in financial regulation. *National Institute Economic Review* , 206(1), 48-55.

Concern about the adequacy of the present regulatory regime has been raised since the 2008 financial crisis. Goodhart, a professor of banking and finance, argues that, there are some long term generic problems with almost any system of financial regulation. He explores the boundary problem which arises because effective regulation is more likely to penalize those within the regulated sector than the ones outside, and thus, causing substitution flows towards the unregulated. The author identifies the problem by showing the impacts of the boundaries on many proposals, for example, “narrow banking”. The paper also discusses the way to respond to this issue. This paper points out the intrinsic problems of almost all the financial regulation system. This paper offers us implications and directions on the development of future financial regulation system.

Hendershott, T., Riordan, R. (2012). High-frequency trading and price discovery. *Center for the Study of Financial Regulation. Manuscript*, 1, 1-26.

The paper by Hendershott looks at the effectiveness of High-frequency trading (HFT) on the pricing and market equilibrium price of securities. This is important because we will be able to analyze how high frequency has been effective and if there is still arbitrage trading, after the introduction of HFT. Hendershott is an associate professor of finance at the Haas School of Business at University of California, Berkeley and is well known author in papers of financial studies. The limitation is that this paper is technical and focuses on finance but there are underlying efficiency concepts which are key to engineering and we have to look at the subtle message in the paper.

Kosowski, R. (2011). Do mutual funds perform when it matters most to the investors? US mutual fund and risk in recessions and expansions. *Quarterly Journal of Finance*, 1, 607-664.

This paper is a prediction to efforts or progress made in financial engineering. Mutual fund was derived through innovation in financial markets and we are looking at how effective they are. Robert Kosowski is Associate Professor in the Finance Group of Imperial College Business School, Imperial College London, and Director of the Risk Management Lab and Centre for Hedge Fund Research and has been at the fore-front of research in investments during recessions. This could help the paper by giving it a retrospective basis and a foreshadow effect on how financial engineering has affected our investment decisions. The paper only looks at booms and recessions but it would have been better to see performances of mutual funds in stable situations.

Litzenberger, R., Castura, J., & Gorelick, R. (2012). The impacts of automation and high

frequency trading on market quality. *Annual Review Of Financial Economics*, 4(1),59-98.

Money markets in the U.S. have changed from manual markets to automated competitive markets. This article shows that this change affects the markets in terms of bid ask spreads, liquidity, and transitory price impacts. It does this by analyzing NYSE-listed stock prices from 1993 to 2009. In addition, the article goes into the history of this change and thus can be used for the historical context of this project. It also adds to the economic context by showing the effects of automated and high frequency changes in the markets. Furthermore, it can be used in the discussion of the ethical context by helping to answer some of the questions that arise with automated trading. This article is from a relatively new journal; it is only on volume 4. Therefore this data may not be as reliable as other more established journals.

Lo, A. (2012, August 27). Finance is in need of a technological revolution. *Financial Times*. Retrieved from <http://www.ft.com/intl/cms/s/0/107466e2-ed2f-11e1-83d1-00144feab49a.html>

Financial services industry is very different compared to other engineering companies because the industry needs to contend with Murphy's Law. Professor Lo from MIT points out that while technology has advanced, human cognitive abilities have still remained in the same level. The mismatch of the advancement in technology and the stability of human cognitive have caused many problems, for example, the "Flash Crash". The author also notes that technology-related problems in the financial industry seem to be growing in frequency and severity. The complexity of the financial system has reached a level that only highly trained experts are able to manage. There are enough experts because the technological advances have come so quickly. The solution to this situation, Lo argues is more advanced technology. He believes that in the new financial system where the technology is so advanced and the technology becomes foolproof to human operators.

Lowenstein, R. (2012, October 1). A Speed Limit for the stock Market. *The New York Times*. Retrieved from <http://www.nytimes.com>.

With the use of computers and servers traders can buy in sell stock in seconds, a practice called high frequency trading. This article, by Roger Lowenstien, criticizes this phenomena that is currently accounting up to 70% of all trading volume on some days. Lowenstien argues that problem is that high frequency trading focuses on the short term. This is because the market is not made for the purposes of split second trading. Instead, the market is supposed to be an indicator for investors and companies of how much an ownership position is. With illegitimate investors, such as some who perform high frequency trading, this may weaken the accuracy of this price indicator. He also points out the fear that the markets prices may eventually reflect not the investor judgments but those of high-speed robots. Roger Lowestien is a financial journalist and shows strong bias against high frequency trading in this article. This source discusses many of the ethical issues and potential future of this technology. Thus it can be used to discuss the ethical context and where digital computing technology is headed in terms of finance.

MacSweeney, G. (2013). Regulators not prepared for financial services cloud and mobile adoption. *Wall Street & Technology*. Retrieved from <http://www.wallstreetandtech.com>.

The article is a feature on how cloud computing could be implemented to make financial services in the future. This article is key to our project because we are looking to integrate the knowledge we have into how future of finance will be and we can look at possible routes finance could take after going cloud. Greg MacSweeney has covered technology for the past eleven years, mostly in financial services. Mr. MacSweeney is currently Editor-in-Chief of Wall Street & Technology, a TechWeb media property. Hence, the author is reliable on articles of technology in finance. There are not a lot of limitations for this article except that it doesn't take into account the economical context of cloud on financial sector.

MacSweeney, G (2012). Wall Street Data Centers: Does Size Matter? *Wall Street and Technology*. Retrieved from <http://www.wallstreetandtech.com>.

This is another key article by MacSweeney which expands on datacenters for storage of financial data. This is crucial to get to know how all our private financial data will be housed in giant warehouses, which are close to the trans-Atlantic cables. We will look at where these data centers should be placed so that they don't affect the community but also deliver data at high speed rates. The background of MacSweeney is well-known from the numerous articles he writes on technology, so the author is knowledgeable on the topic of technology and finance. The limitation is that the contexts are not explicitly stated in this article and we might need to dig deeper into the article to find relevant contexts for our article.

Popper, N and Protess B. (2012, October 7). To Regulate Rapid Traders, S.E.C. Turn to One of Them. *The New York Times*. Retrieved from <http://www.nytimes.com>.

The article explains that the Securities and Exchange Commission (S.E.C.) has not been able to keep up with the firms it regulates. As a result, they have dispatched help from a high frequency trading company called Tradeworx. This company has created a program for the S.E.C. that will give them real time view of financial markets. The S.E.C. hopes this program will help monitor the new technologies that give sophisticated traders advantages over average traders. The authors of this article, Popper and Protess, are both business journalist. There was no obvious bias in this article; it was an informative piece about the collaboration between S.E.C. and Tradeworx. This article will aid in the discussion of ethical and legislative contexts. In particular, it will address the issue of how legislation lags behind the creation of new technologies.

Powell, P. (1992). Information technology evaluation: Is it different? *The Journal of the Operational Research Society*, 43(1), 29-42.

This paper examines information technology investment in order to assess if it is radically different from other investment decisions. However, Powell at the University of Southampton uses evaluation methods that are widely employed in other fields to evaluate information technology investments. He argues, however, the evaluation of information technology

evaluation is lacking and the costs and benefits associated with computer systems are difficult to quantify. The author also provides explanations about why such evaluation is lacking. This paper lets us rethink the benefits and costs of investing in information technology.

Richardson, A., Gregor, S., & Heaney, R. (2011). Using decision support to manage the influence of cognitive abilities on share trading performance. *Australian Journal Of Management*, 37(3), 523-541.

Trading of the stock markets is not longer limited to expert brokers. Currently anyone with computer access can buy and sell stock. This paper examines this phenomenon by focusing the trading habits of novice investors. This article conducted a study using 30 volunteers to analyze the effect of decision support on trading. The study that showed that novice traders with decision support performed better than those without it. This paper will aid in developing the cultural and social contexts of our project. Before the use of digital computing in finance, trades were done via human interaction. Now anyone can trade a stock with the click of the button; thus making trading more autonomous. This paper will help analyze the profound effects of digital computing on trading.

Rooney, Ben. (2010). Trading Program Sparked May ‘flash crash.’ CNNmoney. Retrieved from <http://www.cnnmoney.com>

Sabelhaus, J., Bogdan, M., Schrass, D. (2008). Equity and bond ownership in America, 2008. *Investment Company Institute*. 3-51.

The paper is about the ownership of investment vehicles in America during the great recession. Sabelhaus heads the section in Fed Reserve for microeconomic surveys and the authors are part of the Investment Company Institute. This could give a context of how the financial markets acted during recession. We can see the trends in to more secure investments and how technology facilitated this trend towards a risk-averse behavior during 2008. The limitation of the article is that it does include derivatives ownership in 2008 and it is actually more valid to look at how derivatives were thought of during 2008.

Schmerken, I. (2013). The market Data Challenge on Wall Street. *Wall Street and Technology*. Retrieved from <http://www.wallstreetandtech.com>.

The article is about the overload of data in Wall Street and how we will handle data storage in the future as transactions in exchanges quadruple. This article again opens up a window into the future on predictions of technology in the finance sector. As an industry expert, Ivy Schmerken has reported on a myriad number of topics including high frequency trading, algorithmic trading strategies, market structure, electronic trading in fixed income , co-location in data centers and as an expert in this field, she is necessary for us to understand how high-frequency trading works. The limitation is that data management is only one side of technological context and we need to look at how redundant technologies get replaced.

Sherman, M. (2009). A short history of financial deregulation in the united states. *Center*

for Economic and Policy Research,

The overall historical financial regulatory background is very important. This paper summarizes the history of financial deregulation. It talks about various act that signed by the government that gave the financial sector more and more freedom and power. It also mentions the relationship between the financial deregulation and financial crisis. The paper is a detailed account of financial deregulation. It is very helpful for our project because it provides the historical legislative context. Understanding the regulatory background is very critical for students to understand the issue of digital computing and stock markets.

Spiers, B., Wallez, D. (2010). High-performance Computing on Wall Street. *IEEE Computer Soc*, 43(12), 53-59.

This article looks at high performance computing and the algorithms, hardware, and programming languages they use on Wall Street. The authors argue that financial institutions would benefit from using parallel computing which involves running multiple computations sat once. This benefit can only occur if programmers are able to meet the software challenges parallel computing entails. The Authors, Spiers and Wallez, are experts in their fields both with at least 14 years of experience in the finance industry. However, both work for Bank of America Merrill Lynch. This may result in bias since they come from an industry background. This article can be used in describing technical and economic contexts. In addition, it looks at the potential of high performance computing. Therefore it will aid in explaining where digital computing in the finance industry is headed.

Watson, T. (2009). System error. *Canadian Business*, 83(14/15), 16-17.

This periodical criticizes the use of stock-trading supercomputer on financial markets. The author, Thomas Watson, highlights the potential risks and problems of this technology. High tech traders who use supercomputers may be overwhelming or outcompeting investors who own shares for more than a second. High frequency traders do not look at long term prices and flip shares in seconds to make quick profits. This generates huge profits for companies that deploy supercomputers. The article also criticizes regulators and the media for not recognizes this issue. Watson, an award winning journalist, is extremely critical of the use of supercomputers in finance and thus shows some bias towards this technology. Despite this bias, the article can be useful in the legislative and ethical contexts. This periodical directly discusses some of the ethical issues of digital computing technology.

Weber, B. (2004). Adoption of electronic trading at the International Securities Exchange. *Decision Support Systems*, 41(4), 728-746.

This paper looks at a new electronic trading platform called the International Securities Exchange (ISE). Electronic trading platforms offer reduced costs, immediate trading, and offers users direct access to the internet. This article examines the recent raise in the ISE's trading volumes in the US as it competes with other incumbent markets. It does this by looking at 188 quarterly reports from 20 brokerage firms. It was found that 60% of ISE growth was attributed to firm specific factors and 40% to network effects on market liquidity. Bruce Weber is a

Professor of Information Management at the London school of business and appears to have no bias in this paper. This article is from 2004, therefore the information may not be as up to date as more recent articles on the subject. However, this article will still be able to aid in the discussion of historical, technical, and economic contexts. In addition it shows a potential use of new digital computing technologies and how it can influence and create new financial markets.

Zappa, M., & Cox, S. (2012). Envisioning financial technologies. *Envisioning financial technologies*. Retrieved from <http://envisioningtech.com/finance/>

This website demonstrates the Envisioning financial Technologies project. The contributors presented the envision for future financial technologies. Projected from different angles such as reputation, data, currencies, automation, mobile, securities, crowds, and disintermediation, different kinds of technologies is suggested and discussed. This website gives us examples of future financial technologies. It will help us gain understanding of the direction of the financial technologies. It also tells us what financial technologies projects people are currently involved in. The illustration is very impressive and we can use it in the project.