LITERATURE REVIEW AND COMPETITOR ANALYSIS

MScFE Capstone Project

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1. Problem Statement:

1.0 Summary:

Speed and time are essential ingredients in High Frequency Trading (HFT). Traders look for ways of reducing the latency. Latency is the time it takes to make and execute trading decisions on HFT.

Low-latency and system turnaround time requirements for HFT systems generally influence trading firms' decisions about their choice of networks and physical hardware location of their servers. Traders are deploying cutting edge technology to stay ahead of their competitors.

Therefore because of this problem in this trading business, exchanges are building huge data centers where traders can place computers containing their trading algorithms next to an exchange's matching engine, which matches "buy" and "sell" orders. This "co-location" /"proximity hosting" saves crucial milliseconds from the time it takes to complete a trade.
This enables high-frequency traders to more rapidly adjust their quotes as market conditions change and thereby increasing their chances of being profitable.

The ultimate goal of this research paper will be to develop a model of Market microstructure and order matching process that clearly identifies the benefits of co-location based on the degree of proximity.

2. Literature Review

2.0 Introduction

Trading Exchanges have been investing quite heavily in advancement of their machines to reduce latency (the time it takes to send information to customers, as well as to accept and handle customers' orders). These exchanges have gone a notch higher to offer traders the ability to Colocate their trading machines/algorithms in close proximity to the exchange's systems, thereby reducing transmission times to under a millisecond . The entire trading system have undergone a paradigm shift because of deploying technology that is able to reduce latency to the fastest possible way.

Several researchers have put their foot forward to do some empirical studies in regards to HFT in relation to Proximity hosting and co-location. Each research is unique to the fact that every researcher want to demystify this new notion of traders placing their computer systems in close proximity to the Exchanges machines

We intend review the empirical literature on speed in financial markets and high-frequency trading (which is a subset of algorithmic trading comprised of proprietary algorithms that require low latency).

2.1 Review of empirical studies by the key people in HFT/Colocation/Proximity Hosting field

We intend to review the scholarly work of key people in this field, comparing their findings, and examining what is trending.

Hendershott and **Moulton** (**2011**) and **Riordan** and **Storkenmaier** (**2012**) survey current changes in technology that reduce the latency of information transmission and execution, but reach conflicting suppositions as to the impact of such changes on market and market excellence. Hendershott and Moulton (2011) look at the introduction of the NYSE's Hybrid Market in 2006, which expanded automatic execution and reduced the execution time for NYSE market orders from ten seconds to under a second. They found that this reduction in latency induced a worsened liquidity (spreads increased) but improved informational efficiency. On the other hand, **Riordan** and **Storkenmaier** (**2012**) find that a reduction in latency (from 50 to 10 ms) on the Deutsche Boerse' Xetra system was associated with enhanced liquidity. These two studies depict and produce different outcomes. This could be the result impact of how the low latency technology is introduced.

Chaboud, **Hjalmarsson**, **Vega**, and **Chiquoine** (**2011**), in the study of the impact of co location on market liquidity,they did not observe any change in volatility after the introduction of co-location. This is contrary to **Boehmer**, **Fong**, and **Wu** (**2012**), who report evidence of increased short run volatility after the introduction of co-location.

In a study done by **Menkveld (2013),** While it looks like High Trading Strategies is in a trajectory mood [with these low-latency strategies,he argues that it is unclear whether intense low-latency activity harms or helps the economy or the market at large.This a case study of a particular high-frequency trader who acts as a market maker on Chi-X and Euronext

Hagströmer and Nordén (2013) use special data from NASDAQ OMX Stockholm to separately characterize the strategies of "market making" and "opportunistic" high-frequency trading firms depicting low latency strategies advantage.

Carrion (2013) uses the NASDAQ HFT dataset to examine the sources of profitability of high-frequency trading firms, how they carry out their strategies, and their impact on market efficiency. Carrion found that the

aggregate profit patterns of HFT point to intraday market timing skill, but not essentially the aptitude to profit from minute-by-minute activities. High-frequency traders also seem to supply liquidity when it is threatened and demand it when it is more abundant.

Brogaard, Hendershott, and Riordan (2012) study the impact of high-frequency trading on price discovery in U.S. equities . Brogaard investigates the impact of high-frequency trading on market quality using two special datasets of 120 stocks: HFT dataset from NASDAQ, as well as another one from BATS with 25 high-frequency traders. He found that high-frequency traders contribute to liquidity provision and that their activity appears to lower volatility. This study was quite impressive to the fact that while others were just concerned with liquidity provision as an advantage of low latency, he went a notch higher to study about volatility. He also investigated the role high-frequency trading plays in price discovery. He concluded that HFT help fix price efficiency

Hoffman (2010) introduces fast traders into the limit order book model of Foucault (1999). Their presence can lower transaction costs due to increased competition in liquidity supply due to low latency.

Gerig and **Michalyuk** (2010) assume that automated liquidity providers are more efficient than other market participants in extracting pricing-relevant information from multiple securities in HFT ,therefore better prices, lowering the transaction costs of investors in the market courtesy of the high speed computer systems.

2.2 The cutting edge in HFT/Co location/Proximity Hosting field.

The current Trading field is branded by high level trading strategies and information need. The speed at which traders receive this information, process it and make a decision is very important .Traders want to be faster that the other. The trading is cubed with the problem of latency. The traders are in an effort to keep this latency as low as possible. For them to remain competitive they are deploying technologies to lower the latency.The Exchanges have introduced colocation of traders computer systems in close proximity to the exchanges machines.

Many studies reviewed indicate that despite Colocation reducing the latency, it somehow increases liquidity and lowers short term volatility. It also levels the playing field among competing HFT market makers.

According to a research done on Algo trading in the Indian market by National Institute of Financial Management ,there is also strong evidence of a **decrease in bid-ask spreads and an increase in market depth** following the introduction of colocation, across all futures contracts examined. It is

also proved that the introduction of colocation resulted in an **improvement in liquidity** of futures contracts

The ASX introduced co-location for ASX futures markets on February 20, 2012. As per the research paper by **Frino Mollica Webb (2013)** "The Impact of Co-Location of Securities Exchanges' and Traders' Computer Servers on Market Liquidity", there is evidence of an **increase in HFT activity** following the introduction of colocation

2.3 Conclusion

The goal of this paper is to develop a model of Market microstructure and order matching process that clearly identifies the benefits of co-location based on the degree of proximity. We shall further develop a sample order matching system which can simulate the benefits of co-location using a sample HFT strategy. We shall also review relative expense of co-locating HFT servers for different global markets.

Many of the scholarly articles reviewed has not clearly demonstrated all the benefits of co location using a model micro structure except Hendershott and Molton(2010) who tried to study the impact of automated matching system. We wish to extend this study by developing a model of Market microstructure and order matching process that clearly identifies the benefits of co-location based on the degree of proximity which can be affordable even to the small trader . Most of the key writers have based their research on how low latency affect the market structure but has not gone deeper to explain to the traders all the benefits that may accrue out of proximity hosting.

Competitor Analysis

Many researchers in this field have reached to conflicting findings. For example Hendershott and Moulton (2011) and Riordan and Storkenmaier (2012) examine market-wide changes in technology that reduce the latency of information transmission and execution, but reach conflicting conclusions as to the impact of such changes on market quality.

Using this paper we wish to present stable findings on the benefits of Colocation and Proximity hosting to the HFT traders and the economy at large. We wish to extend Hendershott and Molton(2010) study on the impact of automated matching system.

The strength of most of the research work reviewed above lie in demonstration of how reduced latency can affect prices positively, improve

the speed of trade execution, improve liquidity in the market and also improve information transmission.

One of the weaknesses in these research papers is that they have not stipulated clearly the benefits that accrue to the individual traders under Co location and proximity hosting. This paper will come in to clearly demonstrate the benefits to the traders using a model micro structure and a simple matching order system. This will strengthen some of the previously done papers on this topic.

Being a new dimension in HFT, few people have done research on Co location and proximity hosting. There lies a challenge in getting many scholarly articles, books and editorials on the same. The threat of relying on research work done ten years ago could be that it is overtaken by technological advancement and that the findings can not be used to do future predictive analysis. Increasing bargaining power of buyers due high level of information dissemination poses a huge threat to the Colocated traders. This was not tackled by the researchers reviewed. This paper will seek to advise the companies o how they can pursue horizontal integration to consolidate and bring efficiencies.

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