

VIRTUALITY AND NON-VIRTUALITY IN REMOTE STOCK TRADING

Abstract

Advances in information technology allow for remote working, leading to suggestions that remote individuals can work as well in virtual teams as in face-to-face teams. This paper considers the continued use of face-to-face communication in a European group of stock traders, despite the capabilities of information technology to individuate the work. The case illustrates that traders prefer to work in face-to-face settings for various reasons. Short term reasons arise from a need for instant and effortless communication in their manipulation of market prices and instant knowledge sharing, leading to both higher individual and collective profits. Long term reasons arise from a need for continuous learning across novices and experts, as stock markets and stock prices settle into behavioral patterns over longer periods of time. The implications for computing and work are discussed.

Keywords: Community of practice; remote working; electronic trading; knowledge work; information systems; virtuality

1 INTRODUCTION

Knowledge exchange appears to be a central issue in the so-called knowledge economy (e.g. Drucker, 1993), and the growing importance of specialist knowledge has become of paramount importance (Blackler, 1995). The implication is that specialists now own the means of production, resulting in human capital being of greater importance to the firm than any other form of capital (Starbuck, 1992).

At the same time, information technology has ‘compressed time and space’, allowing for global access to scarce distributed expertise (Ives & Jarvenpaa, 1991, p.33). This allows knowledge workers to work together without regular face-to-face contact, through advances in IT. Given this, it has been repeatedly suggested that virtual communities could be formed (Mowshowitz, 2002) to support extant structures without (regular) face-to-face communication.

An industry which appears to be strongly influenced by these developments is the financial services industry. An early incarnation of this industry is the stock exchange, and the development of this financial system was aimed at lowering transaction costs in exchanges of capital (North, 1991). By moving towards electronic trading, for example with the introduction of the Electronic Communication Networks (ECNs) on the NASDAQ in 1997, stock transaction costs were significantly lowered. The system also allowed for faster trade execution, and gave more complete price information to traders than before the ECNs (McAndrews & Stefanidis, 2000). This change allowed for the globalization of trading on financial markets, as access to it is now possible from any location.

As an example, Barrett and Walsham (1999) examined the attempted introduction of an electronic trading system on the London Insurance Market. Electronic trading there was to replace paper trading, so that traders could do business from anywhere. Barrett and Walsham (1999) argued that this change towards remote trading (where traders need not meet in person any more) could radically change the way in which traders establish, continue, and enhance their relationships with each other.

In this paper, it will be argued that this form of knowledge work has been influenced by advances in IT to globalize where the work is done. However, it will be argued that the manner in which employees operate has not been individualized. Instead the work is argued to be still done in groups, the group acting as a socio-technical support system leading to substantial learning benefits.

The paper is structured as follows. First, a literature survey is given on how the move towards electronic trading in financial markets is ordinarily conceptualized in the social sciences as leading to individualization of work. Then, the proposed benefits of working in groups in a face-to-face context are put forward. This is followed by the methodology. The case study then details how in a case of European traders on New York's stock exchanges, working in face-to-face groups provides a socio-technical support system. This is argued to lead to short term and long term benefits in knowledge exchange, made possible because of immediacy and richness of communication in direct contact. The implications for theory and practice are discussed in the final section.

2 ELECTRONIC TRADING: DETACHED, INDIVIDUALIZED, AND VIRTUAL?

The following is a survey of the literature on the change from paper trading to electronic trading on financial markets as perceived in the social sciences. The aspect looked at is what the implication of the advent of electronic trading is argued to be. The argument will be that it is ordinarily viewed as an opportunity to severely decrease human contact in financial exchanges following this change for cost benefits. An emergent property of this change is the decreased need for personal contact with colleagues, which leads to the common perception of the individualized, detached, and virtual financial work environment. This is contrasted with the the next section where benefits of working communities are discussed.

Barrett (1999) and Barrett and Walsham (1999) have shown how these transformations are often resisted. Their case study was based on the structure of the London Insurance Market and the attempted implementation of electronic trading. While there appeared to be significant business benefits to the introduction of electronic trading, the market's participants resisted the transition, for various human and social reasons. A member of the establishment commented that "*[traders] feel they have to see the whites of their eyes and to see if their hands are trembling [in business transactions]*" (Barrett and Walsham, 1999, p. 13), signaling an interest in maintaining rich and intense communications when trading. Despite this institutional inertia, Barrett (1999) and Barrett & Walsham (1999) predicted that market participants would eventually be induced to participate in electronic trading. This is argued to perhaps lead to the situation wherein the need for face-to-face interactions would no longer be required.

Similarly, Knorr Cetina (2002a; 2002b; Knorr Cetina & Bruegger, 2000, 2001, 2002) examined the transformed world of the foreign exchange market, where global investment banks electronically trade currency. In her view, the market changed from being embodied by a dispersed network of trading partners into a life form on its own. This is then exteriorized and embodied on the screens of the currency traders, who engage with this new object. She postulates that this is an example of the contemporary 'postsocial' world, wherein humans and objects have changed to relate in new ways. While she mentions that traders sit next to each other on trading sites, she feels traders are disengaged from the local setting. This view quite

strongly represents the notion that detachment and individualization is a possibility of technological advances in financial markets.

Other research (Barrett & Scott, 2000; 2004; Scott & Barrett, 2005) looked at futures exchanges in London and Chicago and how developments in IT led to the implementation of electronic trading in those locations. The focus here is on how IT functions as a disruptive technology, leading to a reconfiguration of work life. They note that the new work environment with IT will lead to the need for different skills. In a physical trading pit, physical cues lead to a personal feeling for price movements, whereas in the virtual trading pit intellectual skills will dominate. It appears that this will lead towards a calculative and individualized work environment.

Finally, Millo et al. (2005) looked at clearinghouse mechanisms in financial markets, which are aimed at settling trades after they have been financially committed. They oppose the view that a move from buildings and paper towards electronic systems will create a detachment in trading. Instead, they argue that the bureaucratization of the clearing process in financial markets led to a reconfiguration of the way business is done. They argue that, paradoxically, the introduction of electronic markets merely transformed and reintroduced where face-to-face contact takes place. They argue that IT has been able to redistribute work, but has not been able to individualize it. In their view, this contrasts the common perception of the electronic financial markets as virtualized.

Thus, most studies emphasize a detached, virtualized and individualized nature of work in financial markets through the introduction of IT. In the following, we turn to two literatures on knowledge exchange which views the benefits of face-to-face communication in groups. This will serve as a theoretical comparison and contrast with the increasingly common view on individuation of work through IT.

3 KNOWLEDGE EXCHANGE

There are two literatures we will use to provide a theoretical contrast to purely dispersed and electronic work: dispersed team work and communities of practice. This interest for knowledge exchange is based on the nature of the business world, wherein some degree of learning will always be necessary. This holds both for novices who are entering a profession, and experts who

can exchange insights on renewed circumstances. In the following, benefits of working together in face-to-face communities are put forward. These will revolve around the increased opportunities, desire, and intensity of communication in such knowledge exchanges.

Sapsed and Salter (2004), in reviewing the dispersed team working literature, suggest that knowledge is ordinarily described as locally embedded, and difficult to transfer over distances. Second, they suggest that face-to-face interaction is critical in facilitating the transfer of complex knowledge. Furthermore, face-to-face interactions help to build trust, commitment and social capital amongst participants. They argue that often the absence of face-to-face interaction produces distrust among distant partners, thereby inhibiting the sharing of knowledge.

In general, spatial proximity enhances organizational communication as it permits intense and ongoing face-to-face interactions. The reason for this is that it is the 'richest' form of interaction, despite various (electronic) forms of communication such as instant messaging, groupware, videoconferencing, etc (Daft & Lengel, 1986). Most studies find that co-location leads to better knowledge sharing and overall performance as opposed to the situation of dispersion (Kiesler & Cummings, 2002).

It also appears that more is at stake in the question of co-location than just the *ability* to communicate – trust, commitment and social capital also lead to a *desire* to exchange knowledge. Co-location thus appears to not only allow for the most efficacious exchanges of knowledge, but also provides an impetus through social means.

Community of practice theory deals more specifically with how knowledge is shared and distributed in a work context. Theoretically, communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (Wenger, 1998; Wenger, McDermott, & Snyder, 2002). Knowledge in the view of community of practice theory is accumulated at the worksite in a situated sense, and is the result of a group processes. In other words, members entertain a mutual engagement in a common action or idea, work in a joint enterprise leading to mutual accountability among participants, and have a shared repertoire consisting of the way things are done . Furthermore, Brown and Duguid (1991) later built on

Orr's (1987; Orr, 1990) work to explain how knowledge pertains and is transferred in informal relationships, through shared insights and narratives.

Knowledge in a community of practice theory is accumulated at the worksite during situated work, and is the result of a group processes (Lave & Wenger, 1991). Community of practice theory has been said to have originated in a wider tradition of learning, education and cognitive theories (Fox, 2000). More specifically, it has been addressed as a specific version of social learning theory, wherein individual members learn in the workplace ('situated') by participating in shared activity. Knowledge and practice as inherently intertwined was put forward to challenge the then prevalent view of learning constituted as students 'receiving' knowledge in a classroom, and allowing them to exercise that knowledge later on (Lave & Wenger, 1991).

Others using this theory, have considered enterprises or organizations as constituting a multitude of such communities (Fox, 1997a, 1997b). Following this line of reasoning, individual members communally learn by participating in a shared activity in the work place. In this view, knowledge is transferred within a group by participants, tying learning to ongoing activities in practice.

In short, community of practice theory argues that knowledge and practice are intertwined. In this view, learning requires its performance. When this is done within a group sharing common interests, knowledge is spread through socialization. This allows for new entrants to get up to speed quickly in an area of work, through an apprenticeship. Second, more experienced members of the community benefit from each other's presence as new insights are shared.

This communal conception of learning in a work context is at odds with the prediction that knowledge work would be performed individually in the financial markets. This leads to this paper's key question, being if the ability to perform knowledge work on an individual basis is of greater benefit than the learning benefits of working in groups.

This paper will argue that even where work could be done individually through electronic systems, face-to-face work still occurs in order to augment what electronic systems cannot deliver. It will contribute to the discussion on the effects of IT on work by a description of the reasons why people still work together, and for what reasons. We explore this through the description of a daytrader community in Europe, which trades on various New York stock exchanges.

4 METHODOLOGY

Data was gathered during the second half of 2007, as an interpretive (Orlikowski & Baroudi, 1991; Walsham, 1993, 1995, 2006) in-depth case study (Yin, 2003) in and around the work site at TradeCo (a pseudonym) in a major European city. Data collection was focused on the learning processes of expert and novice daytraders within the community.

The objective was to perceive the understanding of social situations from the viewpoint of participants in a daytrader community at TradeCo. To explore social phenomena within groups and to interpret the meaning attributed to actions by those groups, data collection consisted of semi-structured interviews, direct and participant observation, and secondary data using internal reports of the firm to broaden possible interview topics.

Four different groups of individuals were found in the case. The *owner* of the company, who is not directly involved in the company's day to day operations, is a gatekeeper to the financial trading capital. The three other groups all perform essentially the same job, with slight variations. *Traders* trade for TradeCo on the stock markets, to receive a portion of their gross profits as compensation. *Trainee* traders and *managers* generally do this same work, but trainees do not receive any salary (or any other kind of compensation) until they have proven themselves as good traders. They can do this by 'graduating' from trainee to trader by earning 2000 dollars in one month. Managers, in return for a small portion of all the other traders' profits, are responsible for day-to-day operations. Both the managers of this daytrader organization and seven of the twelve traders were interviewed. Both the trainees were interviewed, and the owner. These twelve semi-structured interviews varied in duration, ranging from 30 minutes up to 2 hours.

In the following, the case data will be contextualized by a short history of the development of the stock market. Following that, the work is described, and how the community of traders are a community of practice. Finally, reasons for working together in both the short and long term are addressed, and counter-evidence which further support these findings.

5 CASE DATA

Since the stock market's conception in 1602, people have made a living on the quick trading of stocks based on price fluctuations. Some specialized in very short term investments, so that at the end of every working day they would have a cash profit or loss, without owning any shares.

Making a living based on such short term stock investments is believed to have first been described in the book *'The day trader's bible'* (Wyckoff, 1919). In characterizing this line of work, his definitions will be quoted, as they are precise, concise, and interestingly hold to this very day.

With the introduction of Electronic Communication Networks (ECNs), 'daytraders' could work from any location hosted software with links to the respective stock market. Extending a line of innovations in remote trading which began with the telegraph in the late 1800s, ECNs are an evolutionary broadening of the remote work possibilities.

Many of the reasons for these innovations is related to the dynamic nature of the stock market, where information increasingly loses relevance quickly. Any new information must be acted upon quickly. The development of the ECNs in 1997 on the NASDAQ allowed for fast trade execution worldwide, and gave more complete price information to traders (McAndrews & Stefanidis, 2000). This change allowed for the globalization of trading on such markets, as access to financial markets has become possible from any location.

In 2004 TradeCo was established, thereby allowing daytraders to work remotely from a well known location in Europe, operating on the NASDAQ and NYSE. TradeCo is a branch of a global daytrader organization which was founded in 1997.

The daytraders at TradeCo are focused on minimal price differences (in terms of cents) to 'shave' stock price differences between ECN's or expected minimal price fluctuations on a single ECN. This type of trading is only possible because of the minimal transaction costs involved in exchanging stocks on an ECN.

5.1 Work characterization

Daytrading work has been described as modern knowledge work (Royal & Althausser, 2003), as daytraders are essentially investment analysts. The various computer screens used by a trader

signal a voluminous amount of information, which is far more detailed and instantaneous than what the occasional investor sees. Traders make short term investments in stocks, their contribution being an ‘analysis’ – primarily based on experience and hunches – of the stock’s price, and the buying and selling of investments resulting from quick price changes – sometimes two or three cents. The objective is to benefit from such price movements, and within fast-active communities of practice, it typically is.

Quick and experienced interpretation of the information is crucial to good decisions. The speed and direction of a price fluctuation is only an estimate, and some estimates are better than others. Novices in this particular profession have a very hard time making any money at the outset. In the words of an early daytrader:

“Let anyone who thinks he can make money analyzing the stock market [attempt to trade in a simulated mode]. [...] Put my name down as the opposing side of every trade and when done send me a cheque for what you have lost” (Wyckoff, 1919, p. 80).

On average, more experienced traders have higher payrolls, supposedly through knowledge in the form of tacit ability, which allows them to make correct predictions of where the stock price is headed.

Daytraders operate by viewing historical data on prices of the particular stocks they specialize in, further aided by a time and sales window which shows them what amount of shares are being bought and sold in real-time. Furthermore, they can see how many stocks are offered in real-time for which prices.

In becoming a good trader, one must figure out both the technical terms being used and how to use the tools at the trader’s disposal. Again in the words of an early daytrader:

“It seems to us, based on our experience, that Tape Reading is the defined science of determining from the tape the immediate trend of prices. It is a method of forecasting, from what appears on the tape now in the moment, what is likely to appear in the immediate future. Tape Reading is rapid-fire common sense . (Wyckoff, 1919, p. 7)”

Replace ‘tape’ with ‘electronic price information’ and ‘tape reading’ with ‘the art of analyzing price information’ and this definition is essentially the same today. In continuation of this definition,

“The Tape Reader aims to make deductions from each succeeding transaction - every shift of the market kaleidoscope to grasp a new situation, force it, lightning-like, through the weighing machine of the brain, and to reach a decision which can be acted with coolness and precision . (Wyckoff, 1919, p. 8)”

5.2 TradeCo as a community of practice

Daytrading is a skill, which can only be learned by actually doing the job. Novices at TradeCo can only learn by employing daytrader tools in its specific setting, by mistake and correction, through continuous learning. This is far from an individual affair, as the aim and speed of learning by a trainee is affected by their face-to-face community.

For example, sitting near someone with a successful technique can facilitate transfer of knowledge, so that elements of that technique can be implemented in the trainee’s own trading. The same holds for more experienced traders, as learning is a perpetual work-in-progress and insights are shared quickly, between face-to-face workers. As price and stock market behaviors take unexpected turns, learning is a continuous necessity. The situated nature of learning is noticeable for both novices and experts.

Members of the community gain legitimacy as they become experts, often seen and expressed through their income. Legitimization is primarily measured in a trader’s salary, which also denotes his rank in the ‘collective’. Further to this, the amount of screens a trader’s desk sports indicate how much money he is able to earn. Trainees and ordinary traders start out with two computer screens. Once they earn \$10,000, an extra screen will be added ceremoniously and yet another one when a trader has once earned \$20,000 gross in a single month. Finally, when problems arise, the better trader will always be helped first by management. For example, software problems leading to ambiguity in the data stream from the ECNs ordinarily require a phone call to the ECNs to determine how many shares a trader owns or owes, in which case the biggest traders are helped first.

Because of this, the community of daytraders at TradeCo can be seen a community of practice. The data beforehand details the manner in which learning to be a daytrader occurs. This is expressed by the situatedness of learning, and how legitimacy is expressed.

5.3 Short term communal learning benefits

Within this community of practice, there are a number of short term learning benefits from co-located work. First, co-location leads to the ability to take short breaks, and how it enhances the scope of the market. This is possible through the community's watchful eye and the quick communication possible through direct physical presence. Second, knowledge is also shared in terms of price behavior estimation from person to community. As they act as a community, opinions on price behavior stack so that knowledge is produced from the community's opinion. These factors are put forward in more detail in the following.

When little happens on the stock market, there are few opportunities for profits, as traders report their trading style depends on moving prices. Traders then resort to social chitchat with their close neighbors, and discuss what the stocks might do. Some even go outside for a smoke, or for a glass of mineral water. This is potentially dangerous, as the market can make a sudden move. The few traders who are then left at their stations then give a loud warning. All the traders who thought they could take a break because of low market volume then run back to their stations to make a quick evaluation, before starting to trade again.

Such sharing is not just limited to observation of general trends, but also extends to a communal watchful eye of events: As traders feel cognitively limited to monitor six or seven stock prices at the same time, and nobody can monitor the entire market at the same time. Instead, all daytraders have a favorite stock to trade, with a few others which vary from day to day. When one daytrader picks up an interesting movement on a stock, he signals this to the community, who switch to view this one. As a result all participants can join in on an unexpected price shift, leading to profits which would otherwise probably would have been missed by most.

Instead of working individually, people try to help each other. During conversations, traders exchange insights to achieve a common understanding of where prices are headed. "*Wow, the markets are in bad shape again!*" the best trader at TradeCo commented. This signals to the other traders that prices will fluctuate more aggressively than usually. Traders help each other out by communally and continuously commenting on their beliefs of where prices are headed.

On one occasion a trader screamed "*It's going up, it's going up!*" Another one joined in, by pointing out signals which confirmed this conclusion. In the end, the individual is the only one

responsible for pushing the buy or sell button, but when experienced daytraders indicate their belief that stock prices are headed in a certain direction, the novices respond. Thus, while the buy-sell and its responsibility are inherently individual, the group at TradeCo helps each other by having their personal analyses ‘confirmed’ by other traders.

Had they worked as individuals instead of as a group, their view on the market would be more constrained in terms of scope, and they would not have been as able to take a break when little happens. Knowledge is shared purposefully, and traders are socially stimulated to add their opinion to the community’s view of what the stock market is doing, with the hope that it will lead to higher individual profits. It thus appears that knowledge sharing in this community leads to communal benefits, made possible by face-to-face communication.

Furthermore, in the following it is argued that their co-location and social arrangement allows them to communicate directly. This allows for cooperation in terms of internal non-interference and for an amplified ability to better manipulate stock prices.

Traders at TradeCo explain they have tacit agreements not to bother each other on the market. For instance, traders have enough buying power to manipulate stock prices; they each have several million dollars at their disposal. Assume that one trader, for instance, is 10,000 shares long (owns that amount of shares) in such a stock. Another trader could manipulate the price by aggressively selling that stock, so that the price would go down.

Furthermore, individual traders can only “shake” and “move” market prices to some extent, on their own. When cooperating in small task force groups, however, they are able to manipulate stock prices further, to their advantage. This is especially useful in situations where they feel a price will continue to rise or fall after they have given it a push. The traders each have a several millions of dollars at their disposal. When these dollars are combined, the impact on the market can be enlarged. This is especially useful when they feel a stock price is at a price barrier, and pushing it over or under that barrier would lead to a strong shift in price. Ordinarily, they would then push the price in the direction they would like it to go. On occasions where the stock price gains more momentum than is the result of the daytraders’ combined forces, the continued movement of the stock price leads to a profit when the trade is cashed in after this continued price movement.

It appears therefore, that traders' knowledge of each other's 'whereabouts' on the market occurs in this face-to-face group of traders. The stock market is a continuously moving target, and the ease, intensity and richness of direct communication allows for such intensive and continuous dialogue. This would be severely hindered by even the best electronic systems.

5.4 Long term communal learning benefits

In addition to the benefits of short term benefits sharing knowledge, there are also long term reasons for working as a group in the same setting. There is a continuous need for learning, as stock markets and stock price behaviors continuously evolve in continuously unpredictable ways. It can be argued that complex knowledge is here transferred by continuous directions from traders with knowledge that is profitable.

Being a daytrader is a continuous learning process, where one must continuously learn and adapt to learn and manage the market, and improve his or her trading skills. As it is a continuous learning process, learning from each other's mistakes and insights is beneficial for all traders.

Knowledge in this case cannot be easily (if at all) captured and distributed through electronic systems. As decisions are often split-second, finding and examining an electronic analysis is of little benefit. Instead, knowledge sharing consists of hints provided at the right moment in time, when individual and collective trades can be combined with a current market price situation. As this is necessarily a verbal hint due to the need for instantaneous communication, the role of information technology in this case is limited to delivering market signals. Skype and IRC are used for background reflections and long-term predictions between traders of various daytrader organizations; but as action in this line of work is so short-term, this serves few beneficial purposes. The high volatility of market knowledge with a very short expiry date, makes a face-to-face community-of-practice essential.

One trader reported that he was a trainee for a very long time, until the traders who were sitting next to him quit their jobs because they were unable to adapt quickly through a community. The replacements increased his capability.

“When they left the company, other traders were relocated nearer to me, and watching them work helped me a lot. By continuously attempting to copy their strategy I managed to earn almost as much money as

they did. They showed me why they acted upon which signals and helped me understand what I was doing wrong, as much as what to do and when”.

In this instance, social behavior appears to have stimulated the direction and speed of learning, over a longer period of time. Copying ‘old’ knowledge was not helping this person. This tells us that socializing with the recently successful traders is key to individual success.

To summarize, learning is not merely of necessity for the inexperienced new entrants to the organization but is instead a continuous necessity. As the necessary knowledge for trading is complex, a more successful trader ‘teaching’ another trader or a trainee demands ease and intensity of communication. This can only be done when traders are co-located. In addition, it is argued that socialization between traders provides an impetus for knowledge sharing.

5.5 Detachment leads to diminished profits

Also, there is evidence that those who do not socialize as much as the others, do poorly. Three traders, seated in a more distant area of the office which is a quieter zone, believed they could perform better by just concentrating on the market. According to the other traders, however, their distance has been associated with poorer profits than in the past. While they acknowledged that they were not earning as much as they did before, they attributed this to external circumstances on the market and not to a diminished ability to learn from fellow traders.

Next, we turn to our discussion of the results, and implications for theory and practice.

6 DISCUSSION AND IMPLICATIONS

The case illustrates the need for working as a community in day stock trading, even when the ability to work individually through IT or in separate offices, are possible. The example of three traders who isolate themselves from the community provides an interesting comparison with their decreased profits after moving to a separate and quieter office.

Confirming our results, Millo et al. (2005) argue that the introduction of electronic markets merely transformed and reintroduced where the social takes place. This view contrasts the common belief that the computerization of financial markets would lead to dematerialized, detached, and virtual individuals. The current case contributes to the discussion on the role of

technology in work transformation, by delineating the specific areas where a community of practice is still required to be an effective day trader.

The survey of the literature on community of practice theory and dispersed team work suggests that the intensity and richness of face-to-face communication allows for the transfer of complex knowledge. In contrast, electronic communication systems impede such complex knowledge exchange. It suggests that knowledge transfers are argued to be best accommodated by working in a group where trust and collective goals are shared, so that insights are exchanged between novices and experts. This does not imply that there should be less IT in communities, to prevent intermediations in knowledge exchange. Instead, it is argued that learning and knowledge exchange are just best accommodated by direct human contact.

Furthermore, the literature on community of practice and dispersed team working emphasizes the role of the social knowledge exchange. This is not only due to its role as a stimulant towards knowledge sharing in face-to-face contact. It also suggests that the performing of a shared activity within a group is where relevant knowledge is produced and exchanged. TradeCo's case supports the argument for a need for direct social contact in knowledge exchange, in particular in this case where the knowledge is fleeting.

Based on TradeCo's case of European traders operating on some of New York's stock exchanges, we argue that co-location remains of great importance in facilitating learning processes, thereby impeding the expected individualization, virtualization, and detachment. The richness and social nature of the community allows knowledge and expertise to spread more rapidly, thereby directing and accelerating the individuals' activities and capabilities within the community. This materializes in TradeCo through short term benefits such as internal cooperation and external manipulation. In the long term, complex knowledge is distributed through the same rich and instantaneous means, by facilitating transfer of insight into renewed market circumstances, so that traders must continuously adapt their methods.

In terms of knowledge management, face-to-face contact in communities of practice continues to best accommodate learning and knowledge exchange. However, an implication of this research is that in order to better spread knowledge across various communities, direction should be given to community formation. By regularly exchanging employees across different communities within

an organization, new insights would spread more rapidly through co-location. This would allow for virtual communities to exchange insights by regular exchanges of members.

This paper also contributes to showing how electronic trading changes but does not lead to a complete detachment, virtualization, and individualization of work. In many ways, computerized systems are contributing to a rearrangement of work that began with an earlier application of the telegraph to send stock prices outside of the stock exchange. Thus, more recent developments in information technology have only broadened the scope of where this work can be done, but not the need for face-to-face interactions in fast-moving knowledge work.

A problem of single case studies is that there is a limitation in generalisability and a risk of observer bias, a multiple site study helps guard against such a bias and adds confidence to findings by validating results across sites (Leonard-Barton, 1990). Also, a cross-case analysis could specifically seek out a contrasting case to highlight differences between sites (Miles & Huberman, 1994). Future research in the form of a multiple site study and cross-case analysis can help address these limitations.

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