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Viewing The Market:

The Architectural Design Of Trading Rooms In The Interplay Between Face-To-Face Communication And Face-To-Screen Communication

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This paper explores the architectural design of trading spaces in the interplay between space, communication and technology. Trading activities in the financial industry are considered a distinctive example of knowledge work strongly driven by communication and collaboration. Following the rise of telecommunication and information technology in the last decades, trading activities have become mainly electronic and highly time-critical today. The new trading environment allows traders to trade from remote trading spaces without interacting with their market counterparts face-to-face any longer. Connected via screens and other technological devices worldwide, the organisational and social dynamics of trading activities have, thereby, fundamentally changed. The key research question of this paper concerns the importance of face-to-face communication and physical proximity of traders in modern trading spaces, and their implications for trading room design, as state-of-the-art technology has globally transformed the access to market information and market participants. The paper looks both at traditional trading spaces of financial exchanges, in which trading activities are conducted face-to-face, and modern trading spaces of financial firms, in which traders interact with market counterparts via electronically mediated communication. The analysis of these two different settings concludes that the increasing use of technology has not made face-to-face communication and physical proximity of traders obsolete but even more important for technology-intensive trading activities. The abundance of market information and the complex decision-making process makes close human collaboration and highly transparent spaces essential in order to effectively assess market situations and act accordingly without delay. The architectural design of trading rooms, therefore, needs to accommodate both for face-to-face communication and face-to-screen communication

Keywords: Trading rooms, Financial market, Knowledge work, Space, Technology, Workplace studies

1. Introduction

Trading activities in the financial market form a distinctive example of knowledge work (e.g. Knorr-Cetina & Bruegger, 2002; Vopel, 1999; Piel, 2003). The collaborative and reflexive process of analysing, developing, evaluating and interacting globally in real-time, as commonly practised in trading firms, is widely acknowledged as the characteristic mode of working for knowledge industries today. In the financial market, work is strongly driven by technology, as trading activities have become mainly electronic and highly time-critical. Human capital and state-of-the-art technology are considered key assets in the innovation process, uniting the skills and experience of people with the efficiency and speed of machines.

Over the last decades, the nature of trading activities in banks, proprietary trading firms and investment firms has fundamentally changed following the rise of telecommunication and information technology. Today, most traders are electronically connected with the financial market without trading face-to-face with their market counterparts any longer. Due to new technologies, trading activities have become more efficient in terms of capacity, speed and market structure enabling market participants to trade in global financial markets in milliseconds. The deployment of innovative technologies has, thereby, not only created new modes of trading activities but also new types of trading spaces.

Trading spaces refer to the physical work environments in which trading activities take place. Historically, trading activities took place at the so called 'trading floors' of financial exchanges, in which market participants from different financial firms gathered physically at a common location to trade with each other face-to-face. In contrast, trading activities today are predominantly conducted at remote 'trading rooms' of financial firms, in which market participants trade with their counterparts via electronic systems, telephones and other technological devices. In the existing literature the term 'trading floor' and 'trading room' are sometimes used interchangeably, but are differentiated in this paper for unambiguous reference, as defined above.

Trading activities represent one of the oldest business activities. Trading as a profession is a widely discussed subject in many literature and media sources today, as financial trading has become a key industry in the knowledge society engaging a large number of workforce. Despite their growing economic significance, however, trading spaces, and especially modern trading rooms, are much less known as workplaces to the general public, and scarcely researched in the field of workplace studies. However, as the importance of talent, technology and time in many firms increases worldwide, trading rooms provide an exemplary research subject for the analysis of the spatial dimensions of knowledge work in technology-intensive industries.

Current research on knowledge work, communication and technology in modern trading environments predominantly focuses on actors and their activities in the financial market. Analysing the social structure and dynamics of face-to-screen communication, most of these research studies are conducted in the socio-economic, socio-technical and anthropological fields. Some of these studies also refer to the spatial dimension of trading spaces, but do not explore their architectural design in detail (Beunza and Stark, 2005; Bruegger, 1999; Zaloom, 2006).

On a macro level, current sociological literature on financial markets suggests that the rise of information technology and globalization has generated a spatial concentration rather than a spatial dispersal of the financial market. Sassen, for example, argues that trading activities depend on 'material and human resources, state-of-the-art office buildings, top talent, and the social networking infrastructure that maximizes connectivity' (Sassen, 2001: 120). For this purpose, the presence of financial firms and related service providers in financial centres such as New York, London and Tokyo, the so-called 'global cities', has not become weaker but even stronger due to technological

transformations, as these cities provide a special workforce and infrastructure. Furthermore, many of these global cities also host technological hubs of electronic exchanges and trading platforms that connect market participants worldwide. As automated trading activities increase and demand instant execution in milliseconds, physical proximity to the location of the matching engines of electronic exchanges and trading platforms becomes a crucial factor.

On the micro level, a number of socio-economic studies suggest that electronic trading activities are both collaborative and competitive. Introducing the concept of 'heterarchy', Beunza and Stark (2005), for instance, highlight flat hierarchies in trading rooms while having competing teams with different value systems. The diversity of information created within and across trading teams, is essential for the decision-making process, enabling traders to profit from various knowledge sources in the trading room. The information disseminated in the trading room provides additional value to the general information provided by the screen. For this reason, traders are usually seated closely together in trading rooms in order to better communicate with each other. Similarly, as Zaloom (2003) addresses in her anthropological study, verbal communication in modern trading environments is also important. In addition to abstract numbers on the screen, 'social narratives' of other traders provide important indicators in the evaluation of market activities beyond the screen. As Baker's observations on the traditional trading floor suggest (Baker, 1984), market information is not only communicated in concrete numbers in trading rooms, but also through the social behaviour of individuals and groups.

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In contrast, workplace studies that likewise discuss aspects related to knowledge work, communication and technology do focus on the architectural design of trading rooms, but rarely look at these environments as a research category. Since the access to trading rooms of financial firms is usually restricted for regulatory and corporate reasons, empirical studies tend to be difficult to conduct. Recent literature on trading rooms in the field of architecture and workplace studies is, therefore, relatively limited. While there has been a growing research interest on office design of diverse industries for many years, trading rooms tend to be a rather 'exotic' research subject. The following references present examples of existing literature on the design of trading rooms.

One of the few articles in this field is a contribution by Duffy (1988). It describes selected aspects of space planning with a focus on building technology, including cooling, cabling and lighting among other issues. Similar aspects can also be found in Robathan (1985), who looks especially at ergonomic issues of trading rooms. In addition, a number of short articles published in industry magazines in the 1990s exist (Davidsen, 1990; Philipps and Strauss, 1994; Moudis, 1996), which highlight the intense use of technology in trading rooms, and describe some spatial characteristics. More recent articles addressing the spatial dimensions of trading rooms include Scholtes (2006) and Kohlhaas (2005). In summary, recent literature on the architectural design of modern trading rooms is relatively rare. Various publications from the 1980s and 1990s provide useful insights and references, but their application to today's further advanced trading technologies and trading activities has limitations.

This paper explores the architectural design of modern trading rooms in relation to space, communication and technology. The key research question it investigates is the importance of face-to-face communication and physical proximity of traders in modern trading rooms, as telecommunication and information technology has substantially increased in financial firms. If computerized trading activities prevail and predominantly drive the dynamics in trading rooms, the question that arises is whether co-location of traders and physical transparency of trading spaces is or will finally become obsolete. Bridging spatial and sociological dimensions, this paper adopts an interdisciplinary approach, contributing to the scarcely researched field of trading room design. It also provides insights and important considerations for workplace studies in general.

The paper is organised as follows: Part one describes the key methods and data, which are used in the research. Part two gives a brief historical overview on the development of trading spaces. It explains the origin of trading activities, highlights the shift from outdoor marketplaces to trading floors of exchange buildings and modern trading rooms of financial trading firms, and provides some essential information on the institutional background of the financial trading industry. Parts three and four analyse selected aspects of trading floors and trading rooms respectively. These parts of the paper are similarly structured looking at the typologies, the dynamics of trading activities, the technological setup and the spatial configuration of these spaces. Finally, part five summarises key findings on the interplay between space, communication and technology in electronically mediated trading. This section gives special attention to the nature of face-to-face communication and face-to-screen communication, and their implications for the architectural design of trading rooms.

2. Methods and Data

The research on trading spaces, forming the focus of this paper, was conducted in the context of the author's doctoral dissertation thesis¹, and uses several methods. One of these methods encompassed the collection of qualitative data. It included thirty-three semi-structured expert interviews and several site visits in trading rooms and trading floors from banks, proprietary trading firms, investment firms and exchanges. These firms and institutions were predominantly located in Frankfurt, New York and Chicago. The expert interviews were conducted between August 2005 and October 2006. Each interview took between 30 and 120 minutes, tape-recorded - if permitted by the interviewee - and later transcribed. For confidentiality reasons the name of the interviewees were kept anonymous.

In addition, an online survey was conducted including a total of sixty multiple-choice questions. The survey included questions on spatial requirements and features of the existing trading room spaces to complement the data of the expert interviews. A selection of 470 trading firms in Germany, the United States and the United Kingdom was contacted and invited to participate in the survey. 83 trading firms (approximately equal numbers of banks and proprietary trading firms) answered the survey. Because of the relatively small number of respondents, however, the results were not statistically representative for the financial trading industry in its entirety.

Furthermore, different types of visual material such as photos, sketches and architectural plans were analysed. These included published and unpublished material supplied by architects, trading desk manufacturers and other sources as well as some company websites. For the historical part, additional archive work was conducted at the New York Stock Exchange archive to collect and analyse original building documents of the traditional exchange trading floor.

3. From Fairs to Financial Markets

Historically, financial trading activities can be dated back to fairs, trade fairs and trans-regional commodity markets in the middle ages. Walter (1992) highlights that places for trading activities were usually located at strategic sites, such as at intersections of main routes of commerce, or at shipping ports like Genoa, Frankfurt, Bruges and London. These market places existed in Europe as early as the 7th century and transformed those sites into main centres of trading activities.

Merchants regularly assembled at these market places, trading goods such as produce and commodities, exchanging market information and speculating about future prices. While carrying out these merchandising activities, they also negotiated about financial products such as interest rates, exchange rates for currencies as well as insurance policies (Meseure, 1987). Gradually, forward contracts for future goods were also introduced creating additional trading opportunities for both speculation and risk management. In the 15th and 16th century trading activities for physical goods and financial goods started to take place at different locations, establishing an independent market place for financial trading activities (Zeller, 2002).

In the beginning, trading activities were predominantly informal outdoor activities located at market places. As trading activities were professionalized, trading activities became institutionalized in formal exchanges and later moved from outdoor sites to indoor sites. In the 16th century the Antwerp exchange was established as the first purpose-built exchange building in Europe. It resembled a courtyard building with several access points from the surrounding streets. The intersection of these paths formed the actual trading space.² The architecture of early financial exchanges was influenced by the architecture of market squares, market halls and cloisters, as Meseure (1987) highlights.

In the United States, the first financial exchanges were founded in the 18th and 19th century. Philadelphia, New York, Boston and Chicago were also known as strategic sites with shipping ports, and were located at the intersections of main routes with central transportation infrastructure for intensive commercial activities. As in Europe, early trading activities were conducted outdoor in the streets. Later, they moved into coffee houses and taverns before dedicated exchange buildings were established. The 'City Tavern' in Philadelphia, for example, was renamed the 'Merchant Coffee House' indicating a popular place for trading activities (Philadelphia Stock Exchange, 2006).

Exchanges formed the centre of trading activities for many centuries, both physically and socially. Traders came together in exchange buildings trading with each other, and engaging in various business and social activities. This spatial concentration created a strong bond within the diverse trading community. Face-to-face communication, thereby, took place both on and off the trading floor. Many exchanges like the New York Stock Exchange, for example, provided a number of social spaces for informal communication such as cafés, oyster bars, smoking rooms as well as public and private dining rooms in addition to the actual trading area (NYSE Archive, 1919).

On the traditional trading floor, viewing the market essentially meant seeing and hearing other market participants and their orders well. Supported by their voices, gestures, hand signals and movements on the floor, the trading floor formed a vibrant environment, which was driven both by 'opportunism and social control', as Baker (1984) argues.

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Following the modern technological transformation starting in the early 1970s, the nature of trading activities fundamentally changed. Traders were able to trade from remote places without assembling face-to-face with their market counterparts on the trading floor any longer. The access to the financial market was, thereby, moved from the trading floor to the trading screen. This had major implications for the nature of trading activities and the structure of trading spaces both on the macro and micro level, which will be elaborated in the following two sections.

4. Trading Floors

This section explores traditional trading floors in which traders used to assemble face-to-face with their market counterparts. Looking at the relation between space, communication and technology, the architectural design of trading floors is examined, and the following aspects are highlighted: a. The typologies of trading space, b. The dynamics of trading activities, and c. The technological setup and finally their spatial configuration.

4.a. Typologies of trading floors

Trading floors can be generally differentiated into two main typologies: 'trading posts' and 'trading pits'. Historically, trading posts were mainly used for equities and securities trading activities, while derivatives trading activities were mostly conducted in trading pits. The typologies of trading posts and trading pits differ in their spatial organisation and design.

Trading areas with trading posts are characterised by trading counters today, often arranged in a circular or horse-shoe shaped geometry. Inside the trading counters, a dedicated person from the exchange is responsible for keeping a fair and efficient market and matching orders of one product. Facing outwards to traders and brokers that are located on the opposite side of the trading counter, this person can ideally oversee market participants and market activities. The term trading post relates to vertical sign-posts, which marked the location of traded products in early trading spaces before trad-

ing counters were introduced. The top of the sign-posts was labelled with the name of the product that was traded at the post making it easier for market participants to identify all products from a far distance [Figure 1].

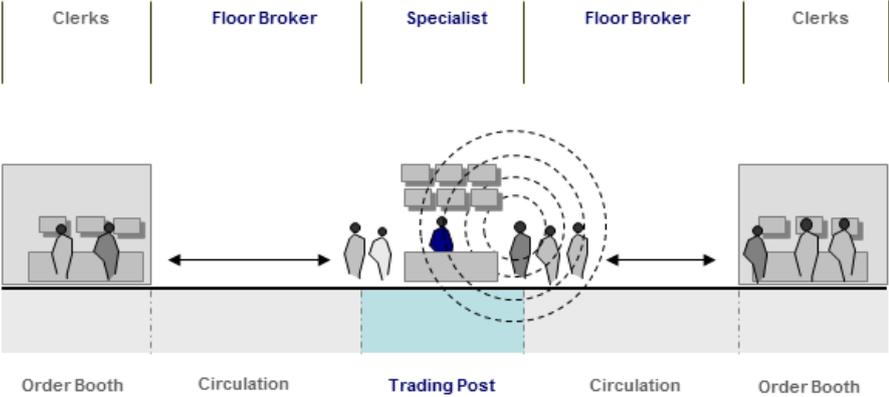


Figure 1: Typical example of trading post.

In contrast, trading pits describe a trading platform with rising steps along the perimeter of the platform creating a 'hole' in the centre of the trading pit. The Chicago Board of Trade introduced the trading pit in the 19th century and patented it in 1878 (Faloon, 1998: 72). It had an octagonal shape organising the crowd of traders in each section of the octagon according to expiration months. In the centre of the trading pit, traders, so-called 'locals', faced outwards to brokers who stood on rising steps at the edge of the octagon looking towards the traders at the centre. In addition, clerks were located at the order booths on multiple levels along the perimeter of the trading area, which allowed them to communicate visually with their brokers at the trading pit, and vice versa. Variations of the trading pit include circular and irregular shapes. The general design concept and use of the trading pit remained relatively similar for many decades [Figure 2].

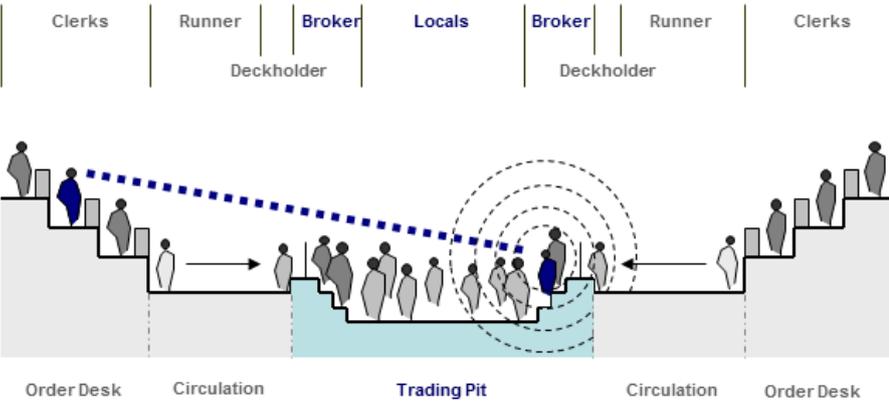


Figure 2: Typical example of trading pit.

4.b. The dynamics of trading activities

Floor trading is a conversational activity. Traders, brokers, clients, intermediaries as well as support people such as clerks and runners were involved in a continuous exchange of information creating a vibrant trading environment. Market participants communicated their orders verbally, directly shouting their bids and offers into the large trading crowd. Every pronounced word was a commitment and hence, represented a legal contract (Zaloom, 2003). On the trading floor, market participants had access to a large number of information from different sources. Trading can be considered a reciprocal process in which a piece of information provided a basis for a new trade, which in turn became a new piece of trading information for other market participants.

At some exchanges like the Chicago Board of Trading or the Chicago Mercantile Exchange, for example, verbal trading activities were additionally supported by coded hand signals. Especially in large, noisy crowds, hand signals were advantageous, since they enabled communication across the trading floor over some distance (CME, 2004). Hence, the trading floor did not only convey verbal but also visual information allowing traders to observe multiple market events at the same time.

Important trading information consisted not only of concrete numbers, but also of social and ambient information such as noise level and identity of traders. Coval and Shumway (2001) showed, for instance, that 'ambient noise level' correlates with increasing price volatility and order flow as well as declining market depth. The noise level, therefore, also provided valuable information about potential trading opportunities and trading risks in addition to 'hard fact' market information.

Furthermore, in some trading floors social information was also embedded in the specific clothing of trading participants. In many exchanges traders wore coloured jackets, which indicated their company affiliation. Similarly, knowing the identity of market counterparts provided additional information in the complex decision-making process. Large investment banks, for example, usually placed orders of substantial size, which could potentially move market prices. An interviewee explained, for instance:

'In the pit if somebody comes in with an order from Morgan Stanley or from Lehman [...] you can be pretty much sure there is a lot of size behind that order'.

Interviewee PTF 03³ in Tsen (forthcoming)

In busy market situations, visual information such as the colour of jackets could, therefore, help to quickly identify sudden activities and movements on the trading floor, thus signalling and contextualising changes in the market.

4.c. The technological setup

Technology has always been an important catalyst for innovations in financial exchanges. On the trading floor itself, however, it typically played more of a supporting role compared with the strong presence of people. Floor trading activities were predominantly driven by face-to-face communication. As described in the previous section, traders assembled in the trading pit or at the trading post and interacted verbally and visually with each other. In this way, they created a vibrant trading environment with diverse noises, gestures, facial expressions and movements. People and their physical activities essentially embodied the financial market.

Key technological inventions for communication such as the ticker, pneumatic-tube, telegraph, telephone and monitor screens were early introduced by financial exchanges; since real-time communication was a key factor for trading activities, financial exchanges were usually one of the first commercial users of technological innovations. The London Stock exchange, for example, started to use the telegraph in 1840 only two years after Morse developed and patented it in 1838. Similarly, the New York Stock Exchange introduced telephones in their trading floor in 1878 after Alexander Bell patented the telephone in 1876. At trading floors, technology was utilized to display current market prices, route client orders to order desks and later optimize other floor trading processes.

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4.d. Spatial configuration

The spatial configuration of both trading posts and trading pits aims to provide a high degree of visual and acoustic transparency. Social connectivity to other market participants essentially meant visual and acoustic transparency across the trading floor, and was, therefore, defined as a key requirement for the architectural design of exchange buildings.

On the building level, the location of columns was considered a critical issue for this reason. Both historical building documents and more recent literature underline this aspect, as the trading floor design of the New York Stock Exchange and the Chicago Mercantile Exchange show:

"The first essential of this building was the extension of the Board Room⁴ to cover as great an area, unobstructed by columns, as possible. Practically the whole floor has been given up to this purpose. This determined the location of the elevators on the west side and also required that the whole super-structure of the building should be carried on trusses, spanning the distance from Wall St. to the north wall of the old building. These great trusses, which occupy a full story in height, rest upon columns, one of which carries the greatest concentrated load of any column that has ever been erected in this city'.

NYSE Archive 1919, p.2-3

'[...] the Merc moved into the 40-story CME Center of Wacker Drive (its current location), boasting a 70,000-square-foot, 10-story high trading complex - with the largest clear-span, column-free trading arena of any futures exchange in the world'.

Tamarkin, 1993, p. 290

In addition, the spatial configuration of the trading post and the trading pit also aimed to support the flow of information. The rising steps around the perimeter of the trading pit, for example, allowed brokers to better observe both the traders at the centre of the pit and the clerks at the elevated order desks along the perimeter of the trading floor, creating a high degree of visual transparency and hence, better communication across the space.

Visual transparency between trading pits or trading posts of related traded products was considered another important issue. At the Chicago Mercantile Exchanges, for example, the S&P 500⁵ futures trading pit used to be in close physical proximity to the S&P 500 options trading pit allowing market participants to overview trading activities in these products simultaneously. Market participants could thereby quickly identify sudden changes in the market, as they were visually and acoustically connected having access to market information from both trading pits.

Furthermore, the column-free space did not only support better communication, but also enabled faster movement across the trading floor. Walking between trading posts or trading pits as well as to order booths, traders would trade more efficiently in terms of circulation space, as speed was critical for trading activities.

5. Trading Rooms ⁶

This section describes modern trading rooms of financial firms in which traders interact with their market counterparts via telephones, electronic systems, or other technological devices. Similarly to the previous chapter, the analysis of the architectural design of these rooms focuses on the interplay between space, communication and technology. Observing a shift from traditional floor trading to advanced electronic trading, this section gives special attention to the role of face-to-face communication and physical proximity of traders in trading rooms.

5.a. Typologies of trading rooms

Trading rooms are predominantly open space workplaces. One can distinguish between four main typologies: the 'football field', the 'square donut', the 'flowing bend' and the 'theatre' (Tsen 2008). These typologies differ in their spatial configuration and design, mainly according to the positioning of service cores and support spaces in relation to the main trading desk area [Figure 3]. Some trading room typologies refer to configurations from traditional trading floors.

Football fields describe a continuous trading area with service cores such as elevator, stairs and technical infrastructure as well as support spaces such as meeting rooms and service rooms located along the perimeter. Square donuts are double height spaces with two trading areas stacked on top of each other and connected with a central void. The flowing bend refers to a trading area in which service cores and support spaces are placed inside the overall space. This arrangement creates an H-, L- or U-shaped trading area that is partially fragmented. Finally, theatres describe trading areas, which step up towards the edges of the space. In this typology, service cores and support spaces are located along the perimeter of the trading area.

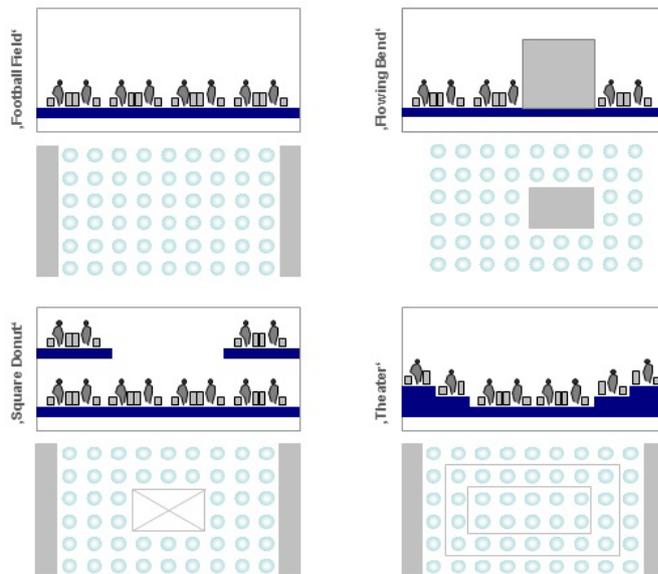


Figure 3: Typologies of trading rooms.

5.b. The dynamics of trading activities

Viewing the market involves observing multiple sources of information. Via their screens traders have access to market information worldwide such as real-time prices, orders, news and other trading resources making the market highly transparent. The abundance of market information is both a chance and a challenge, as all the data needs to be carefully analysed, evaluated and managed.

Trading activities as knowledge work depend on a close collaboration between many different actors in the trading room including traders, sales people, financial engineers, IT developers and IT operations among others. For example, an interviewee described:

'The things that we found that work best in our firm, [...] is when you have close collaboration between an experienced trader that's learnt how to work in the electronic markets and that's learnt the methods and makes money, and then to use IT and some financial engineering to try to exploit that [...]'.

Interviewee PTF 03 in Tsen (forthcoming)

Trading activities are, therefore, typically organized in teams. Traders represent, thereby, the interface to the market developing trading ideas, placing and executing trades as well as managing existing trading position. Sales people interact closely with clients providing sales recommendation and selling trading product. Financial engineers develop financial models for trading ideas usually intermediating between traders and IT developers. IT developers are responsible for transforming individual trading ideas and trading models into actual trading tools and applications. In contrast, IT operations are in charge for maintaining the overall computer system.

Within trading teams there is a permanent flow of information. Each team member possesses special expertise individually contributing to the complex trading process. Depending on each other's skills and experiences, trading teams form an interdisciplinary entity. Because of the extreme speed of trading activities, the mode of communication within trading teams is mostly brief, precise and highly ritualised. Although the atmosphere in trading rooms is usually informal, trading conversations between team members usually follow strict codes and processes.

Because of the interdependency of many financial products, communication between trading teams is also a key factor of trading activities. Being aware of activities and changes in interrelated financial products is important for the evaluation of own trading positions. Because of the quantity of market information available, however, the flow of information is difficult to be monitored and filtered. As Simon remarked: 'People possess limited cognitive ability and so can exercise only "bounded rationality" when making decision in complex, uncertain situation [...]. Hence, a wealth of information creates a poverty of attention' (Simon, 1971: 40). For this reason, trading teams need to collaborate closely with each other in order to identify and alert each other of critical market information.

In the trading room, the exchange of critical market information is communicated both explicitly and implicitly. Explicitly, this exchange involves formal electronic communication media and face-to-face interaction in which one trading team informs other trading teams of important news and information. In addition, critical information and alerts are also implicitly disseminated, simply by increasing activity and noise from certain trading desks in the trading room, as trading teams manage their trading positions. As with traditional trading floors, trading teams in trading rooms also profit from social and ambient information.

5.c. The technological setup

The rise of technology liberated traders from the trading floor, but did not make them mobile. Working in one of the most technology-intensive knowledge industries, traders depend on high-performance technological infrastructure in order to connect to the financial market. This has a physical dimension. Not only servers and processing units, but also monitor screens form critical devices of the trading room. Especially, co-location is critical, as traders need to permanently monitor the market, and hence, being aware of market activities. In addition, the connectivity to their clients drives the dynamics in the trading room. For example, an interviewee explained:

'Very rarely do people get out of their position because of the way technology is set up, for example, phones. If your customers have direct lines back to you, you kind of want to be there to answer as quickly as you can. You don't typically see people congregating unless it is an absolute necessity or a slow point in the market. Certainly, there is no meeting agenda. If you will, there is no scheduled meeting that people go to. I would say that typically a sales person or a trader would be at their desk, at their station with their headset on probably 80% if not more for the whole day'.

Interviewee B 03 in Tsen (2008)

5.d. Spatial configuration

In order to manage the flow of information in trading firms fast and effectively, trading rooms are required to possess a high degree of transparency. Two aspects need to be considered here:

Firstly, on the architectural level, the trading room typology is critical in order to provide good sightlines and high acoustic transparency. Seeing and hearing within and across trading teams is key factor for the time-critical knowledge work. Depending on the typology of the trading room and the layout of the building structure, the degree of visual transparency can vary strongly influencing the flow of information in the trading room. An interviewee remarked:

'We need to figure out how our businesses sit based on the columns and the shape of the floor plan, and people fight like 'I am not sitting around the bend' or 'I am not sitting by this column because I cannot see four traders' and stuff like that. It is always a challenge'.

Interviewee B 04 in Tsen (2008)

Secondly, on the technological level, the use and spatial configuration of screens is of great importance. These form the 'window to the world', but simultaneously act as barriers in the trading room inhibiting the sightlines to other traders or trading teams. As traders frequently use several numbers of monitor screens, the arrangement of these screens next to each other and on top of each other matters largely with regards to visual transparency [Figure 4]. Therefore, the spatial configuration does not only include built elements such as walls and columns, but also technical devices such as screens. The following description was made by an interviewee:

'It was eight people on one side of the desk and then eight people on the other side, and they were supposed to work together, traders and sales people but the problem is everybody's got monitors up, and a lot of time you got double headed or quadruple headed monitors, two sideways and two up. Then you try to talk through a monitor or above it or whatever. It's a disaster'.

Interviewee PTF 07 in Tsen (2008)



Figure 4: Example of a typical monitor screen layout.

For this reason, seating orientation is considered as another critical aspect of transparency in trading rooms. In the interviews and survey conducted in the research, respondents considered seating orientations for members of one trading team sitting side-by-side as equally positive as seating orientations facing each other. In contrast, seating orientations in which traders and their team members sat back-to-back and hence, could not see each other were negatively evaluated. As traders and sales people often communicate via visual signals in busy situations, seating orientation needs to be carefully planned.

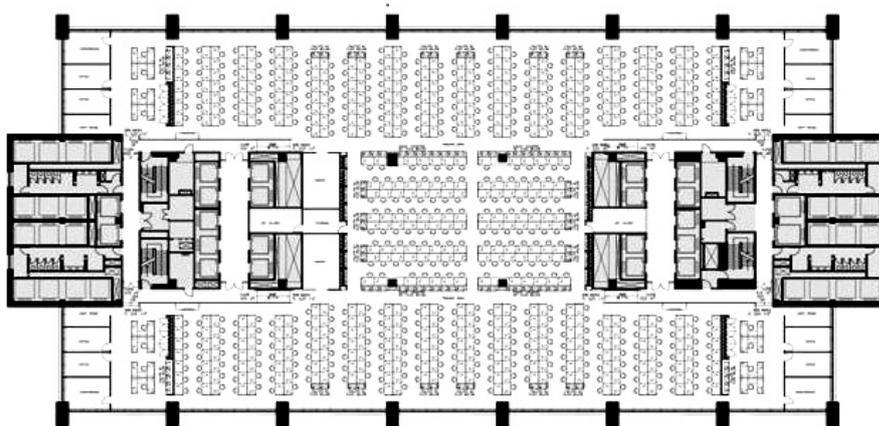


Figure 5: Example of typical trading room.

In addition, a high density of trading desks was deemed important for transparency. Verbal communication was easier to be conducted in denser furniture arrangements, especially in the case of confidential information, reducing the need to shout across space. Furthermore, the denser the trading

desk layout was, the more actors were located in close proximity to each other [Figure 5]. This enabled fast visual and acoustic communication with a large number of different people in the trading room. An unpublished study comparing seven trading rooms built between 1995 and 2004 in New York and London, which was conducted for a global investment bank, indicates that the net area per trader ranges from a minimum of 7.4 m² to a maximum of 9.9 m² (Gensler, n.d). Based on this sample, the average net area per trader is 8.5 m². As a comparison, the British Council for Offices (BCO, 2009) in 2005 recommends that the net area per person for commercial office spaces should be 12-17 m².⁷

To summarise, trading rooms need to act as seismographs. Their architecture and spatial design has to support and enhance awareness of activities and changes in the financial market, enabling market participants to identify critical events quickly. An interviewee explained:

'What is very important is to be aware of events, although I do not know exactly what has happened. The same here - we have a relatively large floor with many sections - if suddenly something happens in FX, suddenly it gets loud and the people ask 'what is going on?' and hence, it is like a snowball effect. It then goes very quickly, and if only everybody looks at Reuters to see what is going on. [...] Simply because something happens, somewhere it gets loud, everybody looks up and look at their screens or something, without knowing, what has actually happened. That is a very important point'.

Interviewee B13 in Tsen (2008)

Trading opportunities in the financial market can change very fast. Financial firms such as banks, therefore, needed to be able to reorganize their trading rooms very fast. Enlarging and reducing the size of existing trading teams or setting up new trading teams required a high degree of flexibility of trading rooms, a factor that needs to be carefully considered from the beginning of the planning process.

Consideration should be given to the typology of the trading room, the basic layout of the building structure and its partitions as well as the type of trading desks used. As indicated above, visual transparency is considered highly critical for trading activities and this should also be ensured with changing trading team set-ups. The characteristics of the trading room should remain relatively constant in terms of visual and acoustic transparency.

6. Conclusion

Trading floors and trading rooms are two different spatial settings for trading activities. In the case of trading floors market participants are centralised at one physical place, while in trading rooms they are connected via their screens or other technological devices, creating a global network without physical boundaries.

As previously shown, trading activities on trading floors depend on the people and their physical interaction, as face-to-face communication is the main source of information for assessing market situations and making trading decisions. The architectural design of trading floors, therefore, needs to maximize spatial transparency across the physical trading space allowing fast communication. Good sightlines and acoustics, thereby, are important design considerations for the creation of an effective trading environment.

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In contrast, trading activities in trading rooms are driven by dual sources of information obtained via face-to-face communication on the one hand, and via face-to-screen communication, on the other. Viewing the market involves continuously observing and evaluating electronic, visual and verbal market information. Traders can observe and engage in market activities via their screens, but organisational and social dynamics in their own trading room are equally important for their decision-making process. As shown in the analysis, technology makes trading activities faster and more efficient, but also more sensitive requiring intense monitoring, maintenance and collaboration. In other words, technology enables efficient communication with remote trading partners worldwide, but only physical space and physical proximity can facilitate close communication on complex issues within and across teams in the trading room. In addition to the numbers on the screen, collaboration between different disciplines and products is essential to manage trading positions effectively. Ideally, these two scales of communication, face-to-face and face-to screen, should work as one entity uniting the individual values and contributions of people with technological media.

The dual nature of communication creates a major challenge for the architectural design of trading rooms. As the findings suggest, modern trading activities are strongly driven by state-of-the-art technology allowing traders to interact from remote places. The technological connection to the market is reflected in the large number of screens, which extensively occupy the trading room. At the same time, face-to-face communication within and across trading teams demands a high degree of spatial transparency. In the trading room, however, places with high technological connection, i.e. trading desks with a high concentration of screens, are not necessarily places that enable high levels of spatial transparency, and vice versa. Screens create a window to the market providing important electronic information, but also act as visual barriers.

In addition, collaboration includes not only conversations at the trading desk, but also more informal exchanges and discussions away from the trading desk, via face-to-face communication. This can take place, for example, at meeting rooms, enclosed offices or coffee points. Even if the

technological connection to the market at these places is weaker than that in trading rooms, the physical space can ideally expose and foster awareness of electronic market information and news, by creating a high degree of visual and acoustic transparency.

The architectural design of trading rooms, therefore, needs to consider both face-to-face and face-to-screen communication. A detailed analysis of the spatial configuration of trading rooms including the position of walls, columns, technological devices such as screens and other machines and the overall furniture layout is crucial in order to create an effective trading environment. The interplay between space, communication and technology needs to be carefully considered and taken into account when conceptualising, designing and planning these spaces.

Further research on the physical arrangement of trading rooms can provide a more detailed analysis of these dimensions and their reciprocal influence. The space syntax method is a valuable approach in analysing the overall spatial configuration of these layouts, taking into account the ways in which walls, columns and screens act as visual barriers. It can help to address various research questions that can contribute to a better understanding of trading room design and a better use of spatial resources. For example, an interesting research question concerns the systematic analysis of the four main typologies of trading rooms in terms of their basic spatial 'suitability'. This analysis would require an integration of the vertical spatial dimension for the 'square donut' and 'theatre' trading room typologies. Furthermore, as there are high spatial constraints of trading rooms in terms of visual transparency and high density of trading desks, another research question may examine if different examples of existing trading rooms in the financial industry have similar spatial configurations. Finally, many trading room spaces are accommodated in buildings, which have been originally developed for general office spaces and not for the specialized use of trading. Modelling different layout variations including a visual graph analysis, for example, can help financial firms make better design decisions, which are both effective and economic.

In summary, trading activities form a unique case for today's knowledge work, being highly collaborative, global, technology-intensive and time-sensitive. Looking at trading rooms as examples of workplaces in knowledge industries that are technology-intensive this paper can contribute to a better understanding of the spatial configuration of socio-technical structures. Current research in workplace studies, predominantly focuses on the importance of face-to-face communication and the necessary formal and informal spaces related to it. However, as the analysis of trading rooms shows, the architectural design of new workplaces needs to consider both face-to-face communication and face-to-screen communication as one entity in order to inform the design of effective work environments. Face-to-screen communication is not solely a task for IT departments but needs to be also carefully considered and spatially designed by architects, interior designers and workplace consultants.

8. Notes

- ¹The doctoral thesis consists of four major parts. In the first part the analytical framework and terminologies of financial markets are defined. The second part gives an historical overview on the transformation of trading spaces and investigates the spatial dimension of trading floors. In the main part of the thesis an empirical analysis is conducted using two types of trading rooms as examples: banks and proprietary trading firms. In the final part, lessons learned from the trading rooms are discussed in a broader context. The research for the doctoral dissertation, was supported by the Deutsche Forschungsgesellschaft (German Research Foundation). It was conducted at the Faculty of Architecture, Technische Universität Dresden, Germany from 2005 to 2008, and will be published under the title "Knowledge Spaces of Financial Markets: The Architecture of Trading Rooms" at Tectum Verlag, Marburg.
- ² For a detailed description and analysis of the architecture of the Antwerp Exchange see Meseure (1987).
- ³ All interviewees of the conducted research were assigned with an anonymous code. 'PTF' refers to interviewees from proprietary trading firms and 'B' to interviewees from banks. This coding is used for all direct quotes from interviewees referred to in this paper.
- ⁴ The Board Room was the trading floor for bond and stocks. (New York Stock Exchange, 1919, p. 3).
- ⁵ S&P 500 is an index which is traded in the USA based on five hundred large cap stocks. The index was introduced by Standard & Poor. Futures and options are both derivatives instruments.
- ⁶ The following chapter focuses on trading rooms of banks. In the author's doctoral dissertation thesis, trading rooms of both bank and proprietary trading firms are examined (Tsen, 2008).
- ⁷ A more recent BCO publication from 2009 has decreased the recommended density to 8-13 m² per person.

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