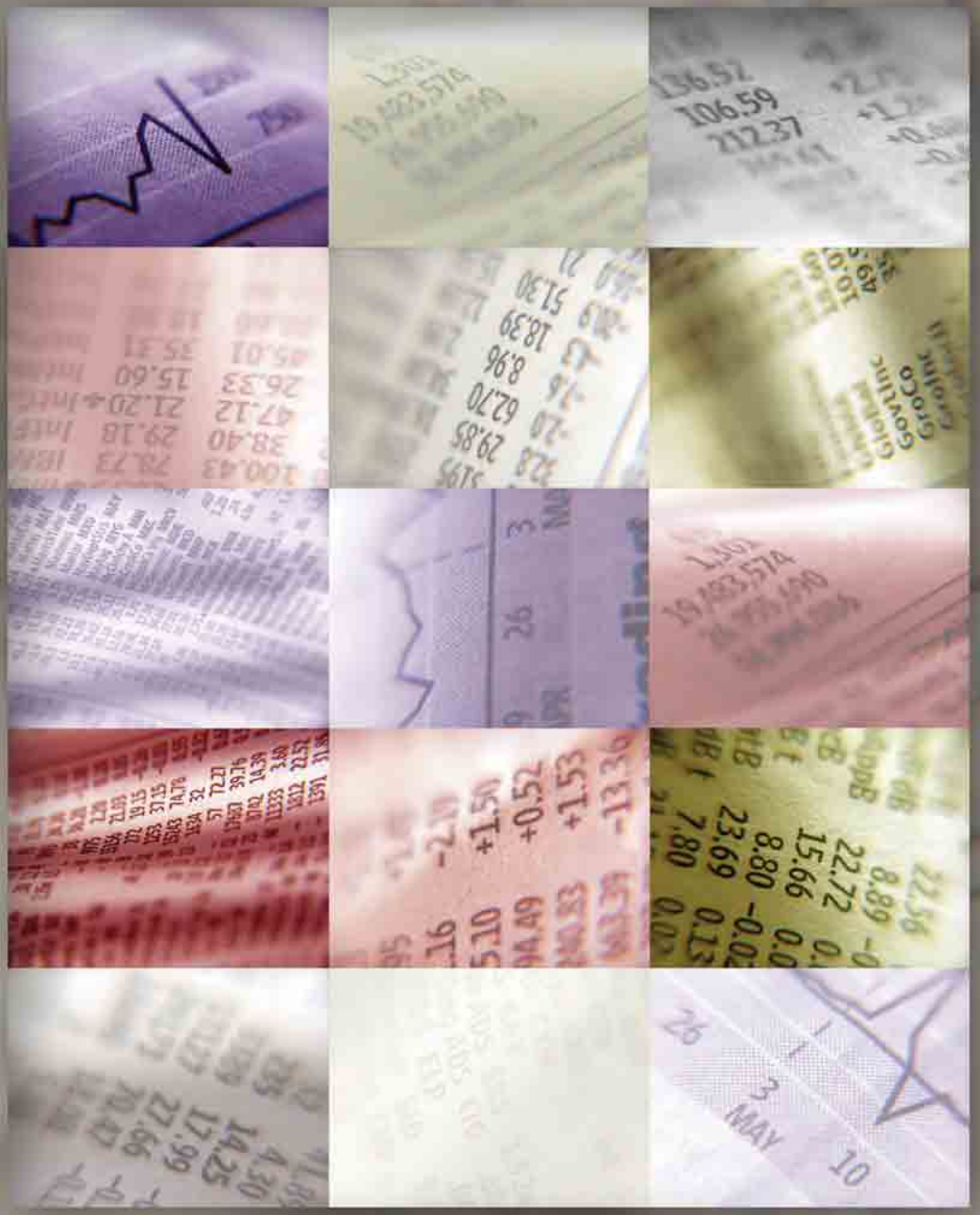
Trading System Complexity: Keeping the Trader in Control



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Financial and energy traders live in a world of data in which information systems support complex, risky, time-critical decisions. The easier that information is to access and understand, the better their trading performance. Contemporary thinking in interaction design has a great deal to offer the fast-paced, complex and seemingly abstract worlds of financial and energy trading. Accuracy, speed of decision making, and the maintenance of a broad and up-to-the-minute view of trading conditions are performance-critical factors that can be enhanced through a trader-centered redesign of the trading system interface.

Transforming the trader from a trading system bottleneck to the most capable system is necessary if new trading technology is to be introduced that consolidates rather than replaces the trader's role at the center of the trading system. Recognizing that the trader is a member of a collaborating team rather than a heroic loner is a key first step towards this goal. Identifying what traders need to stay on top of changing market conditions; to stay abreast of the status of their book; to manage and hedge risk; track flow, interpret counter-party behaviors, understand changes in price, and search for information to inform a view—are also important steps in the redesign of trading systems.

This article describes the findings of two recent, complementary studies in the financial and energy trading world. They have been chosen because they emphasize the differing interaction design challenges confronting trading system design.

In conclusion the paper points toward opportunities for a fundamental rethinking of the interaction design of future trading systems. There is little research linking trader cognition or behavior to the technologies that traders use to achieve their objectives; this paper describes work that begins to bridge this gap.

Current Trading Systems

Energy and financial trading systems are examples of complex socio-technical systems that are risk and performance-critical. They tend to be technology-centered designs uninformed by the philosophy or practice of user-centered design.

Investment in trading systems development often emphasizes back-end technology enhancements aimed at increasing system speed, delivering more real time data, and handling more products. In practice, trader-interface development tends to focus on patching existing systems; however, these measures may or may not actually

enhance trader effectiveness.

Frequently powerful, but not necessarily usable, high technology systems are often found alongside useful, home-grown low technology systems. Workarounds are prolific and in many trading systems an Excel spreadsheet serves as the traders official or unofficial scratch-pad. Although versatile, spreadsheets can become unwieldy and difficult to navigate, and seem over-stretched, covering widening gaps in trader support.

In fact, the fundamental understanding and insight that interaction design specialists recognize as critical to design is largely missing in the trading world. An effective understanding of how traders really work—their practices and work flow, workarounds and shortcuts, decision and information requirements, mental models, objectives, tools, strategies, functions, interaction issues, bottlenecks, priorities, redundancies and team collaboration—is lacking or simply doesn't exist. Even the physical designs of many of the interfaces found in financial—and particularly energy trading—do not comply with the most basic ergonomic principles of consistency, simplicity or functional grouping.

Financial and energy trading are becoming faster and more competitive. Banks and energy companies are seeking to reduce the number of traders while increasing the volume and profitability of trades. Traders—particularly financial traders—can be found working at capacity, providing the "glue" in systems that may not have been designed for the purpose for which they are being put to use. The solution that seems "obvious" is to automate many of the traders' functions and tasks. But although the attendant risks in doing so are well-known to the interaction design community, to the trading community they are largely invisible. Already, and with only limited automation implementation, many of the problems that characterized the rush-to-automation seen in the aerospace field are emerging in the trading field. Over-reliance and complacency, clumsy and uncommunicative designs, reduced trading team coordination, skill degradation, role fragmentation, and degraded situation awareness, [2] all contribute to emerging and somewhat ironic automation solutions.

The challenge for the interaction design community is to communicate the message to the trading world that good design is user-centered and can enhance trading productivity and competitiveness. That trading companies can benefit from the work that has been undertaken in other fields, and that improvements grounded in an understanding of traders working practices that support traders workflow and decision-making are likely to deliver a better return on investment than visually attractive graphical displays or wholesale automation.

The Trading Environment

The typical modern electronic trading floor of a major investment bank or energy company appears as a large, noisy indoor high technology park, where predominantly young men and women monitor and occasionally interact with three or more screens mounted on their desktops, chat on the phone or in pairs, and watch news-based programs on overhead TVs or overhead information displays. Noise and activity may increase in localized areas around the room, voices may occasionally be raised.

In fact trading rooms comprise many groups or teams of individuals trading different products in different markets. Teams will specialize in a type of product, such as bonds, equities, warrants, etc. Each team typically constitutes a head trader, a group of traders of varying experience, and a few novices who probably don't look relaxed

and are likely to be buried in their screens.

The Trading Culture

The head traders are typically responsible for the profit and loss (P&L) of their team. They may have selected the team, influenced the technologies used and the products traded, and decided on trade and hedging strategies as well as other things. Each trader has a book of products that is used for trading, and typically, at the end of the day, each book is summarized to establish the P&L from the day's trading. The head traders' views carry a lot of weight; their personality influences the way the team works and affects the teams' culture. In thinking about system re-design, the head traders' view is important but as in other fields, the trading system should be designed to support all users. Given the sometimes autocratic influence of the head trader, ensuring that many voices are heard can require some negotiation.

Myth has it that the trader is a lone decision maker heroically mastering technology (in spite of the design) to do battle with the market. But this is generally not the way that traders see it themselves and there is widespread frustration expressed with the existing technologies. IT departments are typically inundated with requests to upgrade and patch systems (that were not developed with the traders needs in mind.) Traders cycle between independent working and team working, they monitor each other's desks, share information, interpret the noise of the trading floor, work with distributed team-members over the phone and watch broadcast news and other shared information sources. Shortcuts and home-grown assistive technologies abound. Indeed, there is a great deal of personal initiative, and a fair amount of team support, but there is little support from the tools that traders actually use. For the experienced trader, working with the technology can interfere with achieving objectives; for the novice, learning the system and the job is an even greater problem.

Figure 1: A view of a trader's spread sheet "book" illustrating approximately 1600 cells of numerical information. In fact this book contains over 40,000 cells.

Figure 2: Part of a trading floor.

Relevant Work

Findings in the fields of behavioral finance and interaction design are relevant to the design of trading systems. Whereas economists typically describe human economic behavior in terms of rational, logic-driven strategies, recent work by psychologists in the field of economics has turned this thinking on its head by introducing the notion that humans do not always exhibit logical or rational behaviors. Some of this work has proceeded "in the wild," much in the tradition of Klein's [7] naturalistic-decision making work; others (such as Daniel Kahneman [5]) have pursued their work in the laboratory. In spite of these methodological differences, a body of work has emerged, emphasizing the crucial importance of context in financial decision making, demonstrating that people have a limited ability to manage multiple information variables in decisions and tend to rely on heuristics (or cognitive short-cuts). They form views on "gut feel" and have a tendency to "jump" at patterns

they recognize and implement solutions that have previously proved successful.

In the interaction design community, work continues to broaden the scope through which we understand the evolving relationships between people and complex, digital systems. Several studies, including Rasmussen [11], Vicente [12], Woods [14], Hutchins [4], and Klein [6] have convincingly demonstrated the value of engaging with the real world of work as a primary means of understanding human behavior within it. Others such as Billings [1] and Weiner [13] have helped introduce concepts that are useful in understanding facets of human-technology interaction.

CASE STUDY 1

Our first case study describes an initiative to apply user-centered principles to re-conceptualize and design the front end of a warrant trading platform. Business drivers for this initiative were the awareness that a more powerful backend would push up the traders' workload. In addition management wanted to reduce the number of traders while increasing the trade of complex products. Finally, there was a general dissatisfaction with the existing trading interface.

Approach: We adopted a field study methodology which drew upon the tradition of ethnographic methods [10] in that we interviewed and observed traders in their work setting and became familiar with warrant trading and the context in which it was undertaken. Our particular focus was the cognitive and collaborative processes of trading.

We sought to understand the experience of trading equity warrants from the perspective of the traders, paying particular attention to identifying their objectives, the strategies they used to achieve these in the current system, the heuristics used, the assumptions made about trading (see Figure 3), decision points, and the factors that affected trading performance.

To do this we became familiar with the language, practices and technologies that traders used. We also sought traders' pain points, drawing a distinction between those issues linked to poor surface design of the user-interface and those associated with deeper factors. In this sense we took a work-domain analytic, rather than a task analytic approach. [12]

We used a participatory design methodology [8], encouraging traders to become involved in the design process and work with us using prototypes of varying maturity, ranging from sketches and illustrations to dynamic Visual Basic mock-ups. This approach reflects our view that this is the most effective and rapid means of producing effective designs. Participation also reduces the risk of negative organizational outcomes, enhances traceability (and accountability), and increases the probability of adoption.

Product: It is useful to have some understanding of the complexity of the product being traded to better understand the nature of the traders' work. Warrants are financial derivatives—financial products whose value is contingent on another financial instrument or "underlying" (that is often a share). The main categories of derivatives are futures, forwards, and options. Warrants are "forward transactions" in that they are based upon a transaction which will only be executed in the future. Warrants are a special case, in that they have a life-span and expire usually after a year. They are valued differently according to where they are in their lifespan.

The buyer of a warrant makes a bet on the underlying share's future performance—the warrant characterizes this bet. At any given point in the life of the warrant, the performance of the underlying share

may be in line with—or better than—the bet, in which case the warrant holder is described as respectively "on the money" or "in the money"—if the share is trending the other way, the warrant holder is "out of the money."

Warrant traders issue warrants onto the market at a certain price and a certain volume. They are products issued by a bank that can, in principle, be linked to any underlying share. Some warrants are based on the view that an underlying share will go up (calls); others are based on the view that an underlying share will go down (puts). It follows that in this way a profit can be made on a falling as well as a rising market.

Warrant traders have many warrants in their charge—this is their "book." Warrant traders may continually adjust the "buy" and "sell" price of the warrants in their book. They try to encourage a high volume of trades (lots of buying and selling) and they are careful not to let clients take advantage of them by exploiting loopholes in their published prices.

Findings & Design

Structure of the traders' work: Initially we sought to identify the structure of the traders' work, what they did, when they did it and with what. We found that although not described as such, the traders were, in effect, managing four interlinked functions. Identifying this helped us better understand what traders were actually doing, where roles overlapped and how to start defining traders' information requirements and workflow.

We found that a day in the life of a warrant trader follows rhythms that are largely dictated by market opening and closing times and events that occur between these points. Before the markets open, traders gather information about the markets they are about to enter, noting information concerning predictable events that will take place during the day and updating themselves about recent events that may have occurred since the last trading period or reviewing previous events. They work with the information displayed on their desktop screens to check the state of their book, making sure it is up to date and trade worthy—in other words, that it is being fed by the correct information, that prices of warrants will be attractive to the desired customers and invulnerable to the less desirable. They check a range of information sources to ensure that they are well placed to anticipate and respond to the day's trading events and then wait for the market to open and trading to begin. This aspect of the job is similar to developing and filing a flight plan in aeronautics.

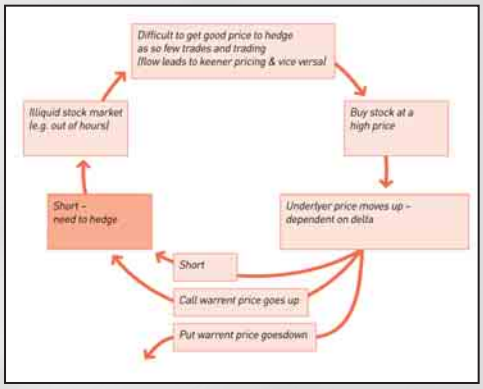

Figure 3: Heuristic illustrating the dilemma of trading in an illiquid market.

Housekeeping and staying "on top": After the markets open, the trader's priority shifts to staying on top of the information that is changing in real time. The trader's book must remain healthy (attractive, but invulnerable) and up-to-date, reflecting the outside world developments that may have a bearing on these factors. The trader is equipped with a range of information resources and tools that are used to understand and evaluate what has happened or is happening, but most importantly, what might happen. During these phases of activity the traders housekeep: They tidy-up,

Figure 4: The trader's management functions.

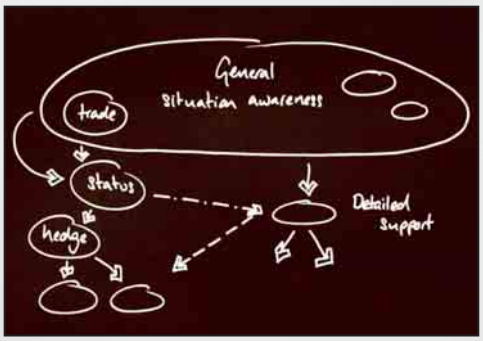

Figure 5: High level, shareable information model.

review, check, and update their books; they talk to colleagues, sample news and information feeds, read e-mail, and explore financial data to ensure they are up-to-date, and have a grasp on what may be "around the corner." As with so many elements of trading, [0]as well as other complex systems, "forming a view," "having a hunch," or "gaining a strong feeling" is integral to decision making.

It became apparent that often precise numeric values were less important than patterns and trends in trading. Traders appear to seek patterns in the market to overcome the complexity and apparent chaotic nature of information. Decisions are linked to past experience with trading patterns and are good examples of recognition-primed decision making [6]. Needless to say novice traders do not have this advantage. This pattern seeking was not aided by the form of the book that the traders in this study used. Instead, they used an Excel spreadsheet with over 40,000 cells of information. We found several problems associated with this system, for example:

- Discrete information was widely dispersed and trade relevant information was often out of view.
- Excessive amount of time was spent scrolling and mouse-clicking to get to the required information.
- Deficient design buried details and caused navigation problems, resulting in traders sacrificing the broad picture when searching for specifics.
- Overall information organization was not driven by usage but by application design.

It was important that the solution was not characterized by these problems and we specified a set of high-level design principles as project success criteria, these included:

- Awareness should be supported by at-a-glance sampling
- Drilling down to more granular information should be easy
- Information and fields should be connected according to usage requirements

Turning Understanding into Design

We identified that much of the traders' cognitive work builds situation awareness [2] or a high level view of the information ele-

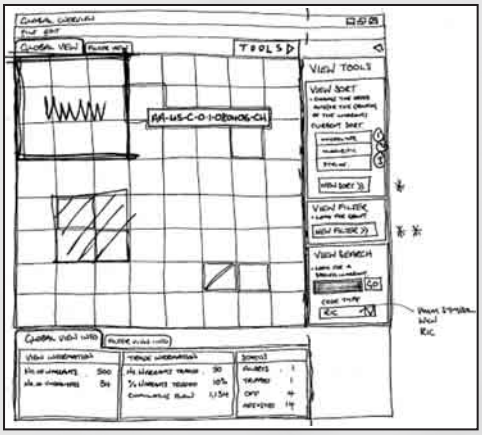

Figure 6: Conceptual, sharable interface prototype.

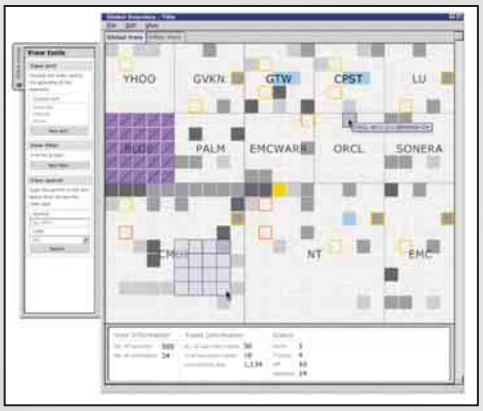

Figure 7: Mature interface design prototype.

ments needed to stay on top and anticipate and cope with events. We observed that traders searched their books to find trading patterns that allowed them to maintain situation awareness about the health of their book. We also noted that they had trouble navigating through their spreadsheets to do this. We observed that there were a finite set of questions to which traders sought answers and that what they really wanted to know was whether the book was trading well and whether they needed to take action.

We represented these findings as text-based "information" models (see Figure 5) that we validated with traders. These models described sequences of events and linked them to decisions and actions. Recognizing the way that traders worked to achieve these objectives allowed us to identify a requirement for a primary information display that would provide a platform for the traders' global situation awareness of key warrant and trade parameters. This should be simple and compelling and of sufficient versatility to provide traders with the information traders need in a form that could be interpreted at a glance. This was necessary as we knew that traders would be expected to take on new roles when the system was launched and that our solution shouldn't require their full attention.

This display also had to provide a platform from which traders could launch summary or detailed evaluations of their warrant book and help them manage events and drill down to explore information.

We incrementally evolved our understanding of the traders' information requirements, through working with traders and using information models and sketches. From informal, high-level, sketched information models we worked with traders to validate more formal informational representations that reinforced early conceptual, functional designs. We identified the information that traders needed for a summary view of the book, and then addressed the dimensionality of that information (such as how many dimensions of information were necessary for traders' total awareness.) After iterative testing and verification a shortlist of information requirements emerged. From this we developed a candidate representational form to support this information (see Figure 6).

By modifying the traders' information

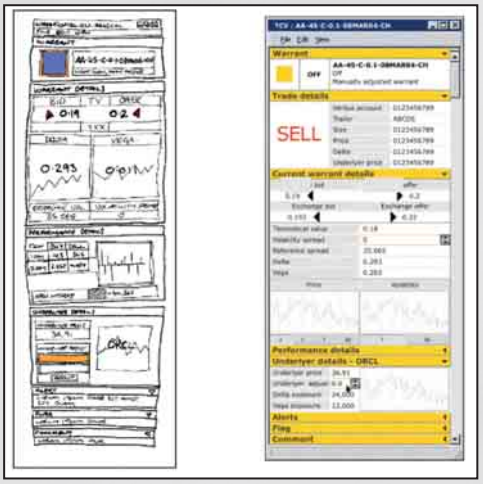

Figure 8: Conceptual and mature interface prototypes.

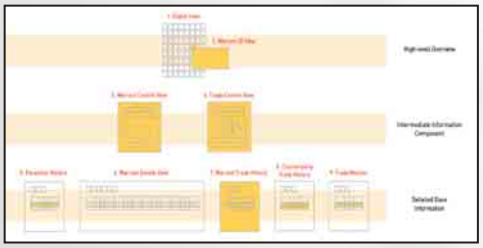

Figure 9: The structure of the traders interface suite.

source we were able to develop the representational form for a warrant from a spread sheet line item covering 80 columns to a single square cell with five different coding dimensions using color and line orientation (see earlier example). We used a color-coding schema already in use with the trading team, concluding after negotiation with the client, that the building on the familiar outweighed the risks of usage by color-blind traders. We also developed a set of interaction design principles.

A particular advantage of the summary display was that it allowed traders to see patterns and trends in trading that were previously unavailable to them. As the display changed throughout the day, sudden and subtle changes to their book become apparent.

Managing Events

Events can interrupt the traders housekeeping activities. Events may be benign or hostile trades and traders must be alert to apparent hostile trades as soon after they occur. If there is a risk of arbitrage they need to be able to rapidly form a view about the trade and if necessary act tactically.

Tactical Behavior: The speed with which traders can manage events depends on the ability to interpret an event, understand why it happened, and work out what to do. (These are similar to the category of automation surprises reported by Weiner and Curry [13].) Recognizing the way traders worked enabled us to identify a requirement for a secondary set of tactical information displays that could provide event-linked information in a form that the trader could rapidly assimilate.

Working with traders we developed information models that specified the information traders need in these circumstances. Through validation we developed interface prototypes of increasing maturity. These evolved to form an alert-based pop-up GUI that would be triggered by a set of parameters such as the trading activity of a given competitor or trades above a critical size (see Figure 8).

Strategic Behavior: Traders also need to keep an eye on the detail in their books and seek specific information on single or groups of warrants to assess whether they need to make adjustments such as price and quantity. Doing this was a difficult task using a spreadsheet-based system. This activity is more than housekeeping; it's a

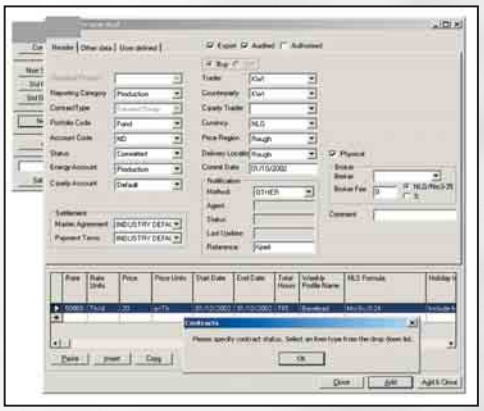

Figure 10: An example of a technology-centered deal entry interface.

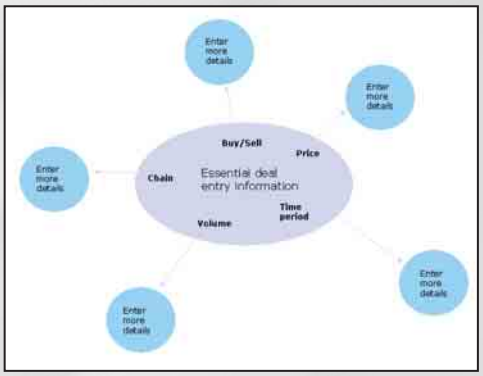

Figure 11: Primary information requirements for deal entry.

strategic information-gathering activity informed by trading patterns. To support it, a selectable GUI solution was designed with a different information structure than the tactical display.

Data Mining Requirements: Finally, a requirement to drill deep into information detail emerged from the recognition that traders needed detailed information to support the development of a flexible view. These requirements stemmed broadly from the traders' need for historical information—how the warrants in a book had previously traded and how they compared in current circumstances.

Outcome

This work allowed us to understand the information that traders need at the different activity stages in the trade process and the different ways in which they worked with the information. We developed a device independent description of information flow. We identified opportunities to combine data and present this as information in completely novel, readily assimilable ways. We designed a means of showing patterns of information that supported rapid understanding of trading performance and tactical and strategic decision-making. Complexity was reduced and transparency increased. The trading team members were supportive of the final design, no doubt in part because they had participated in both its definition and design. Combined, the summary view, strategic view, tactical event view and data mining views constituted a comprehensive trading suite that afforded the trader a flexible means of achieving their objectives without navigating through pages of information (see Figure 9).

CASE STUDY 2

Energy Derivatives: Our second case study describes an initiative to apply user-centered principles to re-conceptualize and design the "forwards" deal-entry screens for a gas-trading platform. The existing deal entry system was paper-based, slow, and labor-intensive. The key business drivers were to develop a usable and useful electronic interface and interaction schema that would be readily adopted by the traders.

Unlike a financial derivative, gas is a physical commodity and a forward option on gas, at some stage, involves someone getting a great deal of gas. The basics of the energy market are similar to the financial

markets—but the physicality of the commodity, the fact that it has a geographical location and requires transportation, takes up a finite amount of physical space and needs storage, is eventually turned into power (electricity), and is affected by factors such as weather and temperature, make it a wholly different and somewhat more complex trading proposition. Deal entry is the process by which traders capture the fundamentals of a gas deal and enter them into the system. It is the business-critical component of the trading system and the primary record of a human-human transaction. If the record is incorrect or lost so may be the deal (there is a period after the verbal transaction in which the deal must be confirmed electronically). Additionally, Deal Entry is the only means by which a trading company knows its position (in terms of what has been bought and sold) at any given point.

Both financial and commodity markets manage their risk by "hedging" their positions—this means that they invest in secondary products that, to a degree, insulate their exposure to their primary investment going wrong. The amount of risk a company is prepared to take at any given point will determine its hedge strategy. To do this effectively it is critical that a company know its position at any given time, which means knowing how many deals and of what type have been made as close as possible to real time.

Organizational Context: Our challenge was to persuade the incumbent system developer not to attempt to force traders to change their deal entry practices to fit with the current interface solution. Additionally, we identified a number of other risks implicit to the proposed solution:

1. The look and feel of the interface proposed by the system developer did not comply with best practice. For example, information and controls were not functionally grouped, activity flow was not supported, actions were not reversible etc. Although the interface appeared to be a Microsoft Visual Basic (VB) solution, the features were not actually typical VB behaviors.
2. Automation was proposed to save the traders' time. We found that when implemented, these were likely to catch the trader in known automation-traps.

The energy traders with whom we worked used legacy technology systems inherited from the financial trading world. Spreadsheets, paper and other home-made resources were central to their activities. The company intended to digitize these processes to speed up the system and to achieve real time position-keeping. Previous attempts to digitize deal-entry had failed to be adopted by the traders, as the interface and associated tasks had proven too onerous. It is relevant that the failed system interfaces had been imposed on the traders. Traders had resorted to their previous practices using their own processes and resources, which relied upon the support of other members of the team (middle-office staff). Not surprisingly, many traders were resistant to the proposed change and there was a realistic corporate concern that traders would reject the forthcoming deal entry system. Late in this process, UCD was identified as a potential risk mitigation.

Approach: As in the first case study, we hoped to adopt a field study methodology, but found that organizational problems restricted access to the trading floor. Instead we adopted a hybrid approach which combined observation and scenario creation with more structured approaches such as card sorting [9]. We used a participatory approach to design, but were more reliant

on using subject matter experts (ex-traders) for design iteration than we would have preferred. Actual trader participation had to be scheduled into design reviews.

We were fortunate that in this context, deal entry was a tightly defined activity using visible, tangible resources such as books and notes, human mediation (middle-office clerks and traders working together), and trader-evolved processes. This visibility made it relatively easy to understand the way that deals were currently entered even with limited access to the trade floor.

We identified and then collected copies of the resources (for example the deal entry book) used in the current system and identified the other factors in the process. Working with the traders we defined the trader activities before, during and after a deal entry.

We found that in spite of the problematic organizational issues associated with previous designs, the process of deal entry was straightforward. It is perhaps salutary that no previous system design team had actually looked at what traders used or did to make deal entry work. Consequently complex, error prone, multi-page solutions had been developed that traders could not, and would not integrate into their work practice.

Findings & Design

We found that the speed of trading often meant that traders tended to negotiate a deal and immediately afterwards write details of the deal into a shared deal-book. In this book the traders laid out a number of columns, but we noted that traders didn't necessarily complete all of the columns if pressed for time.

We discovered certain redundancies between the columns traders used to reconstruct specific content later in the day by drawing on their knowledge of context and trading patterns. This information defined the primary information elements required to record a deal. We found that the left-right ordering of the columns reflected an implicit understanding of the structure of a deal, and we recognized the importance of maintaining this structure.

The shared affordances of the deal book were such that the traders held a common view of the deals the team had done and had an immediate history of their own (and their teams) trades.

Finally, the business required new information fields be integrated within the deal entry form. As these were unfamiliar information categories for which there was no precedent, we worked with subject matter experts and traders using a series of card sorts both on and off the trading floor. From these we were able to elicit a decision and information flow that we used to structure and integrate the new fields within the information hierarchy we had extracted from our observations of deal-entry book usage.

Turning Understanding into Design

We knew that the structure and affordances of the Deal Entry book provided powerful support to the traders. To encourage trader adoption it was important to replicate the simplicity, flow, and affordances of the book, although additional complexity was inevitable through the addition of new information fields.

Following the card sort, some information could be categorized as key to all trades whereas other was secondary and some of no value.

We decided to follow the basic representational form of a book in our design and using the information flows and structure revealed through card sorting, observation and knowledge of financial trading we pro-

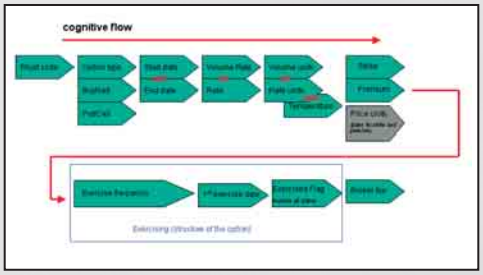

Figure 12: Deal entry information flow requirements elicited through card sorting.

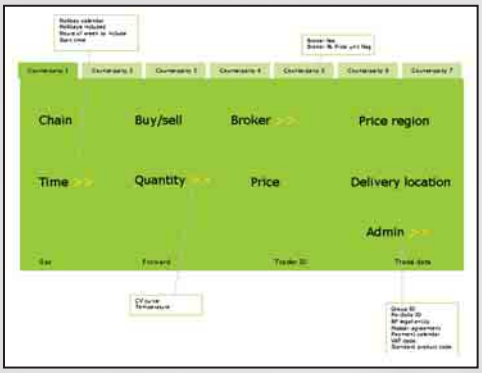

Figure 13: Power-point early sharable-prototype of deal entry information flow and structure.

posed a multi-page solution that used a tab structure based around the counterparty (the other trader). This we tested as a basic power-point prototype of a tabbed page (see Figure 13).

We found that although most of our assumptions were broadly correct, elements of our design interpretation were not correct. This was a useful reminder that although financial and energy concepts can appear similar, contextual nuances can fundamentally change users information (and subsequent design) requirements.

It was difficult to give-up the concept that appeared so appealing to the interaction design team. In fact our confidence in this concept had led to the development of a sophisticated deal-entry screen with literally book-like properties.

The physical appearance of this concept was received enthusiastically by traders but not so by the system developers who declared the design "out of scope."

The concept was retired (see Figure 14) when we realized it didn't meet the traders' information requirements (even if they found it aesthetically pleasing) and exceeded the technology constraints imposed by the system developers. However we maintained the central concept of a booklet.

Working with traders and ex-traders, the interaction design team returned to the basic information flow and structure and rapidly iterated a concept that was "within scope." Through testing we produced a Deal Entry interface that appeared to meet all the traders' information and control requirements, one that they believed would work and, more importantly, that they could be happy with.

We were able to pull through our knowledge of behavioral automation phenomena to ensure that the deal-entry screen comprised only "light" defaulting principles whereby fields were automatically filled. We ensured that these fields visibly communicated their defaulted status through prominent information highlighting that was part of the activity flow of traders. This level of automation is consistent with the principles of management by exception. [1]

In designing the new prototype, we integrated that the following interactive design principles:

- All displayed information is similar in look and feel.

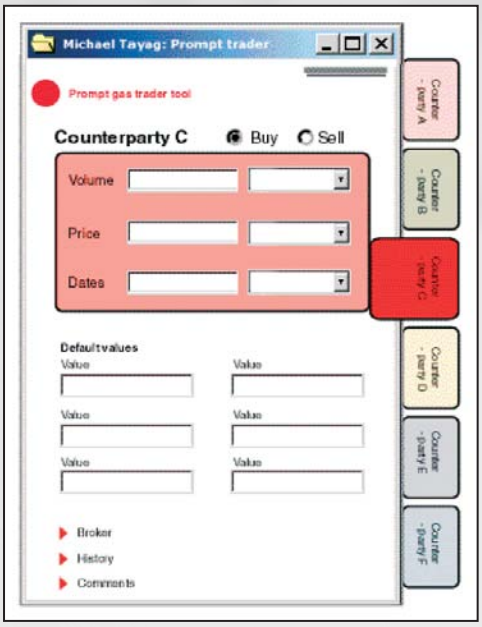

Figure 14: Deal entry interface concept.

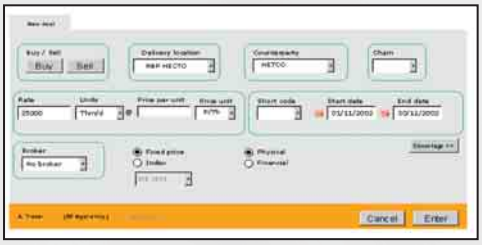

Figure 15: Mature interface design prototype.

- Information is displayed and behaves consistently and information layout is consistent with trader expectations and the way they think and work. Known visual symbols and features exhibit typical behaviors (e.g. menus drop down etc).
- There is a consistent design metaphor. This is of a "booklet" and associated affordances. Traders work from left to right and from the top to the bottom of the screen. "Pages" in the booklet remain in a stable state when they are recalled (as they were when last dismissed) and traders can leaf through the booklet using the 'tab' interface elements that represent the navigation system (not to be confused with the keyboard 'tab' command).
- Information is organized into local, functional groups where possible so that, for example, all information relating to Price is located in the same physical area on the screen.
- All information is accessible, but the most frequently used information fields are most prominent.
- Status is visible. Traders do not have to seek out status information. They can glance at their screens and gather a basic understanding of state.
- Automation status is clearly apparent and can be easily overridden.
- Actions are reversible. The design allows traders to work as they wish; it does not require following prescribed procedures. "Undo" is always possible, except after deal entry.

Outcome

In summary, the first step in the project led to the recognition that the current trader-working practices and resources should be, and could be, supported in the transition of deal entry from a material to digital format. Equally it became apparent that successful introduction of a deal entry system design would be contingent upon the active participation of the trading team within the requirements capture and design development stages.

Due to access restrictions to the trading floor and the reduction in time available to follow a fuller ethnographic approach, the elicitation of basic deal entry information requirements was achieved through the use of structured participatory techniques such as card sorting. At this stage the usefulness of new information fields was evaluated. This generated insights into the relationship

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between information elements and allowed a basic information flow and structure to be established, however it was only through a series of rapid, iterative test and design cycles with the trading team that a final design was achieved.

Integrating basic interaction design principles in the design of the emerging deal-entry screen interface provided a significant improvement in the usability of the system over that of predecessor systems. The participation of the trading team in the final design assured the usefulness of the solution.

Discussion

The trading systems considered in this article were (until this study) largely uninfluenced by the progress made in the field of interaction design. Perhaps this is not surprising when it is considered that the human performance critical areas of aerospace, marine, rail, automotive etc. which have benefited from interaction design input are all areas where there is a clear and direct link between system safety and risk to human life. Consequently interaction design is mandated as a requirement in system design in these fields. However while the risk to life and quality of life in financial and energy trading may be less apparent, it clearly exists. If energy or financial traders make mistakes or leave themselves exposed to risk or can't reach their quotas, individuals or funds stand to lose a great deal of money, energy shortages occur or prices increase. These factors have a significant and material impact upon the quality of individual lives. Today many ordinary people have a great deal invested in the capital and energy markets and transparency and diligence are cornerstones of the market's operations. Unfortunately, many individuals working at the cutting edge of these industries continue to use antiquated front-end designs and technologies that may not even pass the most basic usability test, let alone be considered user-centered.

There is a great deal of knowledge in the interaction design field which should be brought to trading system design. There is a quiet, but relentless pressure to introduce wide-scale automation to trading systems. While the motivation is well intentioned—to allow the trader to supervise trading, to speed up the process, to reduce the decision burden and error—the interaction design community has a great deal of evidence indicating that this is not a path that should be taken lightly or blindly.

All the major topics that have emerged in the interaction design field over the past twenty years exist as real and tractable challenges in the trading field.

These case studies highlight the value of employing an inclusive, participatory approach to design. Traders are viewed as high value resources in trading organizations and can (and do) choose not to adopt systems if they don't like them. Participatory design principles not only produce better designs, but also invaluably buy-in stakeholders in the user community.

In both case studies the final designs did achieve the objectives of simplicity, transparency and concordance with trader working practices. In both cases traders declared themselves satisfied with the design. However among ourselves there was concern that in the second case study (the energy deal-entry screen study) there was some uncertainty about the basic requirements. This concern stemmed from our lack of access to the trading floor during the requirements capture phase. We were specifically concerned that the Deal Entry booklet reflected only the views of the traders involved in the later stages of design. Had a deeper level of contextual inquiry been possible, this may have yield-

ed a more profound information structure than the one created by the traders involved in the final design.

The case studies produced many findings and insights. Those which seem of the greatest value underline the importance of understanding:

- Participatory design enhances the probability of adoption.
- The role of "hunch" and "gut feeling" is central to trading. Informed by patterns of activity, the expert decision-making we observed was highly naturalistic. Designs that support pattern recognition buy advantage.
- Contextual, ethnographic enquiry provides insights into trader requirements definition that can be turned into actionable design solutions. Design processes that can invest in these activities early on may buy advantage in terms of time and value.
- Novice traders are different from expert traders. They don't see patterns and trade as effectively until they learn heuristics which help them interpret the apparent chaos of the market. Initially they have to look at everything until they work out what is important and what is related. Designs which facilitate pattern recognition by delivering this information in a form that can be readily assimilated and will also support novice users.
- Even basic user-centered design principles provide traders a great deal more control than they currently have. This is particularly the case given changing market conditions. There are great opportunities to enhance traders' performance through leveraging the existing knowledge in the interaction design community.
- Delegating agency to automated systems will cause more problems than it resolves unless implemented very carefully and with due regard to the knowledge resident in the interaction design community.

Finally, challenges for the future lie in better understanding the traders' mental models of trading and the way the market works. Expert traders hold a complex set of interlinked heuristics that inform their understanding. This kind of knowledge can be hard to articulate as it is developed through repeated exposure to patterns of instrument and market behavior—and not through verbalization. This knowledge and these patterns are hard to get at, but doing so is a necessary step in designing more sophisticated tools for trading. Some understanding of this detail emerged during these studies, but we anticipate that a far more thorough treatment would yield significant insights into opportunities to develop intelligent decision-aiding tools and discretionary automation that, together with advanced forms of data visualization, may point the way towards the future of trading.

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