TWEETSIGHT: ENHANCING FINANCIAL ANALYSTS’ TWITTER USE

A Thesis in
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by
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ABSTRACT

Social media usage in corporate work environments has increased tremendously in the last few years. Recent studies have explored various purposes which social media serves in these environments. However, research is still limited in understanding how this technology is used in work activities; specially in the sensemaking process. Financial analysts are an important part of this corporate community. They utilize information from heterogeneous sources (for example corporate filings, economic indicators, news, and tweets) to generate unique trade ideas. This thesis seeks to understand the role of social media in their work activity; specifically, sensemaking process.

For this purpose, I conducted a semi-structured interview and identified essential benefits and barriers for the primary social media platform used by the analysts - Twitter. Analysts use Twitter as a query exploration tool, as a bellwether to understand sentiment, and to gauge knock-on effects. However, there are few key problems which prevent an analyst from using Twitter to the fullest potential. Based on these problems, I developed four scenarios to guide the design of TweetSight. In my second study, I evaluated the design of TweetSight by walking analysts through the prototype. Analysts responded positively to anchoring contextual tweets in news articles to facilitate discovery and exploration of Twitter.

My resultant findings and design implications can be applied more broadly in leveraging social media for various work activities, benefiting other corporate communities.
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Chapter 1
Introduction

In the current age of digital connectivity, social media has become one of the significant mediums of communication on the internet. Due to the increase in its importance, the usage of social media is no longer limited to informal activities; it has extended beyond day-to-day exchanges of user generated content to more formal work cultures. Consequently, various research studies have attempted to understand the practices of social media usage in corporate environments (Skeels & Grudin, 2009; van Zoonen, Verhoeven, & Vliegenthart, 2016; Zhao & Rosson, 2009). For instance, Zoonen et al. (2016) observe that work personnel use Twitter for performing field research and sharing ideas with their colleagues. In another study, Ehrlich & Shami (2010) find that working individuals use social media to find specific solutions to work problems and to conduct field research.

With this progress in the general understanding of social media usage in work environments, there is an increasing need to expand this research area. One possible direction is to investigate how specialized work communities use social media in specific work processes, such as in sensemaking activity (often referred to as giving meaning to an experience). The sensemaking process in the field of Human Computer Interaction (HCI) is often defined as the process of forming meaningful representations and using them to facilitate insights and actions (Pirolli & Russell, 2011). For the purpose of my study, I focused on one such specialized community- financial analysts. These personnel are responsible for generating financial reports and providing stock recommendations for buying and selling various financial instruments (L. D. Brown, Call, Clement, & Sharp, 2015). The recommendations made to clients are often provided in the form of unique trade ideas, which are the primary revenue generator for the analysts. In
order to generate these trade ideas, the analysts need to perform the sensemaking process by consuming external information from various sources. These sources often include corporate filings, company fundamentals, news from traditional media, and opinions on social media (Blankespoor, Miller, & White, 2014).

Financial analysts are of particular interest in this regard due to various reasons. First, their work is extremely time sensitive. They need to generate unique and relevant trade ideas at an extremely fast pace, as these ideas lose value over a period of time (Xiong, Prasad, & Chapple, 2016). Second, their work comprises of high pressure decision making (Wehbe, Wahid, Gupta, & Ishak, 2016). Financial analysts work in an environment where their earnings are directly tied to their trade ideas and research reports. For this reason, they must be extremely competitive and produce unique trade ideas in the market space to gain advantage over their peers. However, there has been very little research to improve my understanding on how financial analysts make use of social media to perform their sensemaking process and to generate trade ideas.

Research Aims and Objectives

Therefore, to expand the body of research in the direction of social media usage of specialized communities, I ask two important research questions:

**RQ-1** *How do financial analysts leverage social media in sensemaking to generate trade ideas and research reports?*

To gain insight into this question, I performed semi-structured interviews with the financial analysts to understand their perceptions and usage patterns of social media. Additionally, in this investigation I uncovered some of the problems analysts experience using Twitter as an information source. I derived four scenarios from these problems, which were built to further probe and verify the discovered problems around past financial events. These scenarios were then
used to design *TweetSight* – a medium fidelity prototype which allows financial analysts to explore important and contextual tweets while reading a news article.

**RQ-2** How to support the practices of financial analysts in leveraging social media (Twitter) for sensemaking?

To understand the potential effectiveness of the tool in supporting sensemaking process of the financial analysts, I conducted design analysis interviews to validate the effectiveness of TweetSight.

**Contributions**

My study can help researchers and designers alike to understand how social media is used in sensemaking by organization professionals whose work is time critical and involves high-stakes knowledge creation. Even though my results are in the field of financial domain, they are equally applicable to any other specialized corporate communities whose work is time critical and comprises of high stakes.

**Structure of the Thesis**

The thesis is organized into seven chapters. The first chapter introduces the problem at hand and provides an overview of the research questions which the study tackles. Chapter two provides comprehensive literature about the financial analyst’s work in a financial ecosystem, an overview of research in theory of sensemaking, and existing research in the usage of social media in work organizations. Chapter 3 provides the first of the two-part study. It tries to answer the first research question – “How financial analysts use social media in their work process” by
producing relevant findings. Chapter 4 presents the design of the tool – TweetSight which was developed using the problems discovered in the first study.

Chapter 5 talks about the second study which presents the findings from evaluating the initial prototype of TweetSight presented in Chapter 4. Chapter 6 tries to make sense of the findings for both studies and provides several design implications. It ends with discussion of limitations and my future research direction. Finally, Chapter 7 ends with the thesis conclusion.
Chapter 2
Literature Review

Chapter Overview

This chapter lays a foundation for my research problems (mentioned above) by providing a prior account and identifying major gaps related to my main contributions: How financial analysts use social media and how to support their sensemaking practices by improving their usage of Twitter. The chapter is divided into three main parts. The first part talks about the work of financial analysts, describing research in financial, accounting, and HCI. The second part talks about the theory of sensemaking, its development in various domains, and the rationale for choosing the conceptual model of sensemaking as the research lens. The final section explores the previous research conducted in different usages of social media in work environments.

The work of a Financial Analyst

Analysts’ function in the financial ecosystem

Financial analysts are an important piece of the financial market’s ecosystem because of the role they play in collecting, studying, explicating, and disseminating information to various market participants (Brown et al., 2015). They are responsible for performing market research from various sources to generate earning forecast reports, trade ideas, and recommendations. The effectiveness of these deliverables is evaluated by analysts’ clients based on the resultant market performance of enacting the recommendations of the deliverables. As the revenue of the financial analysts is directly proportional to the commission they earn by selling their deliverables, their reputation in providing profit-making deliverables directly impacts their overall compensation.
Brown et al., (2015) specifically mention that the analysts accumulated knowledge, the amount of votes they receive from clients, and their responsiveness towards them are a few of the variables which affect their performance (L. D. Brown et al., 2015). They are always pushing to keep abreast of industry knowledge by gathering information from various inputs and making sense of key trends from news and interacting with management (N. C. Brown, Wei, & Wermers, 2014; Cutler, Poterba, & Summers, 1988; Soltes, 2014). This need also pushes them to be highly responsive to their clients and gain their approval (L. D. Brown et al., 2015).

Understanding the technology usage of financial analysts

There is extensive research on financial analysts in the field of business, finance, and accounting in recent years (L. D. Brown et al., 2015; N. C. Brown et al., 2014; Wehbe et al., 2016). The first thread of research has been in the direction of understanding how analysts transform ideas into target price and stock recommendations (Mark T. Bradshaw, 2002; Mark Thomas Bradshaw, 2000; Zabihi Soltan Ahmadi & Baghani, 2015) (Figure 1A). Demirakos, Strong, & Walker (2004) and Loh & Mian (2006) present various information sources which analysts use to produce both accurate and profitable recommendations. Another thread of research has been in the direction of the analyst’s incentives (Ramnath, Rock, & Shane, 2008) (Figure 1B). Jackson (2005) highlights the conflicting nature of an analysts’ incentive of reputation-building; providing either accurate or optimistic forecasts can improve an analysts’ reputation.

One more significant thread of research direction has been to understand the analysts’ deliverables (Block, Stanley B, 1995; Hirst & Hopkins, 1998; Loh & Mian, 2006; Plumlee, 2003) (Figure 1C). For instance, the analysts use their forecasts to generate profitable recommendations for their clients (Loh & Mian, 2006). Also, the quality of their forecasts depends on annual
reports and investor relations more than the official communications which are released by the corporations (Lang & Russell, 1996). A common attribute across all the major research is that they have looked at the work of the analysts to understand how they impact the financial market’s eco-system. Their research shows that analysts are an important part of this eco-system.

Figure 1: Environment of a typical financial analyst. 1-a Conversion of information to trade ideas and reports, 1-b nature of analysts incentives, 1-c Deliverables produced by the analyst at various levels. Taken from (Ramnath, Rock, & Shane, 2008)

Research in the field of Human Computer Interaction on the other hand has largely focused on other elements apart from financial analysts in the stock market environment. These include studies that have leveraged financial information available in public spaces like online news and social media to predict future market movements using various data-mining techniques (Chen, De, Hu, & Hwang, 2014; Ruiz, Hristidis, Castillo, Gionis, & Jaimes, 2012; Yang, Mo, & Liu,
Specifically, Twitter has proven to be an impacting factor in the financial market (Bollen, Mao, & Zeng, 2011). For instance, studies like Hagenau, Liebmann, & Neumann, (2013) and Si, Jianfeng et al., (2013) have used sentiment techniques and text mining techniques respectively to predict stock movements. In addition, these studies have also provided an indication that social media applications like Twitter are valuable information sources and have the potential to be used in the financial industry. As an example, Hagenau, Liebmann, & Neumann (2013) showed that release of breaking insights on social media platforms have a significant effect on stock prices. Despite these benefits, there is a gap in the literature between the important information they can provide and how this information is used beyond quantitative computation.

I want to fill the above-mentioned gap in the literature by trying to understand how social media applications like Twitter are used by the analysts as an information source in their financial deliverables. Analysts are an important part of this eco-system. However, the HCI community’s exploration is very limited in understanding what kind of role analysts play in this context. Therefore, my focus in this thesis is to explore if financial analysts utilize the social media resources to capture break-through insights and use them in their analysis to provide an accurate forecast.

Sensemaking and its development in various domains.

What is Sensemaking?

Sensemaking is often defined as “how people make sense out of their experience in the world” (Duffy, 1995). The process takes place in activities involving seemingly simple problems such as “What kind of presentation should be made for the next meeting?” to activities involving more complex problems such as “Generating predictive forecast details for future based on
various radar data types”. Even though sensemaking as a phenomena is related to various psychological elements such as creativity, comprehension, curiosity, mental modeling, explanation, or situational awareness, modern researchers have made a distinction between both type of uses (Klein, Moon, & Hoffman, 2006). It is a self-propelled, continuous effort to figure out various connections such as people, places, and events to drive their understanding in a direction and act adequately. Depending on the task and domain, sensemaking activity often can be an independent task in itself (Furnas & Russell, 2005).

Examples of such tasks include conducting research by researchers (X. Zhang, Qu, Giles, & Song, 2008), designing professional artifacts by industrial designers (Wahlstrom, Salovaara, Salo, & Oulasvirta, 2011), performing business analysis by business analysts, and intelligence analysis (Pirolli & Russell, 2011). The earliest roots of sensemaking can be found in library and information sciences from the 1980’s (Dervin, 1983) which later propagated to different areas such as education (P. Zhang & Soergel, 2016), organizational studies, and Human Computer Interaction (HCI). Beyond the common foundations of sensemaking process mentioned above, the purpose of the research differs widely based on focus of the field. To keep the discussion within the scope, I expand my discussion to the following relevant domains – information and communication, organizational studies, and HCI.
Sensemaking in information and communication

Sensemaking (often referred to as ‘sense-making’) in the field of information was introduced and developed significantly by Brenda Dervin. Grounded in phenomenological perspective, Dervin’s research has focused on two perspectives: 1) Understanding how people make sense out of information with a goal of improving computer mediated communications, and 2) Proposing communication messages as “constructions that are tied to the specific times, places and perspectives of their creators” (Foreman-Wernet, 2003; Naumer, Fisher, & Dervin, 2008).

She explains the complex nature of sensemaking using the sensemaking metaphor (Figure 2). In this metaphor, a person is imagined crossing a gap (visualized as a sensemaking need) which often arises out of the situation in hand (Dervin, Lois Foreman-Wernet, & Lauterbach, 2003). Through the process of gap-bridging, the person engages in various activities which leads to different outcomes. During this time, they consider outcomes from various information sources. Despite model’s maturity, its weakness lies in over-simplification of the situation (gap) and the activity (sensemaking process). It fails to appreciate the breadth and depth of complexities occurring in the real-world situations.
Sensemaking in organizational studies

Another discipline where sensemaking has been developed strongly is in organizational studies, which produced considerable literature in last 25 years (Maitlis & Christianson, 2014). Weick laid the foundation by defining sensemaking as an activity through which various individuals in an organization work to understand new, confusing, and unanticipated events (Weick, 1995). Weick used sensemaking to underscore attention towards the cognitive aspect of bringing meaning out of an experienced situation.

Sensemaking in organizational studies has been used to fill the gaps in the organization theory (Weick, Sutcliffe, & Obstfeld, 2005). In his article, Weick presents the idea that sensemaking is an important and necessary step for organizations to undergo. Research of sensemaking in organizations has followed two directions. First, the category of the studies has investigated how certain groups influenced others’ understanding of issues in the organizational settings. For instance, leaders in various organizations have attempted to influence the sensemaking process of others, defined as sensegiving (Gioia & Thomas, 1996; Kezar, 2013; Tallon, 2014). Sensegiving was found to be an important leadership activity within organizational sensemaking development (Maitlis, 2005). The second category of the studies have focused on how middle management uses the sensemaking process to shape organizational accounts by gaining attention and influencing organizational action (Dutton, Jane E, Ashford, Susan J, O’neill, Hayes, Erika, & Wierba, 1997; Hofmann, Lei, & Grant, 2009; Rouleau & Balogun, 2008). In addition to this, Maitlis & Christianson (2014), produce an exhaustive survey of the sensemaking process; specifically looking at (1) how sensemaking is accomplished, (2) how events become triggers for sensemaking and (3) how sensemaking enables the creation of organizational processes.
Sensemaking in Human Computer Interaction and technology

Sensemaking in HCI (often differentiated from ‘sense-making’ from other fields) was brought by Russell, et al. (1993). Russell et al. framed sensemaking as the process of forming meaningful representations and using them to facilitate insights and actions. These meaningful representations, often called as externalizing representations of knowledge, were a central idea presented in this seminal paper. One of the most widely accepted models for explaining the sensemaking process is Pirolli and Card’s conceptual model of sensemaking (Pirolli & Card, 2005). It is based on the extension of Russell et al.’s (1993) work (Figure 3). In Pirolli and Cards’ model, the overall process is divided into two loops - Foraging and Sensemaking (Pirolli & Card, 1999; Russell et al., 1993). The foraging loop involves activities such as seeking, filtration, and extraction of information; the sensemaking loop involves the development of representational schemas used to draw conclusions and form hypotheses. The data transforms from raw information to reportable results by flowing through the sequential steps (shown in boxes in Figure 3 Conceptual model of Sensemaking (Reproduced from Pirolli & Russell, 2011)).
Figure 3). The steps are ordered by effort, starting from collection and ending with telling stories using their presentations. This sensemaking loop is also called a bottom-up process containing following steps (Pirolli & Card, 2005):

- **Search and Filter**: At the first step, the user performs query operation on various repositories or databases. Results obtained from these databases are filtered based on various parameters and stored as smaller components in a temporary store called a *shoebox* for further processing.

- **Read and Extract**: After information gathering, useful data snippets are then extracted from the shoebox as evidence that is useful in forming inferences and supporting or disconfirming a set theory. Evidence can also be used in triggering new hypotheses and searches.

- **Schematize**: The information from the evidence snippets are re-represented and structured in the form of *schema*. This re-representation process can happen either informally in the mind of the user or in an external space using the assistance of a computer-aided system (see Figure 4).
- **Build case and tell story**: Schema created in the previous steps are used for building a strong case towards answering questions which confirm or disconfirm determined hypothesis. A presentation or publication of such case is made to some audience (client).

  The conceptual theory of sensemaking has few overlapping features with Dervin’s and Weick’s theory of sensemaking. However, the conceptual theory of sensemaking excels in exclusively supporting, creating, organizing, and shaping such external representations of knowledge using the support of technology (Paul & Morris, 2009). Specifically, the theory assists in designing and developing effective interaction techniques and tools which can assist in performing specific steps of the sensemaking process. Therefore, building upon the collective knowledge in this area, in this study I 1) specifically focus on understanding how financial analysts’ workflow process follows a conceptual model of the sensemaking process, and 2) how a newly designed tool can assist in supporting the shaping of external representations of financial knowledge.

**Facilitating sensemaking using various technological tools**

Substantial work has been done using Pirolli & Card’s sensemaking processes for designing assistive tools to support and shape external representations in recent years. These tools have extended over various domains. For instance, Citesense is a tool which assists academics in making sense of vast amounts of literature (X. Zhang et al., 2008); Wahlstrom et al. (2011) provided an analysis of sensemaking in making safety critical decisions in car racing championships. Other research includes the areas of web searching (Amershi & Morris, 2008; Baldonado & Winograd, 1997; Paul & Morris, 2009) and education (Anaya, Luque, & Peinado, 2016; P. Zhang & Soergel, 2016). However, there is a lack of research in understanding the
design needs and development of technological tools to support sensemaking processes in the financial industry.

The closest research is in the studies of intelligence and business analysis (Pirolli & Card, 1999, 2005). In addition, various visual tools have been developed which have an indirect scope of serving financial analysts. For instance, Harvest is a web based application which incorporates semantic actions to improve the sensemaking process (Gotz & Zhou, 2009). Financial analysts can be potential users for such a system. In the following study, I try to bridge the gap present in this area by providing new insights into how financial analysts leverage social media in sensemaking and propose the design of a social media tool to support these practices.

**Social Media in the Enterprise**

With the rise of social media in recent years, research into how it is used in the enterprise has increased. Over time, the studies have taken two major outlooks. First, the most commonly explored outlook, is how organizations communicate with external parties such as customers (Piskorski, 2011). A second and less commonly studied outlook is how employees in the organizations have used social media for internal purposes (Leonardi, Huysman, & Steinfield, 2013). Based on these findings, social media usage by corporate employees showed engagement in various tasks such as (1) opportunities used by colleagues to form better relationships in the organization by following updates of other employees, (2) to learn about their colleagues, and (3) have discussion about various issues (DiMicco et al., 2008; Ferguson, Soekijad, Huysman, & Vaast, 2013; Zhao & Rosson, 2009). For instance, Facebook’s wall updates are used extensively for connecting with employees on a personal level, whereas on explicitly professional social networks, e.g. LinkedIn, users are interested more in the current professional lives of their social network (Skeels & Grudin, 2009). Another example is usage of social media by cyber-volunteers.
to conduct their internal training and knowledge sharing (Raja-Yusof, Norman, Abdul-Rahman, Nazri, & Mohd-Yusoff, 2016).

The focus of my thesis is to explore how social media is used as an information source for work deliverables as opposed to its other uses. (van Zoonen et al., 2016). However, there are comparatively fewer studies which have investigated how social media facilitates more primary work processes in organizations. One example is Bhattacharjya, Ellison, & Tripathi, (2016) where they found that Twitter is used by many e-retail platforms to engage and solve customer problems. Facebook and Twitter are also used in the academic domain to recruit participants (Gu, Skierkowski, Florin, Friend, & Yi, 2016). There is a more recent body of literature in the study of social media usage in the financial domain. In one such study, Blankespoor et al., (2014) examined the impact of using Twitter by firms to disseminate their news. By using Twitter, it is possible for financial firms to reduce their reporting asymmetry level (Xiong et al., 2016).

However, these studies still leave the gap in understanding the direct use of social media, specially Twitter, as an information source in financial analysis. In the following two part study, I seek to add to this growing body of literature, through investigating how social media is directly used by financial analysts in their work.
Chapter 3
Research Methodology

Chapter Overview

The following chapter talks about the overall research approach taken in the thesis. It also describes Scenario Based Design framework used in designing TweetSight.

Rationale

My study uses design research methodology to design a technological intervention which can solve the important problems experienced by the financial analysts in Twitter usage. Design research allows researchers to conduct systematic inquiry around the practices of people (Bayazit, 2004). The process helps in discovering gaps in such practices, developing man-made artifacts to bridge those gaps, and evaluating effectiveness of such artifacts. My research aims at exploring the current financial practices and open-minded discovery of associated experiences, problems and suggestions for design. Figure 5 shows the research overview taken in this thesis. It follows an iterative structure showing, methods on the left and the feedback paths on the right.
The major framework used in this study to analyze our study is Scenario Based Design (SBD). It is a collection of techniques to envision a system by understanding and describing how...
people use the system (Carroll, 2000). SBD uses the concept of scenario creation and analysis to accomplish this understanding and facilitate efficient communication. Designers are always looking for ways to effectively extract various motivation and usage practices to refine their prototypes (Sears, 2009, Chapter 8). Scenarios help them achieve this in a few ways (Rosson & Carroll, 2002). First, scenarios provide an easy way of capturing human activities which correspond to technical functions. Second, they allow representation of the system usage within the limits of its operation, usually consisting of various actors, task, settings, and goals, and presenting specific problems out of them. Third, effectively communicating the design ideas and receiving feedback from them.

The resultant design prototypes are aimed to be fluid; adaptive as the goals of actors develop and change. Moreover, the SBD process facilitates iterative feedback to help designers make informed decisions about the functional and visual aspects of the system (Carroll, 2000). The simplicity of scenarios also help other stakeholders to engage, introduce missing ideas, and raise questions.

SBD framework has obvious advantages mentioned above; however, they are some problems too. For instance, designers might get overwhelmed by considering various design options after every single iteration. Therefore, I have utilized certain parts of SBD to fit my design enquiry. Due to exploratory nature of my research, I decided to use a customized framework that incorporates essential parts of SBD (Figure 7).

![Figure 7: Variation of SBD for Design research](image-url)
I start with qualitative interviews to understand the how financial analysts (a) carry their analysis process, (b) use social media to conduct parts of analysis and (c) the problems faced in the process (see Study 1 in Chapter 4). The problems uncovered in the interviews then used to motivate problem scenarios. Problem scenarios in SBD framework depict the issues in the world of user (Rosson & Carroll, 2002). In my case these problem narratives described real world sequence of financial problems occurred in the recent past for the financial analysts.

Using these problem scenarios as and the stakeholders profile I produced interaction scenarios which provide detailed solutions for the problem situation in hand. Using these interaction scenarios, I designed the storyboards for the new tool. For each step, the inputs from stakeholders were taken to iteratively improve the designs while progressing towards a more concrete prototype. After the first milestone of major design prototype was reached, another study was performed. I conducted formal evaluation interview with the financial analysts to understand how well could I solved the problems which I discovered in the Study-1. These results will be used to develop a concrete working prototype.
Chapter 4

Study-1: Understanding How Financial Analysts leverage Social Media

Chapter Overview

The following chapter presents the findings around the financial analysts’ (a) work process, (b) usage of social, and (c) the main problems they felt in using Twitter – one of the important social media applications for the financial markets. I also present my study details and the procedures used to report the findings.

Data Collection Method

To investigate financial analysts’ existing practices with social media, I conducted semi-structured interviews with six participants. My research partner, belonging to a large, privately-held financial corporation, acted as a mediator in selecting participants, planning, and scheduling interview sessions. Since my goal was to understand the usage of social media by the financial analysts, my research partner reached out to candidates with highly extensive experience in the financial domain. Additionally, they also understand how social media is used by the analysts in the financial industry. Study participants were recruited by snowball sampling. The research partner sent out email invitations to his associates. They were also asked to forward the invitation to their associates in other departments.

A total of six participants volunteered for the interview based on their availability. The participants consisted of three subject matter experts and product managers respectively. Participants were selected to have a minimum experience of ten years in the financial field whereas the average experience of the participants in this field was about 16 years. The
interviewees spent an average of nine hours in their work environment per day. All the interviews were scheduled as a part of scientific collaboration between the company and my research lab.

Table 1: Demographic information of the participants for study 1

<table>
<thead>
<tr>
<th>Interviewer Number</th>
<th>Designation</th>
<th>Area of Expertise</th>
<th>Overall experience in the field</th>
<th>Experience in current organization</th>
<th>Work Engagement hours</th>
<th>Previous Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>Product Manager</td>
<td>Financial Research</td>
<td>12+ years</td>
<td>9 years</td>
<td>10+ hours</td>
<td>Product Manager</td>
</tr>
<tr>
<td>I2</td>
<td>Subject Matter Expert</td>
<td>Equity Buyside</td>
<td>22 years</td>
<td>2 years</td>
<td>10+ hours</td>
<td>Portfolio Manager</td>
</tr>
<tr>
<td>I3</td>
<td>Subject Matter Expert</td>
<td>Equity Buyside</td>
<td>12 years</td>
<td>3 years</td>
<td>10+ hours</td>
<td>Portfolio Manager</td>
</tr>
<tr>
<td>I4</td>
<td>Subject Matter Expert</td>
<td>Equity Buyside</td>
<td>24+ years</td>
<td>18 years</td>
<td>10+ hours</td>
<td>Financial Risk Assessment</td>
</tr>
<tr>
<td>I5</td>
<td>Product Manager</td>
<td>Financial equity Research</td>
<td>15 years</td>
<td>2 years</td>
<td>10+ hours</td>
<td>Portfolio Manager</td>
</tr>
<tr>
<td>I6</td>
<td>Product Manager</td>
<td>Financial news</td>
<td>16 years</td>
<td>2 years</td>
<td>10+ hours</td>
<td>Sellside equities</td>
</tr>
</tbody>
</table>

Procedure

I conducted the interviews over the telephone. Each interview lasted from 45-60 minutes. I provided interviewees with a brief introduction (through email and in conversation) about what I was doing and how it might benefit their organization. My interview prompts started with purposefully high-level, open-ended questions belonging to main themes, then transitioned to more specific questions based on the interviewee’s answers. Shortlisted high-level questions are mentioned below (an exhaustive log of questions which were asked can be seen in Appendix-A):

- What is your typical work session like? What are the essential deliverables?
What are the essential elements that go into these deliverables?

How and where does news and social media (if at all) generally come in these essential elements?

As the interviews were semi-structured, the questions were only used to guide the conversation. All the interviews were audio recorded after obtaining permission from the participants and later transcribed. I used open coding to analyze the material. I started without a fixed coding list. Reading through the transcriptions and notes, I coded the sections to capture various themes related to my exploratory goals: (1) Understanding the common deliverables and practices of financial analysts; (2) Usage of social media in their analysis. I present my findings in the next section.

Findings

Overview—What does a financial analyst do?

As per my interview analysis, the job of a financial analyst (also known as an equity, research, or rating analyst) is to generate trade ideas that create value for their clients’ financial portfolios. These trade ideas aim to minimize risk and generate revenue. Financial analysts are divided into two main categories: sell-side and buy-side. Sell-side analysts perform regular, in-depth research reports about specific companies to provide recommendations to buy-side analysts. In addition to these reports, buy-side analysts conduct their own research to generate unique ideas and recommendations to sell to their investors, referred to as trade ideas. These trade ideas aim at:
According to I3 and I5, irrespective of the category they belong to, they start as junior analysts, covering one or two companies in their portfolio within a sector. As their experience increases, they start covering more companies (as many as twenty) and sectors. The set of companies that an analyst covers are referred to as their target list. Their rise in seniority is marked by their expansion of the target list, often spanning multiple market sectors.

As financial analysts’ end goal is to recommend whether or not to buy or sell shares of a company, a company is the single most important entity for them. Naturally, their research and deliverables revolve around particular companies in their target list. As such, Interviewee-3 pointed out that the analyst’s day to day activities involve reading news, opinions, and other information about the companies in their target list. I found that the information that the analysts gather can be broadly classified into two types: Events and Themes. In events-based research, the analysts are interested in how a specific event impacts a particular company. An example event provided by I5 was when Tesla announced the release of Model 3, a new budget electric car which could revolutionize inexpensive and eco-friendly car production. An analyst covering Tesla would undoubtedly cover this important event in their research. Events such as the release of Tesla’s Model 3 are specific instances occurring in relation to a particular company. In contrast to events, themes are more broad, and refer to a particular phenomenon that may involve multiple events. Themes also contrast with events in that they are an indicator for a sector (such as automotive), instead of a particular company. For instance, in 2016 there were multiple competing announcements of affordable electric cars from Tesla, Chevrolet, Audi, and Ford. In this example, similar events occurred across various companies which represents a theme across
the automotive sector. These themes are important for an analyst covering multiple companies in
the same sector. Based on my interviews there are a few salient characteristics of the work which
financial analysts perform:

- **High stakes job:** Interviewees mentioned that analysts earn most of their income from sales
  commissions on their trade ideas and research reports. Therefore, their income is directly
  linked to the quality and the frequency of their ideas. Analysts need to predict the price at
  which a company’s stock will trade as accurately as possible. This constant pressure to
  frequently generate high quality, accurate ideas makes for a high stakes job.

- **Time constraint:** Financial market prices move fast and unpredictably. As such, trade ideas
  must be generated with a similar speed. As time passes, these ideas quickly lose their
  uniqueness and ability to generate income. Therefore, analysts have to capitalize on their
  unique ideas before other analysts catch up (I2 called this the *crowding affect*).

- **Unique trade ideas:** Lastly, according to I1, it is not enough for analysts to just generate
  ideas. If everyone has the same idea at the same time as the analyst, the ideas are not useful.
  Therefore, they need to present unique ideas through a deeper understanding of the market.
  Analysts gain this insight through meeting with the management of the companies they are
  covering, attending important conferences in the sector, and reading news and breakthrough
  insights.

  [...]So he starts to develop kind of pieces in his head. Pieces in his
  head come from all sort of sources but a lot of them come from walking down
  the street, attending conferences, meeting management and also reading news
  articles. - I4
How are unique trade ideas generated?

The unique nature of financial analysts’ work means that they must be on constant lookout for new information from various information sources. This information is used as input into their models, allowing them to predict trade-prices and build various trade-ideas for their research and recommendations.

Locating new information (Input)

I found that the basis of any trade idea lies in understanding the current events or themes which impact a company or sector respectively. For example, release of information in a quarterly earnings report by Microsoft can impact the company’s stock price. To gauge the impact of such an event or theme, the analyst is always on the lookout for information. Irrespective of specialization, analysts are constantly scouring for information to understand events and themes that impact their target list. Common sources include financial metrics released by the company (such as price-to-earning ratio), official press releases, news (e.g. Wall Street Journal), and social media (e.g. Twitter, Facebook, and blogs). I understood that the information gathered plays a critical role in the analyst’s job.

News often contains information that can impact their research model and feed into unique, profitable trade ideas. As I2 points out “News is the precursor to either unlock value or create an investable idea. News drives the market.” Analysts start each day reviewing news articles. They look at the companies in their target list which have undergone price changes and prioritize those companies when reading the news. If the analyst finds that a company’s stock has moved 20%, they would then read news on what is causing the price fluctuation. Based on this
gained understanding, the analyst can then go and update the portfolio security details or come up with a buying or selling rationale.

When I would start with the beginning of the day, I would come in and look my portfolio and I see which news is associated with each stock. I would focus firstly on stock price changes. So, something was up and down a lot, I would focus on that news first. - I3

To facilitate these practices, many analysts use financial tools like Terminal (by Bloomberg) and Platform (by S&P Global Market Intelligence) which aggregate news from various sources into a consolidated platform.

**Modeling and Analysis**

I1 communicated that a model is a representation of how a particular company is going to perform financially in the near future. Analysts take various approaches to come up with these models. In the top-down approach, the analyst starts from the entire universe of their investable space and filter it down to the names that have fundamental, quantitative metrics and perform analysis at that level. Professionals who use the bottom-up analysis method look at larger themes in the marketplace by gleaning insights at the company level. Irrespective of the approach, the analyst is always adding variables and data to the model to calculate a more accurate output. In I1’s own words, analysts are trying to use the model to understand the answer to the following question: “Do I understand industry well enough to put money in these trade ideas?” Each model is unique to each analyst because the variables and strategy which each analyst uses is always specific to him or her.
Calculation Target Price (Output)

The output of the analyst’s model is a unique price at which a company will be valued in the near future. It is often called the target price. Analysts’ income is directly dependent on how well they can predict this target price. They present these price estimates in the form of research thesis or trade ideas. Every time a major event occurs within a particular company, the analyst has to update the target price predictions as the inputs of the model change. For example, if a company comes out with quarterly earnings, the analyst will need to revise their target price numbers based on this updated data.

Usage of social media by financial analysts

Like news, social media is utilized by analysts as another information source. Opinions on social media are often used to complement the information presented in the news. A major difference between news and social media is that the information available from social media is not something on which analysts put their money on, but rather see as a “head start opportunity” in performing research into newly opened avenues. Within social media, the most frequently used platforms are discussed below.

Blogs

Blogs provide a place for readers to interact with authors, to collaborate with peers, and to share the content with various other readers (Mangold & Faulds, 2009; Meraz, 2009). Analysts tend to develop trust in particular experts and fellow analysts. They follow these professional’s steps and advice, including information from informal writings such as blogs. These blogs provide important information; however, there is an obvious presence of personal judgment involved,
when analysts develop the list of blogs they follow - these may not be same across analysts even within the same domain. The following quote by I1 shows the extent to which trust plays a factor.

*For example, Wall Street Journal can be good for one industry. Some of the columnists might be good. They are experienced in writing, for example, say one industry as opposed to something else. They have a track record and analysts follow that. Sometimes, they follow just other analysts. If the analyst changes from...these subscribers change too - I1*

**Collaborative communities**

I2 and I5 mentioned collaborative communities as another source of information. These mostly take the form of internet forums where a group of analysts pitch their financial ideas and discuss them, such as in a Yahoo community. In communities like these, users often post with pseudo-handles to create anonymity as the ideas and recommendations they provide might impact their personal reputation. Due to this, accountability is not as prevalent. At the other end of spectrum there are high-profile forums referred to as **Investor Clubs** where access is limited to specific groups of professionals to share investment ideas for several reasons. I2 mentioned that one reason is for neophyte analysts to build their personal brand. Analysts who present an idea which predicts the future markets well get recognition in their community. Other times, professionals, like investment managers, want everyone else to see their personal view on an issue and help others understand what the market is currently missing.
Interviewees unanimously cited Twitter as the most commonly used social media tool by the analysts. One thing that is unique to Twitter usage among the financial industry is the use of cashtags, which are special hashtags that use the ticker symbols for each company (e.g. $AAPL and $MSFT). Tweets about financial content often contain these cashtags. I3, I4, and I5 mentioned that Twitter is used for both quantitative and qualitative analysis. In quantitative analysis, text mining programs are used to provide directional and predictive information. In my interviews, I uncovered a few specific reasons how and why Twitter is used in their qualitative research, which I am more interested in.

1. Twitter for breaking information

There are times when social media will pick up an event before traditional news wires, as there are individual experts who are tweeting about an event in an unofficial manner. These unofficial tweets by experts hold potential value to the analysts as they give them a head start.

*It is ‘first-to-market’. You have the advantage of first knowing something. If you are the first to know, you can take the opportunity before anyone else can take it. In that sense, it became primary source for most of the fund managers and analysts I know.* - I1

Sometimes these tweets, especially those by established experts in the field, can also impact the market and move the price of stocks in a particular direction. I6 provided an example where a famous fund had affected the movement of Apple stock.

*What you get out of social media is that often you will have people who have very specific opinions on a stock that they tweet. For
example, the famous fund manager like Carl Ichan (@Carl\_C\_Ichan) he might say Apple is worth $200 a share and in fact he said exactly that. He published a tweet, he said it is vastly undervalued. Once the investor can say that it is Carl Ichan who is doing the tweeting then the stock starts rallying tremendously - 16

2. Twitter as a query exploration tool

In addition to providing access to breaking news, tweets also serve as a mechanism to understand the question of ‘why’ something is moving in the market. There are times when stocks move tremendously, but the traditional news does not provide an immediate reason. Tweets by knowledgeable people in that industry can help analysts fill these lapses and explain the movements of financial markets. For instance, I4 mentioned there are instances when there is a big move in the pharma stock industry and stock of a particular company moves 3%. The analyst does not know why the stock is moving - even the news media isn’t covering the event. In those situations, tweets by experts in the Pharma industry can possibly provide an answer for the analysts.

There are times when social media will pick up before the traditional news wires will and in those instances, you are involved in the trade in a stock and the stock is moving you don’t really know why - 12

3. Twitter as Bellwether

I5, who specializes in the retail market sector, reported many companies use Twitter in the retail and fashion sector to engage customers and inform them about their new product lineup, interesting offers, etc. This engagement is used by analysts as they often provide a bellwether as to how well a company is attracting customers. Tweets from reliable sources are also used in
research reports as a potential reference point. When Bill Gross, a famous financial manager, comes forward and tweets about American infrastructure falling short of 1.4 trillion by 2025, it has a significant impact and analysts might reference this tweet. Two interviewees explained that data gathered from Twitter is often used as input into the analyst’s model. Additionally, financial companies like theirs have created special teams who work exclusively on Twitter feeds. As part of their job, they often manually vet important tweets to push through financial applications like Terminal.

Problems discovered with Twitter usage

Even though there are definitive benefits to analysts using Twitter, there was a hesitancy by analysts in relying on social media to reap these benefits. In this section, I present the major problems which lead to hesitation to use Twitter.

Problem-1: Difficult to Assess Knock-on Effects

Incidents related to one company often have repercussions on other companies in the same sector, and can even extend to companies in other sectors at times. This phenomenon is often called the “knock-on effect.” According to I4, the Mexican government’s decision to deregulate oil drilling off the Gulf Coast had a big impact on the cement industry. This is because this type of drilling increases demand for cement for the filling process. Moreover, it is not cost-effective to ship cement from the US or China; therefore, the obvious choice for many oil companies was Cemex - a major Mexican cement supplier. The deregulation effect had a strong knock-on effect on share prices of Cemex.
Successfully predicting tertiary effects such as these creates a rich financial opportunity for the analyst. The trade ideas generated from these knock-on effects are highly efficacious in that they require a deep understanding of events happening around the company and opinions of a variety of subject matter experts. Twitter, as a complement to traditional news, can provide an analyst with additional information about the event or theme in the form of expert analysis, recommendations, and insider information to deduce such knock-on effects. Currently, analysts consume these tweets in an out-of-context fashion because they are presented based on subscription and chronology. Therefore, it is prohibitively difficult and time-consuming to effectively leverage Twitter for this purpose.

**Problem-2: Difficult to Discover Relevant Tweets**

There are a number of reasons that it is difficult for analysts to find the correct experts currently tweeting important information.

*Subscription structure*

In Twitter, a user can have many followers. When you follow a user, you get all of the tweets that they write. Therefore, to effectively utilize Twitter to find the next breaking news, analysts would need to predict which important people will break the story.

*Too much noise*

An alternative strategy, is to search for specific keywords related to a current event or theme. However, this also proves difficult due to the large amount of tweets and it takes a prohibitively large amount of time to locate the few important tweets.
Problem-3: Small Impact Window

As the market moves quite fast, any breaking tweets lose their value once the information is known widely, thereby causing crowding-affect. Therefore, the manner in which analysts currently consume tweets takes too long to be useful.
Chapter 5
Design of TweetSight – A contextual tweets exploration tool

Chapter overview

The following chapter starts with presenting objectives on which the overall design is motivated. I then describe various parts of the TweetSight in detail.

Design overview

Based on my findings from interview study, I present my design study of TweetSight - a tool that assists financial analysts by situating relevant tweets within news articles. As part of this design study, I conducted walk-through sessions of the initial prototype with financial analysts to determine the potential efficacy of my design. The aim of TweetSight (as show in the figure-1) is to situate contextually relevant tweets alongside news articles. I chose news articles as the anchor point as these articles represented a common artifact that financial analysts organized their information seeking and sensemaking around.

As soon as the analyst opens a news article, TweetSight displays the most relevant tweets alongside it. As an example, if the user is reading an article titled “People are already lining up in tents to pre-order the Tesla Model 3,” they will see tweets about Tesla’s Model 3 on the right-hand side. These tweets are filtered based on additional parameters, such as key people who tweet frequently in the sector, individuals whom the analyst follows, and the presence of Cashtags within the tweets. Once the tweets are loaded, the user can refine the tweets based on either keyword in the news or in the co-occurring statistics.

In my Scenario-Based Design process, I developed five different problem scenarios, each of which was grounded in my previous interviews. Out of these problem scenarios, I developed
four corresponding interaction scenarios. I then constructed a prototype based on these scenarios. While my prototype was interactive, in order to receive quick feedback on the design, I only supported the activities presented in the scenario.

![Image: Design Overview of TweetSight application](image)

**Design Objectives**

**Objective-1 Discovering Knock-on Effects**

The co-occurring statistics bar lets the user observe related companies and helps them understand how events or themes relate with other companies or people. Additionally, the user can refine tweets in order to explore tweets which discuss the co-occurring entities. These tweets can assist analysts in understanding the effects a focus company is having on the co-occurring elements.
Objective-2 Leveraging the short-term market impact.

The option to subscribe and receive notifications for future contextual tweets using the subscription feature allows financial analysts to get to important tweets much faster. This process can provide them with an opportunity to take advantage of such tweets before the crowding-effect takes place.

Objective-3 Reducing the effort required for query exploration.

Using the highlighted keywords in the article, the user can re-formulate the tweets present on the right-hand side. It allows users to skim through an article by looking at the highlighted keywords. Additionally, as they are reading the news in detail, the user can perform query exploration by loading relevant tweets using the keywords present in the article.

Design of TweetSight

The interface is divided into three main components (see Figure 8) - (a) news article section (b) contextual tweets section, and (c) co-occurrence statistics of the news article.

News article section

The news article section (Figure 8 (c)) contains the actual article where the names, organizations, and companies in the article are highlighted as keywords. In the Tesla example mentioned above, Elon Musk is one of the highlighted keywords. The classification and uniqueness of these keywords is determined using Named Entity Recognition (NER) and TF-IDF. As the user scrolls through the article, they can click on these highlighted keywords to refine and reformulate the
tweets on the right hand side, making them more specific. While the user reads through the Tesla article, they may observe the company name - General Motors as a highlighted keyword. If the user adds General Motors to the current query, I display tweets that mention both Tesla and General Motors.

**Contextual Tweets**

The contextual tweet section displays the most relevant tweets regarding the current news article. The tweets are extracted from Twitter using keywords from the article. In order to restrict tweets to the financial domain, the tweets are further filtered by verified accounts and Cashtags. I further restricted the tweets by categorizing them into prioritized and other tweets. Tweets are labeled and shown in the prioritized section if they are published by curated tweet handles who have consistently provided valuable opinions in the sector or by the accounts the user personally follows. The list can be edited and maintained in the settings panel.

For the purpose of my study design, I used the list provided by the partnered financial company. The user has the option to add tweet handles to this list by clicking on the add person icon beside the tweet. Curated accounts are shown with a star beside the tweet. The above filtration process reduces the volume of tweets, making it easier for the analysts to find valuable and relevant information. Users are also able to sign-up for future contextual tweets related to the current article. For instance, if the user subscribes to the Tesla news article, they will receive notifications for any tweets published after they subscribe. In this way, analysts do not need to actively monitor an article to see how it develops.
Co-occurring Statistics

Co-occurring statistics presents an expandable information bar at the bottom to show frequently co-occurring companies and entities. These co-occurring values are computed by performing text mining on the news corpus within the past month. For instance, in Tesla’s article, the most co-occurring companies are GM, Ford, and Nissan. Alongside each keyword, the level of co-occurrence is shown besides each result. Similar to the highlighted keywords in the news article, these results can also be used by the user to refine and reformulate their tweets.
Chapter 6

Study-2: Evaluation Study of TweetSight

Chapter Overview

In the following chapter I provide findings for the initial evaluation of the design prototype showcase to several financial analysts. I also provide details into the method and the procedure of the study.

Method

In order to understand how TweetSight may help to address the problems discovered in my first study, I invited subject matter experts to provide feedback on the initial design of my tool. Based on Agile design philosophy, having evaluation feedback early in the design would improve the overall design of the tool (Chamberlain, Sharp, & Maiden, 2006). For the design evaluation study, I recruited six different participants using my research partner. To maintain similar composition to my previous study, I recruited three application specialists, two financial analysts, and one financial product manager. The average experience in the company for these participants was more than six years (max = 12 years, S.D = 3.3 years). The participants who were application specialists and financial analysts had more than 5 years of financial working experience before joining the company. In their current roles, they actively oversee and collaborate with financial analysts. All the interviewees were told about the study and were motivated in a similar manner.
Table 2: Demographic information of the participants.

<table>
<thead>
<tr>
<th>Interviewer Number</th>
<th>Designation</th>
<th>Area of Expertise</th>
<th>Overall experience in the field</th>
<th>Experience in current organization</th>
<th>Work Engagement hours</th>
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<td>I7</td>
<td>Financial Analyst</td>
<td>Bloomberg Intelligence</td>
<td>11+ years</td>
<td>6 years</td>
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<td>12+ years</td>
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<td>Application Specialist</td>
<td>Research Management</td>
<td>6+ years</td>
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<td>8 years</td>
<td>4 years</td>
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<td>5 years</td>
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<td>10+ hours</td>
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<td>Application Specialist</td>
<td>News</td>
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<td>4+ years</td>
<td>10+ hours</td>
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</tbody>
</table>

**Procedure**

The design evaluation sessions were conducted virtually using the WebEx application. Each evaluation session lasted between 60 - 80 minutes. In the sessions, each participant was presented with three interaction scenarios covering the problems discovered in the previous study. An example of an interaction scenario is reproduced below:

[Scenario-1] *Bill is a sell-side analyst who is covering Apple in his portfolio. He comes across the news item labeled ‘Apple, The FBI and iPhone Encryption: A Look At What’s At Stake’ on Mar17, 2:18pm. As Apple is in his portfolio item, he is interested in the news item which is becoming a big story. The news item talks about how the FBI vs. Apple is going big*
about the issue of privacy about which all the tech giants are concerned. He is curious in understanding what stance are other technology giants going to take.

In this scenario, as Bill is navigating through news, his attention is grabbed by Google which is highlighted as one of the key word in the body. He becomes curious by the presence of the competitor company in the news article. He then clicks on the keyword to re-formulate tweets. The resultant tweets contain nexus of ‘Apple’, ‘FBI’, ‘encryption’, and ‘Google’. User can observe a tweet released by Sundar Pichai (CEO of Google) showcasing support and declaring stance with Apple. Tweets of support like these can help Bill realize the positive support of other technology companies on Apple in relation to the FBI feud. Additionally, he can click on the button on the top to subscribe to the future tweets which arising in context to the news article.

A visual representation of the scenario is shown in Figure 9. For each scenario, the participant was presented with the problem, and understanding of it was ensured. Then, I presented a step-by-step walkthrough of how an analyst could arrive at the solution using TweetSight. I chose to do a walk through as I had a limited time with each participant instead of observing how they use the tool, I was more interested in evaluating the concepts of the design solutions as opposed to its usability. After completion of each scenario, participants were asked a series of questions. For example, one question for the Apple vs. FBI scenario was “How does discovering opinions of support (Tweets from prominent companies like Google, Twitter, and other tech reporters) while reading an article about the feud between Apple and FBI help analyst in coming up with analysis of the stock price movement?”. All of the interviews were audio-recorded with participant permission and transcribed for analysis. I examined the data to find how participants responded to my questions. I created commonly occurring thematic evaluations and have reported them in the findings below.
Figure 9: Navigation Sequence for the analysts.

Findings

Helping to Discover Knock-on Effects

Interviewees found it useful to view highlighted keywords within the news article and using these keywords to find new social media opinions, as it allowed them to create new exploration threads without losing focus on the current one. They felt that this would allow financial analysts to recognize knock-on effects by helping them find tweets that best informed their research thesis. I7 felt that this method of showcasing tweets was much more efficient and productive for analysts compared to the traditional method of subscribing to tweets.

Primarily for our users, they are always thinking about what is the investment thesis here. So, let’s say the story was negative for Apple (talking about scenario-1). If I know that Apple is in trouble, I would want to think of investment thesis I can generate from that. Maybe I don’t want to short Apple, because the news is already out and the whole world is shorting Apple. You are not going to make any money by shorting Apple. Maybe there is a supplier
Finding New Perspectives

Based on the interviewee’s insights, I discovered that financial analysts are primarily concerned in understanding the development of a particular event from new perspectives. They felt that this understanding was easier as TweetSight improved the discoverability of tweets. They felt that using my tool’s design, the analyst could discover tweets of support or disagreement by important tweet handles such as Sundar Pichai (in scenario-1), the CEO of Google, a Wall Street Journal reporter or another respected financial analyst. They were more skeptical of tweet handles that they did not know.

*The first tweet is... (referring to a tweet which has financial numbers)*

this tweet has more impact than the other two because of getting to fundamental numbers that might change someone’s analysis. The analysis would themselves know that but if they don’t, that is the tweet from the article to pull. But again, my point is that the content like that is more impactful - I7

They also felt that TweetSight would allow analysts to form their own perception. However, I3 felt that the analyst might need to verify these opinions with fundamental numbers before presenting these perspectives in a research report.

*But if you had a very technical article about a very niche portion of cyber-security of semi-conductors, then using this technology would help to find the smart people whom you did not know existed on Twitter that aren’t in the social consciousness rather than big news event where a lot of content is*
being produced where most of it is probably going to be regurgitating what
they have in the news article. - I8.

Additional Context

They also thought that TweetSight will be useful when an analyst reads articles containing jargon
or technical nuances beyond their understanding. In this case, having the opinion of a subject
matter expert on the right-hand side can help the analyst to decipher the news article as a part of
query exploration process.

I don’t think it improves the reliability, it certainly improves the
discoverability. It makes it much easier for the customers to find tweets that
they care about - I9

Keeping Abreast

The interviewees felt that subscribing to get future tweets would allow them to follow
developments on the fly. Analysts must follow any developing themes, however, it is difficult to
constantly monitor numerous themes. Therefore, they appreciated the ability to receive
notifications about new tweets as notifications without having the need to go back the the news
article.

That is pretty handy. It is saving me the time which I will spend
you know putting in keywords or looking for it myself. If I can get
relevant alert setup which notifies me pro-actively it is helpful. - I10
Making Connections

Interviewees found the idea of co-occurring statistics most relevant and useful as a design feature in the tool. I11 felt that presenting co-occurring companies and entities below the news allowed the analysts to gain an overall idea about the direction of themes associated with the company. He saw this happening as an analyst tries to link opinions on Twitter with the companies and entities mentioned in the co-occurrence keywords.

*I think it is useful specifically if you are talking about co-occurring products or those kinds of things. For example, if I want to see what people are saying about the new IPhone, and I am reading an article on Apple; I think I can quickly add Iphone co-occurring keyword to see what people are saying exclusively about Iphone -* I7

I8 felt that this feature will be more useful when digging deeper into research and creating new perspectives, versus uncovering tweets which break information on social media. Overall, analysts talked about its potential use case in understanding the developments between rival companies in a particular sector. They felt that this feature has the potential to uncover valuable tweets which cover the competition space between two companies but are not very easy to find.
Chapter 7  
Discussion, Design Implications and Limitations

Discussion

In study-1, having a good combination of product managers and subject matter experts provided interesting insights into the work of financial analysts. These insights include understanding workflow from a technological viewpoint and the stages in which they use social media. In the first part of this section, I try to understand and situate the work process of the financial analysts within the conceptual framework of sensemaking loop (Pirolli & Card, 2005).

- **Search and Filter**: Analysts start their process of work with the first step of performing query operations and collecting information from various sources which include news, social media, financial metrics, and press releases. Often standardized tools are used for automated query processing. These include products such as Terminal, Platform, or in house tools. Analysts also visit other personally vetted informative websites and applications which can provide the essential information to start their information collection process.

  Irrespective of the chosen method, results obtained from these information sources are filtered based on analysts’ chosen parameters and bookmarked for extracting useful information. These can be thought of as *shoeboxes*. Depending on the choice of method, analysts might also use external applications such as Microsoft Word, Notepad, or physical notebooks for taking and maintaining research notes.

- **Read and Extract**: From the bookmarked raw data present in the shoebox, analysts shortlist useful information snippets, called evidence, that are useful in forming inferences. Analysts
store these evidences in the form internal research drafts. I feel that break through tweets can also serve this process acting as evidences. Analysts can then use the pieces of evidences for triggering new hypothesis or fresh line of searches.

- **Schematize:** The information from the internal research drafts are re-represented and used in creating a financial model. The financial model can be thought as a schema representation create by the analysts. In the next step, they iteratively use various information shortlisted in the research notes to evaluate a hypothesis. I feel TweetSight helps analyst by externalizing

![Diagram of sensemaking loop with the work transformation of the financial analysts](image)

**Figure 10:** Mapping of sensemaking loop with the work transformation of the financial analysts

the re-representation process and shortlisting important relevant tweets based on the important news items they have shortlisted in the research notes. Sometimes, if the model is
not providing accurate results, they can also re-represent the financial models to improve their analysis results.

- **Build case and tell story**: The financial model is then used to build insights and support a predictive hypothesis. The analyst records these insights and hypothesis in an official document called a research report. The customer is provided a copy of the research report.

- **Knowledge product**: Using the help of their research report, the analyst pitches the trade idea to their client in the form of a presentation. The trade ideas provide investment strategies for their client. The amount of commission the financial analysts earn is dependent on the quality of the research report and trade ideas.

I also discovered important problems which create hesitation in the mind of the financial analysts while using Twitter. However, based on the results of my first study, I feel there is a strong scope of increasing the potential of Twitter in financial analysis. I felt that there are many attributes of Twitter which make it useful as an information source for qualitative analysis. Using my tool, I try to bring out a few such features.

**Multi-dimensional usage of TweetSight within sensemaking activities**

Building upon the discussion of previous section, the design of TweetSight can support analysts at multiple stages of the sensemaking process. First and foremost, it can act as an external data source. The analyst can perform query exploration using tweets while reading the news to gain new insights into the market. For instance, while reading a Tesla news article, the analyst can stumble upon an important tweet related to General Electric which the analyst might add in his or her research notes (shoebox). Second, the tool can also act as an evidence verification mechanism for news items in their internal research documentation while they are extracting essential information as an input for their model. The analyst can verify the facts of the
news using contextual tweets. Finally, the tool can also allow the analyst to use breaking tweets as evidences in the research reports or presentations to build their case and argue towards their hypothesis.

**Design Implications**

**Making reliability of tweet handles more open**

Even though TweetSight improved the discovery of important tweets, reliability of the tweet handle who tweeted the content was raised as an issue by Interviewee 7 and 9. Despite the assurance of verified accounts using verified account tick, they were hesitant in using important and relevant tweets of tweet handles they did not know personally. I plan to improve this by showing additional information when the user hovers over the tweet handle. This information includes but is not limited to most retweeted historical tweets by the user, information from the Wikipedia page, and other relevant information.

![Figure 11: An example Wiki Infobox for a Tweet handle from Scenario 3](image-url)
Wikipedia Infobox, and an option to give endorsements (in the form of thumbs up or down) by other fellow users.

It is a common practice among the analyst to reach out to various subject matter experts to understand the information in a better fashion (Soltes, 2014). The information such as endorsements, historical tweets and Wikipedia information can be used to mimic this kind of behavior in the online space and improve the credibility of the tweet handles.

Notification Overload

Another challenge which I12 mentioned is to control the number of alerts which a user receives using the subscription feature of the application. The subscription feature is designed to allow analysts to subscribe to contextual tweets which will arise in the future in relation to the news article the analyst is browsing. It is possible for the user to become overwhelmed by the number of notifications they receive when subscribing to multiple news items. It is possible to overcome this challenge by allowing the users to control the frequency of the alerts they receive by changing them to hourly or daily.

Refined Refinement

Another direction of design improvement is to facilitate two-way refinement. In the design evaluation interviews, few interviewees saw the potential use of using tweets as an anchor point to reformulate and discover news items. It is interesting from the perspective of design for a few reasons. First, news is one of the most important sources of information for the analyst to start a new thread of research. Therefore, finding an important news item is also valuable for the analysts. Second, news suffers from a similar problem as compared to Twitter – too much noise.
Providing a way to cut through that noise and read relevant news can be potentially useful. Finally, it is possible for the user to discover contextual tweets which can create a new line of research. Allowing users to find relevant news using this tweet information can help them find relevant news articles.

**Beyond Cashtags**

Cashtags (such as $APPL) are a variation of the hashtags feature used on Twitter. Even though it is a highly useful feature to filter financial tweets from normal ones, interviewees mentioned that cashtags are mostly used by companies listed in American stock exchanges which will limit the tweets results to a geographical location. Events occurring outside America will naturally have fewer tweets. To overcome this problem, alternative filter options are required. These options can include a threshold number of retweets and likes. Tweets having lesser retweets or likes than the threshold will not be fetched.

**Limitations and future work**

In my design research study, I used medium fidelity prototypes as a medium to receive quick feedback on my design solutions. Even though they were quite effective in receiving quick feedback, they are limited in the range of activities they provide to the users. It is possible that this limitation could have inhibited the participants from providing perfect feedback and pointing out all of the exhaustive problems. In order to minimize this possibility, I plan on performing a longitudinal study after developing a working prototype of the tool. In participatory design philosophy, it is productive to conduct multiple iterations of design evaluation by involving the users to develop a more effective application. Another limitation was my constraint to conduct
limited and short design evaluation sessions. It restricted me from providing the free exploration of the prototype to the participants. I was obligated to provide a quick walkthrough of the problem and solution.

This research suggests the following recommendations for future study. First, a study with a more diverse population of financial analysts needs to be conducted. In order to capture the most essential problems, the current study only constituted participants with extensive experience. However, going forward it would be beneficial to evaluate the working prototype of TweetSight with financial analysts across multiple organizations and specializations to receive exhaustive feedback and make the tool more general. Another direction for the study can be to evaluate the effectiveness of TweetSight in the overall process of financial research. A longitudinal research study aimed to understand the actual usage for research projects can help us understand the benefits it is providing at various stages of the sensemaking process.
Chapter 8
Conclusion

In this thesis, I explored a design research study of TweetSight. It constituted of two parts. First, I tried to understand the motivations and the problems associated with social media usage in financial industry. I also discovered essential problems around one of the social media tool Twitter, decreasing its potential to be used as a major information source by these analysts. Second, based on this information I showcase design of a new tool called TweetSight to facilitate the sensemaking process of the financial analysts. In addition, I also conducted initial design evaluation to understand the impact of such tool on the analysts. I feel my findings provide a significant impact on the society of financial analysts by providing them quality
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Appendix A
Interview Questions

Guiding questions

1. What is your typical work session like? What are the essential deliverables?
2. How is it different from research analyst?
3. What are the essential elements that go into these deliverables?
4. How and where does news and social media (if at all) generally come in these essential elements?
5. What essential decision making information you extract from above mentioned elements? How long does it take?
6. How do you use terminal in your work-session? What are the most used functions?

Specific questions

1. Understanding their work process

   a) How would a typical day be for a sell (side\buy) analyst? [Sequence]
   b) What is your end motive/product of your work? [Specific]
   c) What are the most essential elements which go into your end-product? [Specific]
   d) How and where does news generally come in these essential elements? Purpose of the news [Sequence]
   e) What essential decision making information you extract from social media and news information? [Quantity]
f) How do you chose trusted sources to get this information? Is it based on your company or client? Does the strategy change often? [Specific]

g) How does other analyst's (buy side) thought process differ in this process.? [Peer Comparison]

h) How do your higher-level manager use the same news/social media elements for his purpose? [Other viewpoint]

2. Understanding the job of terminal news in the specific process. It's impact and usage.

a) How much do you rely on terminal news to make a specific decision in pitching process? [Specific]

b) How do you use/browse social media and news elements while working on your product? Can you give an example? [Sequence]

c) In which terminal function, do you start using news in the terminal most often? (Given, there are multiple entry points.) [Specific]

d) Do you customize the news you see in the favorites at the bottom? If yes, what are preferences for customization? [Specific]
Appendix B

Design Scenarios

Scenario-1

Tom is a sell-side analyst working for the company XYZ. He covers Technology sector and currently has 5 companies in his portfolio. He came to office early morning (at 9 am) so that he could complete and deliver the periodic report for Ebay (one of his portfolio items). This work kept him busy till 3pm. After completing the report, he feels the need to catchup with today’s happenings in the Technology sector. He starts browsing through the news feeds which Bloomberg is providing him in his customized feed. He comes across the news item labeled “Apple, The FBI and iPhone Encryption: A Look At What's At Stake” Mar17, 2:18pm. As Apple is in his portfolio item, he is interested in the news item which is becoming big story. He opens the news article and starts reading the article. The news item talks about how the FBI vs. Apple is going big about the issue of privacy about which all the tech giants are concerned. He suddenly wonders if there might be a possibility of this news becoming big and spread across industry. He is also wondering what is the overall atmosphere across the companies in the technology industry. He feels, he might uncover interesting connections in the news which can possibly allowing him to research knock-off effects in the industry.

Using our interface when Tom tries to read the same news article as mentioned above he will see tweets pop-up from Rob Pegoraro about “Google's CEO agrees with Apple's stance on encryption. In case you were curious about that... ’ privacy” (at 4:00pm) and by Jack “We stand with @tim_cook and Apple (and thank him for his leadership)! http://www.apple.com/customer-letter/ ...”. These tweets are caught and shown by the system because I know with my past news
corpus that Google co-occurs with Apple frequently and also because Rob is curated tweet handle by Bloomberg. These tweets give analyst signs that there is positive support towards Apple on FBI case thereby chance of share moving.

**Scenario-2**

Claudia is an automotive analyst who works as sell-side analyst in a bank. One of her stocks in portfolio is Tesla. From last two days the buzz of Tesla's new model 3 unveil is building up as Tesla is going to open up pre-orders from tomorrow (Mar 31, 2016). Claudia comes across a news headline - “People are already lining up in tents to pre-order the Tesla Model 3”. She becomes curious to understand the knock-on effects of the hype created around the Tesla car on upcoming GM's Bolt.

Claudia opens the news headline in my tool and starts glancing through it. As she is reading the article, she realizes the anticipation built around the car which is going to release tomorrow. She quickly recollects at that General Motors was also expected to release its own electrical car alongside Model 3. She then becomes inquisitive about the effect of such news on people's perception around Bolt. Keeping that in mind she expands the co-occurrence statistics box to see that GM is occurring most alongside Tesla from last week. Claudia then clicks on GM to re-formulate the tweets which are occurring on the right hand side. Quickly, she can see the tweets from prominent news reporters and analyst expressing their negative opinion on the absence of hype around GM's car (solution-3).
**Scenario-3**

Bill is buy-side analyst. He covers sports sector. He portfolio is quite diversified. He has few Football clubs under his belt which are well known. He turns up early in the office and starts checking early morning news. As he scrolls through the news one by one, he comes across a particular news item which catches his attention. “Johann Cruyff: Soccer Mourns Dutch Visionary Who Inspired Modern Barcelona” by Wall Street Journal. Johan Cruyff a famous football player who belonged to the club during his career (1957-1984) had died today. The news item covers his great days in the football and how his excellent performance had brought him fame. The article also covers a small background about him, his starting days in Ajax FC (a listing which the analyst is having in the holding). Out of curiosity, he goes and checks the stock price of Ajax FC.

He is observing that the stock price of Ajax FC increasing. He wants to know additionally the exact reason(s) as why it is happening so that he can use it in his report. Using my tool, he would be seeing tweets within the context of the news without any extra effort. By default, I will be showing only tweets from the curated Twitter handles by Bloomberg. As soon as he starts reading the article, he will be shown tweets within the scope of the news article. Initially he sees a lot of tweets in general to Johann Cruyff and his death. He is not satisfied with results. They don’t talk anything about the market movement. He then feels he might get better results if he adds the keyword *Ajax FC* from his news to further refine the Tweets. He adds the keyword Ajax FC and then he is returned with the following result shown below by Alasdair Pal (at 9:09am) and few other twitter handles.

*Love this: everyone is buying 14 shares in Ajax as a tribute to Johan Cruyff. Beautiful.*

He now knows the possible reason why the stock of Ajax is having positive movement. All the fans of great footballer are buying 14 stocks in his memory at very regular intervals.
Scenario-4

Lynda a Fund Manager covers Pharmaceutical sector in XYZ hedge fund company. She has 4 analysts working under her to cover various Pharma stocks. She wakes up early morning (7:00 am) switches on her work system and catches up with latest news. She has subscribed to major Pharma companies in news feeds which her team covers. One such company whose news cropped up today at 7:00am was “Heat Biologies”. The news article talks about details of Heat Biologics major next step in fulfilling their goals titled - Heat Biologics Inc (NASDAQ:HTBX) Is Today’s NASDAQ Focus. As she is reading it, there is a major report & an announcement which has come out from Kerrisdale Capital a major investment firm stating another major pharma company called Sage therapeutics drug trial has failed and there is good possibility of stock degradation (6:27 am). This is re-tweeted within 20 min by Martin Shkreli one of the most controversial figure in Pharma industry. This news eventually results the stock to drop for that company by a big 20%. This is not covered by news till 12pm that day. Therefore, even though it was in Tweets and is related to interest and scope of Lynda, I want to ensure she does not miss this great opportunity.

In our designed interface, once she reaches the news page where she is reading the news item - Heat Biologics Inc (NASDAQ:HTBX) Is Today’s NASDAQ Focus, my text mining algorithm can figure out that Heat Biologics was in news alongside Sage Therapeutics within last week and therefore show important happenings from the Sage company. As the most important tweet about SAGE at the time was from Martin Shkreli, who is present in Bloomberg’s curated handles, his tweet and Kerrisdale Capital tweet will be shown in shortlisted tweets.

“A case of a "good company" with an overvalued stock. No disrespect to SAGE, but sometimes stocks get too expensive. “
The above tweet by Skkreli provides his opinion that the stock is undervalued.

**Scenario-5**

John is a sell-side analyst covering Pharmaceutical industry. One of the company covered in his portfolio is Pfizer. Pfizer has recently come under limelight for initiating being a part of merger with Allergan. It is surrounded by controversy as the small European company buying-out huge US Company giving it rights to trade outside US with less consequences in taxes. When the analyst opens the news feeds, he is bombarded with news (9:00 am) with an April fool prank occurred regarding the merger outraging the company. However, which most news did not cover till afternoon was the positive results of a cholesterol reducing drug in preliminary trials. This news along with the call off on merger on 4th April caused the Pfizer prices to improve +10% (appx).

Using my interface when the analyst is reading the article, he can see in co-occurrence statistics box that Pfizer is co-occurring with Allergan from last one week for the obvious reasons. Additionally, he can also see that the drug called 'Bococizumab' occurring in the third most related entities during the last month when the trial started before all the merger controversy. When the user clicks on Bococizumab the tweets on the right sight are re-reformulated to show, tweets mentioning Bococizumab along with $PFE$. The resultant breaking tweets by investment firm called Bio stocks and other analyst mentioning the successful completion of trial can be found as early as 5:00 am in the morning.
Appendix C
Design Artifacts

Storyboards

Storyboard-1
Storyboard-2

Storyboard-3

Notify the center handles all the incoming data from different sources. The user can click on notifications to go to the source (like report).
Apple Has Gotten Federal Orders To Help Unlock At Least 13 Devices

While the dispute over cracking into an iPhone used by the San Bernardino shooter is at the center of a legal case between Apple and the FBI, the company recently told a federal court that it has received — and resisted — similar orders to help unlock iPhones and an iPad in recent months.

That’s according to unsealed court documents in which Apple says that since early October, it’s received orders to access data on 12 devices, from an iPhone 3 to two iPhone 6 Plus models. In the documents, the Department of Justice says the list is secret — and adds that it found “at least one additional All Wits Act order” for obtaining information from an iPhone.

None of the court filings comes ahead of Friday’s deadline for Apple to formally respond to a federal court order in the San Bernardino investigation. Today, Theodore J. Boutrous Jr., a prominent First Amendment lawyer who is a lead attorney for Apple in the case, tells The Associated Press that the company will tell the judge that the case should be decided by Congress, not by the courts.

“The FBI is relying on a law called the All Wits Act from 1799 that’s been used to compel companies to assist law enforcement in investigations,” NPR’s Alina半 said in an April 2017 AP story. “And Boutrous told the AP that Apple also plans to argue that that law has never been used to require a company to write software.”

In the court documents, Apple says the requests for it to help get inside the devices came from U.S. Attorney’s Offices in a range of districts, including New York, Illinois, Massachusetts, and California. The company has said that complying with such orders would require it to create a software tool that could make millions of iPhones vulnerable to invasions of users’ privacy.

An attorney for the tech company, Marc Zavilles, submitted the list of such government orders on Feb. 17. It was in response to a request from a federal court in New York that was weighing a similar dispute over an iPhone in a drug case. The government responded on Monday, and Apple’s list was unsealed Tuesday.

Content Analysis

Basic content body vs. Comments analysis w/ configurable settings and...
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Design prototype

Prototype Screen-1

Contextual Tweets - Opinion discovery with news

News article

People are already lining up in tents to pre-order the Tesla Model 3. 

Pre-orders for the Tesla Model 3 are slated to open tomorrow, according to Tesla's own announcement. As a result, we've already seen a number of reports of prospective Model 3 buyers lining up outside of Tesla stores and dealerships, in order to get their orders in as soon as possible. It remains to be seen how many of these early customers will actually end up buying a Model 3, but it's clear that the company has done a good job of generating buzz. Considering the current state of the electric vehicle market, it's not surprising that Tesla would be able to generate interest in its new product. As we've seen before, Tesla has a history of creating a lot of buzz around its products, and it's likely that the Model 3 will be no exception.