Project Title: Mobile Forecasting User Interfaces (MFUI)
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SAS-IIF Final Project Report

Executive summary

This report explores the potential of mobile forecasting (m-forecasting) to enhance collaborative forecasting practices. This research project was made possible via a SAS/IIF 2011-2012 grant award on how to design mobile forecasting applications and solutions to improve business forecasting practice. Mobile devices such as PDAs, smartphones and tablet computers are becoming increasingly popular, setting out opportunities for new ways of communicating and collaborating. However, m-forecasting poses challenges to researchers and software vendors in designing tools that respond to real users and stakeholders' needs. One might question, for instance, will m-forecasting be as effective as other medium for sharing information or forecasts given its limited textual presentation? In three focus groups user sessions and individual interviews with designers/technology experts, we ask why participants prefer particular specific scenarios and which they would expect to be part of an application. Based on the findings, we suggest a set of mobile user interface guidelines and outline the directions for future research that could increase our understanding of and design requirements for the development of highly effective m-forecasting interventions.

Keywords: Forecasting support systems, Forecasting practice, Software, Mobile interfaces, user-centred design.

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1. Introduction

The past two decades have presented significant technological developments of mobile information and communication technology (ICT), such as portable technologies (e.g. mobile phones, notebook computers, personal digital assistants), and associated wireless infrastructures (e.g. wireless local area networks, mobile telecommunications infrastructures, bluetooth personal area networks). Mobile ICT offers a range of technical opportunities for organizations and their members to implement enterprise mobility. The explosion of mobile applications can be seen in just about every industry, but here are a few of the more notable ones: retail (location-intelligent mobile commerce), travel (mobile booking, check-ins, maps, and deals), healthcare (patient records, physician notes) and finance (apps for real-time trading, portfolio analysis). And mobile apps are running rampant in the business-to-business (B2B) world as well, including spaces such as: business apps in customer relationship management (CRM), enterprise resource planning (ERP) and human resource (HR) system, productivity (docs, spreadsheets, presentations) and collaboration tools (email, publishing). For example, touch-sensitive devices such as the iPhone/iPad and Android have inspired mobile developers to design applications from PC's to mobile devices, as well as the development of thousands of new mobile applications (Qian et al., 2011). Examples include tools for work (e.g. PDF readers), social networking (e.g. Facebook mobile), educational applications (Dini et al., 2007), and mobile banking (e.g. Lin, 2011). Thus, as mobile technologies advance, it is anticipated that people will spend more time interacting with these devices and use them to meet their work requirements. While these technologies offer the benefits of portability and ubiquity, the small visual displays and mobile interactions introduce a variety of challenges. For example, as much of the information is presented to the user through the visual channel, the user is required to focus on the screen to perform a task.

The potential of new mobile applications, along with the technical environment of cell phones and the behavioral challenges posed by a new user base, offer a fertile area for research and development in business forecasting. Consequently, this project explores the potential value of adopting m-forecasting services for effective collaboration and principles that support better user experience (UX). The challenges of unlocking opportunities of enterprise mobility in the area of forecasting are not well understood. Naturally, vendors planning the design of mobile forecasting applications face a familiar high-tech problem, ‘‘How do you know what features customers will want and use from a technology that has not been available before now?’’. Mobile devices connected by wireless technology have changed the ways in which people communicate with each other as well as interact with computers, and the change will continue with the introduction of new mobile devices and services. Existing mobile devices include mobile phones, personal Digital Assistants (PDAs), and smart phones. Another term for the mobile devices provided by Weiss (2002) is “Handheld devices,” which is defined as “extremely portable, self-contained information management and communication devices” (p. 2). These devices are also small, lightweight, and best operated while held in the user’s hand, such as PDAs, pagers, and mobile phones.

Thus, the technical environment of cell phones: the small screen and numeric keypad layout may impose physical constraints for content delivery and interactivity, when compared to traditional computer environments. The second critical issue is to understand how people use a mobile phone to interact with content, as the delivery of data into cell phones is likely to change how companies serve customers with new products and services. Another key issue is to design mobile systems around working practices that are deemed usable by both individuals and the organization (Sanders, 2007; Smith & Mentzer, 2010). As an addition to the traditional understanding of individual usability and single-user interaction in forecasting tasks (Makridakis et al., 1998; Armstrong, 2001), organizational usability emphasizes the role of mobile ICT beyond individual support. Sanders (2007) also suggested that organizational collaboration -the foundation of supply chain management- has been enabled by the development and use of e-business technologies. Sander’s empirical research revealed that the use of e-business technologies impacted organizational performance and collaboration (internally and externally).

Since 1995, e-commerce, e-business, and m-business (mobile business) have also increased dramatically. M-business, in particular, has the ability to change lives and ways of conducting business as consumers and mobile devices have become inseparable (Kalakota & Robinson, 2001). With a penetration of 84 percent of mobile subscribers in the United States, with this percentage surging to 100 percent by 2013 (Kagan, 2007), the mobile phone and network is promptly becoming a feasible channel for business. For example, as indicated in ICT Statistics Newslog (2010), the worldwide number of users of m-banking and related services is forecasted to grow from 55 million users in 2009 at a compound annual growth rate of 59.2% to reach 894 million users in 2015. Market tracker iSuppli Corp. expects smartphone shipments rise 105% from 246.9 million in 2010 to 506 million units in 2014 (Sherr, 2010). Shipments of tablet computers like the iPad are expected to grow from 19.5 million units in 2010 to 208 million units in 2014, according to Gartner Inc. media analysts (Gartner, 2010). In addition, a growing number of electronic health (e-health) functionalities to support electronic healthcare practice have been made available on mobile platforms, making mobile-health (m-health) applications an important subset of e-health applications (Hairong Yan et al., 2010; Hernandez et al., 2001, Vital Wave Consulting, 2009).

The rest of this report is organized as follows. After describing a review of mobile services and applications in section 2, in Section 3 we briefly discuss the reasons why mobile devices are a promising platform for delivering forecasting interventions. In Sections 4 and 5, we review the scenarios and the empirical findings and the types of interventions that m-forecasting applications may enable. Finally in section 6, we discuss the user interface guidelines for m-forecasting, the limitations of this research, and the opportunities for future work in this area.

2. Prior research on mobile services and applications

To date, most research on forecasting support systems (FSS) has focused on the advancement of forecasting models as well as the application of adjustments to statistically-generated forecasts (see Makridakis et al., 1998; Armstrong, 2001; Fildes et al., 2006, 2009; Despagne, 2011; Fildes &

Goodwin, 2012). Desktop FSS have been reviewed and their benefits for improving organizational performance and accuracy was identified and reported in the literature (e.g. Tashman, 2001; Küsters et al., 2006; Yurkiewicz, 2010). Although many commercial FSS have been developed over the years which showed significant improvements in terms of accuracy and performance, issues of user interface (UI) design and collaboration among the different stakeholders still remains an important issue (see McCarthy et al., 2006; Småros & Hellstrom, 2004; Småros, 2003; Sanders, 2007; Smith & Mentzer, 2010). Mobile technologies appear to hold the promise of significantly enhancing forecasting process and collaboration between different stakeholders involved in forecasting (e.g. salespeople, users, managers and customers). Collaborative Planning Forecasting and Replenishment (CPFR) is a concept that employed by supply chain partners to strengthen their relationships in process management and information sharing (Seifert, 2003). In addition to this, Collaborative Forecasting (CF) as an element of CPFR plays the bridge role among partners to strengthen their communication and to build joint forecasting for better demand visibility in the supply chains (e.g. McCarthy & Golicic, 2002; Aviv, 2007).

Mobile devices are a particularly attractive avenue for delivering forecasting interventions because of: (1) the widespread adoption of phones with increasingly powerful technical capabilities, (2) people's tendency to carry their phones with them everywhere, (3) people's attachment to their phones, and (4) context awareness features enabled through sensing and phone-based personal information. A study found that even in 2006 individuals were within arm's reach of their phones on average 58% of the time (Patel et al., 2006). Mobile phones are also used for a range of activities throughout the day, from calendaring and email to social networking, financial tracking, and playing games. As a result, the personal nature of mobile phones can reduce the barriers to adoption and increase acceptance of m-forecasting interventions by integrating forecast-related information with a tool that is an integral part of individuals' daily routines and to which they often have positive emotional attachment. Finally, the combination of their technical capabilities and the proximity to their owners means that through embedded sensing (e.g. such as GPS location tracking), and access to market knowledge, mobile phone applications can infer where their users are and what they are doing.

This knowledge, in turn, makes it possible to create just-in-time interventions that provide users with support at times when that support is most needed. Such interventions can be particularly useful to minimize inaccurate forecasts, or lack of information about a particular product, where product forecasts or accounts are often strongly tied to particular contexts or local knowledge. The authors suggest that the ability to detect such scenarios could enable us to provide users/forecasters who are located in the organization with assistance and information before they produce a forecast, thus potentially eliminating forecasts based on 'gut feelings' or damaging adjustments (see Lawrence et al., 2006; Goodwin et al., 2007; Fildes et al., 2009).

Much work has been done in the area of empirically studying UI for mobile devices in the financial services, business intelligence or healthcare applications, however, we could not find any work on UI (which we felt naturally derived from the capabilities of existing desktop FSS) for mobile forecasting. We consider the nature of this study to be exploratory and, consequently, did not propose any priori hypotheses. However, we do expect to identify several salient scenarios that possibly motivate (or inhibit) m-forecasting services design. Designing mobile forecasting applications may also present different challenges and opportunities for both forecasting research and practice.

Specifically, a number of open issues deserve analysis and discussion, such as:

- ❑ How could mobile forecasting applications benefit users in business forecasting practice?
- ❑ What are the main tasks/features towards mobile forecasting applications and how these may be adapted to different user roles?
- ❑ How can mobile UI empower users/stakeholders with the knowledge necessary to make and sustain better forecasts? In particular, how to encourage salespeople and customers to provide accurate collaborative forecasts?
- ❑ What would be a roadmap for further research and mobile application development for forecasting?

However, the promise of these new devices may remain unfulfilled if users resist or reject the device because the device or its software is not enjoyable to use, or is not intuitive and easy to learn.

For instance, when it was first released the touch screen enabled Blackberry Storm was criticized by reviewers (Segan, 2008; Cha, 2008) for the difficult learning curve of its user interface.

3. Mobile devices requirements and constraints

Mobile technology is more complex than other types of Information Technology environments, as it includes not only the hardware (handheld devices) and software (interface and applications that run in these handsets), but also the communications networks that make possible most of the mobile services (Jarvenpaa et al., 2003). In addition, mobile devices are considered hybrid because they usually combine voice and data features (Sarker & Wells, 2003). Some devices originally designed for voice features are increasingly used for data-related applications. Unlike information systems operating in traditional computer environments, mobile applications present visual and motor challenges to users because they are delivered through handheld devices. In the case of mobile phones, the small screen and numeric keypad layout of the handset may present physical constraints such as difficulties in reading/comprehension due to small screen displays, as well as interactivity restrictions related to the use of fine motor skills when operating the keypad (Buchanan et al., 2001; Palen & Salzman, 2002). Despite these limitations, prior research suggests that users are able to deal with the physical requirements of new mobile environments. For example, Rahman & Muter (1999) examined reading efficiency in different types of small-display presentations. Their findings suggest that reading comprehension is not affected by the type of display because users are capable of physically adapting to smaller screen sizes by reducing their eye movements. In the area of visual and motor skills, Buchanan et al. (2001) studied three types of navigation in an application that delivered news headlines to mobile users. Each navigation scheme (horizontal scrolling, vertical scrolling and paging) required a particular keystroke and resulted in a different visual effect. Their results indicate that while vertical scrolling is more natural than horizontal scrolling, any scrolling is potentially tedious when used extensively. In contrast, paging (moving through pages) represents a trade-off, as it is less monotonous than scrolling but adds a layer of complexity to the interaction. However, their study found that user errors with each type of navigation scheme were very low and not significantly different from each other. In addition to featuring differing keypad layout and screen sizes, mobile phones operate differently from one another, depending on the type of phone. Even if users are familiar with their handsets, they may not be well versed in using these devices for receiving data or downloading content-based applications. Through experience, users develop a set of skills and relevant knowledge that leads to effective performance with a particular technological environment (Schenk et al., 1998). However, lack of familiarity is likely to result in a wider range of challenges for new users of mobile data services, when compared to users who have experience with other mobile data services. Overall, the results of prior empirical studies with mobile technology suggest that user performance with new applications largely results from the user's understanding and subsequent ability to adapt to the physical environment provided by the mobile IT artifact (device and application), given the requirements of the task at hand.

Ideally, mobile applications should also satisfy three desirable properties. First, in spite of the inherent limitations of the underlying hardware, mobile applications should still provide rich and non-trivial functionalities that are similar to PC applications. Such limitations are well documented, which are mainly the computational resources (i.e., CPU, memory and storage) and battery life (Sherr, 2010). Second, the application should be reliable under various network conditions. Not only must it stay responsive under severe network degradation, but also usable when the network is disconnected (i.e., offline usability). Third, the application should be available on various types of devices. Stand-alone mobile applications, which are currently predominant, run locally on a device. As such, they are generally usable regardless of network connectivity. However, the applications are relatively limited in functionality due to limited resources and energy supply available on mobile devices.

4. Methodology: A user-centred design (UCD) approach

In order to provide a good user experience (UX) with forecasting solutions, a user-centered design (UCD) process is key to understand the users' needs and limitations (see Dix et al., 2004). UCD is a design philosophy and a product development approach that places the end user of an application in the center of each design phase in order to ensure that the end product will meet users' needs, wants and limitations. The ISO 13407 (Human-centred design processes for interactive systems) (1999) is an international standard that provides guidance on achieving quality in use by incorporating UCD activities throughout the life cycle of interactive product. A UCD approach was adopted given the purpose of this study is to gain in-depth understanding of the factors influencing the design and adoption of m-forecasting; and consequently, contribute to generating interesting avenues for future research. Data for this investigation was gathered through focus group with users (forecasters) and interviews with designers/technology experts for a number of reasons. First, this method is socially oriented, and the data collected through social interaction is often deeper and richer (Thomas et al., 1995). Second, the free flow of discussion among the participants in a more relaxed atmosphere could stimulate the expression of differing opinions and points of view (Marshall & Rossman, 2006). Third, focus group interviews allows the researcher to discover deeper insights regarding the underlying motives that guide a person's behaviour, which might be largely neglected in the literature. Lastly, previous research has demonstrated the feasibility of focus group discussion in studying innovative technology adoption (Jarvenpaa & Lang, 2005).

Respondents must have at least owned a mobile device (the majority did own a smartphone) and have used FSS as part of their job to be qualified for participation in the focus group discussion. All of the participants were UK-based and all were mobile telephone users. The average age was 33 years and the participants estimated that they spent 25% of their working time outside of their office on average. Three sessions of focus group with a total of 24 users were conducted for this project. The first group of respondents comprised of six males and two females. They are participating in collaborative practices in their organization. The second group of respondents consisted of seven males and one female who have not engaged in collaborative practices in their organization. The third group of subjects composed of eight respondents. Among these participants, two of them have participated in the past in limited collaboration in their organization. Another three participants are currently involved in collaborating practices within their organization, and the remaining three participants never involved in collaboration as part of their forecasting responsibilities.

Each focus group interview lasted for about 90 minutes. The interviews were recorded with prior permission from the participants. The primary data was elicited in semi-structured group interviewing that lasted 1-1.5 hours (hand-written notes and audio recordings, i.e., qualitative data). Prior to the actual field work, a small interview with two experienced forecast practitioners was conducted as a pre-test to check that the questions contained in the interview guide could be easily understood. After confirming the qualified respondents, a verbal consent was then obtained from the participants before proceeding to the interview. An explanatory letter was distributed to willing and qualified participants. The main contents of the explanatory letter were about the purposes of the study and instructions for the interview. All participants were informed that their participation in this study was voluntary and without any obligations, and that all information provided will be kept confidential. Respondents were encouraged to express their own viewpoints that may arise in the interview. The interviewer started the interview with an introduction to the purpose and agenda of the research. The rights of the respondents, confidentiality issues as well as the reasons for the audio taping of the session were highlighted. For warm-up questions, the respondents were asked to introduce their own backgrounds such as hobbies, general interest, schedule, and their main responsibilities as forecasters. Thereafter, the researcher started the discussion by asking them questions related to this research.

In particular, the respondents in the first group were asked to describe their experience in collaborative practices, for example, what aspect do they like (or dislike) about using this practice. Respondents were also probed to express their feelings and intention to continue involved in collaboration as well as whether mobile technology could support them in better collaboration. Lastly, discussion relating to particular forecasting scenarios for potentially using mobile devices for collaboration was covered. In the second group where none of the respondents involved in collaborative practices, they were asked to express their feelings about using mobile devices for specific forecast scenarios and the reasons why they were not involved in collaboration in their organization. In the third group, since there were both practitioners with experience in collaboration and those without collaborative experiences, the participants could exchange their views about collaboration and mobile devices use in forecasting with each other and thus stimulate the discussion allowing salient points to arise. The researcher has also stimulated the discussion with potentially specific scenarios where mobile devices could be used during the forecasting process.

In addition to the focus groups, this research has also initiated 12 further interviews with designers and experts of web-based and mobile applications. The experts included 6 IS development managers, 4 mobile software designers, and 2 executives from m-commerce related industries. To provide idea stimulus for these interviews, we asked each participant at the beginning of the interview, to tell us the first thing that came to mind when they thought about forecasting services that could be provided with the next generation mobile devices. We interviewed each of the participants individually over a 16-week period. The interviews averaged 50 min. In each interview we spent the first 5–10 min on warm-up conversation and discussion of the interview objectives. The interviews have mainly focused to derive a set of best practices that should be followed in mobile applications or services design, as well as how to best support the forecasting scenarios. In addition, we have asked the technology experts about the potential use of: SMS messaging, cameras, native applications, and Internet access for delivering forecast information. The following section summarizes the ways technology experts reported that m-forecasting interventions may take advantage, to a greater or lesser degree, of these capabilities.

4.1. SMS messaging

According to the technology experts, the widespread use makes text messaging the most universally accessible technology for mobile-based forecast interventions and possibly the most accessible way of delivering forecast information of any kind. Beyond its accessibility, text messaging has seen broad adoption as a technology for two other reasons. First, text messages are a push technology, allowing intervention messages to be delivered without any effort on the part of the recipient. As such, text messages are often used for sending reminders, tips and other content, and for maintaining users' awareness of their forecast goals. Second, because text messages can be sent and received by both phones and computers, text messaging provides a way for users to log their products-related activities and other information (e.g. sales price, promotions) and to receive customized feedback based on these data. The ability to process text messages automatically makes it possible for the complete information exchange in an intervention to be done via SMS -users can be sent reminders to log relevant data, they can reply to reminder messages with the requested information and the system or application can process these responses and send users feedback customized to the current forecast process.

4.2. Cameras

In recent years, cameras have become a standard feature on all but the most basic mobile phones. The quality of phone cameras is still below the quality of dedicated digital cameras, but their constant availability makes cameras a useful tool for collecting product-related data throughout the forecasting process. The technology experts have suggested that cameras could be used in m-forecasting services in two primary ways: (1) as a way to provide users with additional information about a forecast, and (2) as a way to document market knowledge relevant to the current forecasting, such as the competitors' activities, upcoming promotions or price changes that might influence users' ability to produce accurate forecasts. Although photos cannot be automatically processed as easily as text can, in cases where a goal of a forecast is to support adjustments or the organizational business plan through active engagement with the user's data, phone cameras can be a valuable tool for low-effort collection of product-related information.

4.3. Native applications

All major smartphone platforms—iOS, Android, Symbian, Blackberry, webOS, and Windows Phone -provide developers with programming interfaces (APIs) that can be used to build special purpose applications. Technology experts, and in particular the mobile software designers in our study, have pointed out ways to leverage these capabilities to build several different types of m-forecasting applications that: (1) enable users to log and chart data about their products as well as track the effectiveness of their forecasts (2) receive data from ERP systems in the organization and allow the registration of field notes and activities (3) support information sharing through reporting between users and stakeholders involved in the forecasting process.

4.4. Internet access

Finally, one of the most important capabilities of mobile devices, from the standpoint of forecast interventions, is their ability to use the cellular network to connect to the Internet from nearly anywhere. This always-on connectivity means that users' information, such as upcoming promotions or local knowledge about their products, latest sales data, can be uploaded to providers' servers as soon as they are captured, thus enabling early detection of critical events. The data can also be uploaded to websites where users can easily view, chart, and edit their information. Lastly, always-on connectivity makes it possible to include web pages and online audio and video as part of collaborative practices with other users or stakeholders.

The analysis of the interviews with technology experts revealed that m-forecasting services can encompass three different kinds of forecast scenarios:

1. Routine use, such as the day-to-day activities for users and forecasting practitioners (e.g. getting regular updates for products, sales data and forecasts).
2. Mobile communication, such as the ability for a user to be reached anytime and anywhere (e.g. a sales person or a manager can be reached on his/her PDA or smartphone for consultation or advice about next forecasts).
3. Mobile information access, such as the possibility of users to access latest forecasts and reports from their mobile devices.

On the other hand, most of the technology experts have reported their concerns for dealing with mobile technology limitations in terms of enabling processing of large amounts of forecast data, the ability to access information from centralized resources, and the portability of the technology, which were seen as key components of the technology that should affect the use/effectiveness of m-forecasting services. Furthermore, given that collaboration within the forecasting industry is enabled by the ability of the users to communicate and coordinate actions with each other, the availability of multiple channels of communication and coordination, and the capability to deliver reliable service and support could also be be distributed in space (i.e., different location within the settings) or time (i.e., working different shifts) and their information needs and communication patterns are highly dependent on their location and other contextual conditions such as their role in the forecasting process or time of the day. In addition to the features of the system, work characteristics (i.e., the structure of the task being performed by the collaborators, the time pressure under which the workers perform the task, complexity of the content being dealt with by the collaborative partners, the mobility requirement of the collaborators, and the asynchronicity/synchronicity of the communication required) would also play an important role.

5. Key focus groups findings and user feedback

Based on detailed analysis and discussions with users participating in the focus groups, this section reports the factors identified as important for m-forecasting services. M-forecasting applications are envisaged as an interactive environment for situations where FSS users, sales people or managers may want to visually capture relevant information or knowledge (e.g. upcoming promotional offer in the supermarket, weather forecasts, competitors' prices, web information on events, stocks and inventories). An m-forecasting environment may also support the process of sharing information real-time, and report of this information in a user based in the organization. The goal is to increase interactivity and collaboration in forecasting with the help of a mobile device. Participants have also mentioned that specific forecasting tasks (e.g. adjustments) could be realized with the additional information provided by the users in the field. Participants reported that the benefit of a mobile service or application is that it goes where the users go for their daily work and adapts as a natural part of the daily work. Users also felt that a mobile app could serve as a recording tool, where the user updates with latest information for specific products or changes that need to be made in the forecasts. Users would, in addition, potentially appreciate a service that allows them to check information real-time before the next forecasts develop.

5.1. Perceive relative advantage

In the opinion of the majority of the interviewees, the relative advantages of m-forecasting solutions included the independence of time and place. M-forecasting was considered advantageous compared to other channels of collaboration, because people carry mobile phones with them most of the time and the mobile device mig ht be conveniently available in most situations:

"I would prefer to use mobile forecasting than other collaboration channels because it is so convenient to use mobile phone compared to laptop or computer which you need more time to start the program, go online….." (Respondent No.1, Group 1)

Another participant pointed that mobile forecasting is suitable for busy managers who always travel and time and forecast is critical to their decisions.

"I think it depends on the person as well. I mean like managers they always find way to do things faster, and they may travel quite a lot, so they will learn how to use a mobile forecasting application…." (Respondent No. 6, Group 3)

Nevertheless, the limited functionality of mobile forecasting may inhibit users from adopting this service. Among the limitations, small displays, keypads, limited transmission speed and memory, and short battery have report to diminish the usability of this mobile technology. During the focus group discussion, half of the participants mentioned about the features of mobile forecasting service. They suggested that this service should include certain features, such as providing full reports of the forecasts, notification and alert messages.

5.2. Perceived complexity

The findings also suggested that users expect the mobile forecasting to be easy to use. This is congruent with past research that found ease of use and convenience to have influence on consumer adoption of FSS technologies. One participant believed that the complexity of mobile devices use frequently emerged as a barrier to adoption. The following statement highlights this issue:

"For FSS in our laptops or desktops you are so used to typing, you can just type faster and view the forecasts, but for mobile phone you have to press the button one by one and if you reset the whole forecast you have to start from beginning again." (Respondent No.4, Group 3)

Another participant also expressed his view on the complexity of using m-forecasting services:

"Although I am using smart phone, I hardly surf net via mobile phone. To me, it is quite complicated to set up an account or application for mobile forecasting….." (Respondent No. 5, Group 2)

In sum, the focus group interviews revealed that ease of use represents a factor that enhances the adoption of m-forecasting, whereas complexity of the usage appears to inhibited the effective adoption of similar mobile services.

5.3. Perceived risk

The causes of perceived risk described by the participants included unauthorized use of mobile forecasting application, and irrecoverable consequences resulting from making mistakes with the information provided to other users. Half of the interviewees were concerned about the unauthorized use of their mobile devices. For instance, they worried that if they lost their mobile phones, or their devices have been hacked, other people might use them to access their forecasting applications and have access to important organizational data and reports. The following statements illustrate this point:

"If you lost your hand phone and if someone know your pin, then they can just use it to access your forecasting application data." (Respondent No. 5, Group 2)

In addition, it was also mentioned in the interview that the respondents are afraid of making mistakes that might lead to providing (or receiving) false information, which ultimately lead to 'bad' forecasts and decrease in their forecast performance. The following statement supports the perceived financial risk associated with use of mobile forecasting services:

"…I am not used to this type of forecasting service. I will be so worried if I accidently press the wrong button and then accidently send information for the wrong products, then it would be a hassle. (Respondent No. 4, Group 2)

It can be concluded that perceived risk towards mobile forecasting has a role in influencing the adoption of an m-forecasting application.

5.4. Network externalities

Many respondents agreed that the number of users using the same forecasting service has an influence on their intention to adopt m-forecasting services. Particularly, one interviewee feels that if many people are using m-forecasting services, she would be more willing to try it out. This respondent further explained that she feels more secured to use the service if more people using it, as shown in the following statement:

"…… like if more people in the organization may want to use it, I know that it is tested already and works for our forecasting requirements. So I will feel more secured to use it." (Respondent No. 2, Group 3)

Besides, the interviewees generally feel that the availability of complementary service in mobile forecasting might influence the consumers' adoption intention to use this service. That is, the more types of forecasting tasks can be performed via a mobile forecasting application, the more likely the users will use this service. For instance, the interviewees mentioned that:

"I would perhaps like to use mobile forecasting if I found that there are more and more types of things can be done through it …." (Respondent No.3, Group 1)

"If viewing forecasts in a graph is the only function, then not many people will use it because it doesn't create more value……" (Respondent No. 5, Group 3)

It can be seen that users expect mobile forecasting to provide more services, such as assessing organizational data and adjust the forecasts, for which market knowledge is available to them. Also, the perception of the number of users using the same service may potentially reduce the perceived risk associated with the service, which in turn increase the likelihood of adoption. It is worth noting that the number of users and the availability of complementary service are two important concepts captured in the network externalities theory, which originated from the economic field (Katz & Shapiro, 1985).

Overall, the results suggest that perceived relative advantages, complexity of usage, perceived risk, and network externalities are salient factors in determining users' m-forecasting services adoption. The finding that perceived relative advantages and perceived complexity exert influence on mobile forecasting adoption highlights the importance of innovation characteristics to vendors who are involved in the design and development of m-forecasting services. Furthermore, software need to consider making their mobile forecasting services usable and easy-to-use. For instance, the design and interface of the m-forecasting application could be created to look similar to other features in mobile phones, making it easier for users to explore this new technology. The finding that the users may be willing to adopt mobile forecasting, which they believe many others have adopted the same service is novel and should be explored further. Similarly, when the potential adopters perceive more types of forecasting scenarios available in this service, they would be more willing to try it. Therefore, vendors may reflect this network externalities effect in their promotional effort by providing information about the current number of users, the types of forecast scenarios, and the planned additional scenarios or tasks supported in the future. This information may stimulate favorable perceptions toward this service among users. The result indicates that perceived risk, past experience and lack of awareness and knowledge also entail an essential obstacle to adopting mobile forecasting. Users are also generally worried about the security pertaining to this service.

5.5. Forecasting scenarios

In this section, we aim to map out the design space of m-forecasting interventions by identifying the main forecasting scenarios that may be used for, and the specific forms that the interventions embodying these strategies take. The scenarios partially based on existing literature and research in forecasting were rather positively received by users, mainly demonstrating the possibilities of future m-forecasting services and not particularly underlining potential risks or problems in using them. Specifically, we have identified three key scenarios:

1. Exception lists reports with information about inaccurate forecast, as well as provision of basic forecast error measures. Moreover, information on last months' sales and price information.
2. Tracking of upcoming events and promotions.
3. Increasing the accessibility of information to allow adjustment of forecasts by users and stakeholders involved in collaborative practices.

For many of the products the forecasting is straightforward, and professional forecasters tend to focus their attention on a small number of products that are in some way exceptional and are organizationally important (e.g. the most profitable). This may be because of external conditions (e.g. sunny weather affects ice cream sales), or because they are important for the organization (e.g. the subject of a special sales campaign). The rest of this section reviews and expands on the three main design intervention scenarios in depth.

5.5.1. Exception lists reporting

M-forecasting may allow organizations to deliver completely interactive reporting and analysis to any mobile device – without the need for specialized software. It leverages the native capabilities of any mobile browser to empower mobile users with analytic functionality that can be applied to virtually any forecast data from any enterprise source. This device-independent solution works by combining data and interactive capabilities into a single document – such as a list, or a report – that can be distributed to mobile devices. From there users can perform advanced manipulations, such as filtering, sorting, calculating, charting, and more. The applications may also enable instant report generation and dissemination across devices. Users may have the ability to customize content on demand by running parameterized reports and drilling down for further details. Reports can then be immediately distributed via e-mail to other users, allowing for unhindered information sharing, regardless of device, platform, or browser. Thus, m-forecasting future applications may be able to offer exception lists reports, readily available to virtually any mobile device, including smartphones (BlackBerry, iPhone, Android-based phones) and tablet computers (iPad). With a pure browserbased (thin-client) architecture that relies entirely on web technologies to deliver mobile applications, organizations can rapidly expand the number of applications and the content available on mobile devices without changing their underlying architecture.

5.5.2. Tracking of upcoming events and promotions

At the core of many m-forecasting applications should be a single strategy: using the device to track upcoming events, promotions and other parameters relevant to forecasts. Tracked forecast information has many uses, but just the process of tracking itself -often referred to as self-monitoring-can provide many benefits, such as better understanding of upcoming events and promotions and awareness of forecasts and product patterns. In mobile-based forecast interventions, self-monitoring could be implemented in three primary ways: through native applications, via text messaging, and through automated sensing and recording. For example, native applications may provide ways to chart forecast and product data to foster reflection on trends over time. The application synchronizes with a website where users can chart their data in different ways to better understand how various factors affect their forecasts. A more advanced version of this scenario would actually reward people if/when they provide such information, which proves to be reliable and useful for improving forecast accuracy. The nature of SMS limits how complex tracked data on upcoming events and promotions can, for example, be making this strategy feasible only for conditions where individuals need to log or share a small amount of information. One of the biggest downsides of self-monitoring has always been the effort involved in tracking forecasting activities. For that reason, individuals rarely manage to keep up with traditional paper-based self-monitoring for longer than a few weeks, and therefore an automated mechanism could be necessary the automated logging of this process, at least for a subset of relevant information (price changes or promotions) provided directly by the client to the application, and added to the user’s activity.

5.5.3. Increasing the accessibility of information to allow adjustments

One of the chief advantages of using mobile devices for business forecasting is that content can be delivered to individuals without any effort on their own part. By using text messages, for example, information can be ‘‘pushed’’ to users or clients’ phones, providing reminders, product information, motivational messages, and other kinds of content that can help them manage their forecasts. Such interventions can provide information at the right time -for example, a reminder shortly before the user develops their forecasts-and can help individuals and stakeholders in the forecasting process to maintain persistent awareness of and commitment to their forecasting goals. In this way, mobile-device services or applications can make it easier for users to manage their forecasts more consistently and, thus, more effectively. Specifically, a common way of using mobile devices is to send users and supply chain partners information relevant to their products or the management of their forecasts. These messages could be delivered via the application and provide stakeholders with concrete strategies to they can use to manage their products or engage in the development/adjustment of forecasts. Reminders could also been used in a variety of collaborative forecasting practices with the aim to provide reliable information as well as to adjust the forecasts. Participants in our research have been very positive about reminders to adjust their forecasts based on market knowledge, partially because the reminders are not obtrusive.

6. From UCD findings to design guidelines for m-forecasting services

In this report, we identified four main user factors and three scenarios that can be used to design m-forecasting services and applications, which create opportunities for further development in the area of collaborative forecasting practices. In this section, we briefly review what we see as the main directions for future work in this important area of forecasting research. These mobile solutions could be delivered via native application, via browser or be custom mobile forecasting solution developed in-house, Firstly, m-forecasting solutions based on monitoring and review of product exception lists are directly tied to individuals' forecast goals. Yet, in collaborative forecasting, understanding the context that informs product forecasts can be very important for developing effective solutions. M-forecasting applications and solutions make it possible to capture such contextual information/market knowledge to help individuals -and their stakeholders-to better understand the concrete circumstances that influence their forecasts. By automatically triggering upcoming events, promotions, selling price and product-related activities with location, time of day, and other information contained on a mobile device, FSS users and stakeholders may be able to construct a rich understanding of the range of factors that influence their forecasts and forecast-related decisions. M-forecasting interventions can also provide data at the times that are most critical to individuals' goals, for example, when they wish to adjust the forecasts based on external information. Such information, in turn, combined with a variety of available data in a mobile dashboard, could enable truly effective just-in-time forecast interventions.

Improvements in mobile technologies are also opening new opportunities for facilitating involvement and collaboration of users and stakeholders in the forecasting process. The quality of photo and video recording available on modern mobile devices makes it possible to use these devices as ubiquitous and inexpensive telemonitoring terminals. This could be especially useful to remotely monitor meetings with clients and discussions about the products for current forecasts, which can then be shared among team members in the organization. These sessions recorded in the mobile device could greatly facilitate specialist product knowledge and facilitate collaboration between customers and suppliers, in areas where local organizational resources are lacking.

In addition, m-forecasting interventions could begin to explore the potential of leveraging social networks. In combination with lightweight tagging and automatically added location data, social networking tools like Twitter and Facebook can enable a whole class of new applications and services that use mobile devices to seek and share advice, expertise, support, and local resources for product forecasts. Such applications could enable creation of ad hoc social networks of people involved in the forecasting process, helping individuals to connect with others, to get forecast-related information and advice, collaborate highly customized to their locations, and solve problems they face with their products' forecasts. Additionally, such loose social networks might avoid some of the social frictions that arise with changes in intensity of sharing in more tightly knit organizational networks or departments. Similarly, location and other contextual information, such as the user's calendar, could be used to alert individuals/stakeholders to opportunities and local resources relevant to their products (e.g. competitors that plan a promotion or a future event).

Future work should investigate alternative scenarios and new ways to motivate users' collaborative practices through mobile devices both inside and outside the organization. For instance, users and/or sales people could be provided with rewards for forecast performance and timely, reliable information and this should be an important direction of future work. The majority of m-forecasting interventions for collaboration we identified during this research focus on three areas: exception lists reporting, tracking product-related information, and adjusting the forecasts, perhaps through providing a dashboard-view of the forecasting process. Although all three areas are perceived as extremely important by the users participating in this research, other aspects of forecasting process could benefit from mobile solutions. Key among them, we believe, is personal forecast management. The ability for users to access their forecast information from anywhere, to easily collect and group product-related information as the information is first encountered, and to have relevant information integrated with other daily tools (e.g., calendar), could greatly benefit users, especially those who are responsible for hundreds or thousands of product groups or products. The work in this area is just beginning, with robust m-forecasting applications that use product and forecast-related records that support users' mobile needs yet to be developed. This current research attempts to fill this gap, but much more work is needed in this area.

The broader dissemination of forecasting insights through the provision of mobile access is a key strategy. This would be possible by deploying mobile forecasting solutions to other stakeholders, such as field sales representatives/team, business managers, and clients. The idea would be to achieve faster 'time-to- information' and shorter 'time-to-forecast' for executives and managers that have mobile forecast access. The deployment of a mobile forecasting solution could start with the sales team. Although some sales staff is based on corporate offices, many either work from home offices or onsite with customers and prospects. By involving the sales force/management team (see Småros & Hellstrom, 2004), forecasting solutions could ensure that the top priority for sales people, access to their account's history and current activities is addressed satisfactorily. Småros & Hellstrom (2004) describe the need for involving the sales and marketing departments in forecasting, and motivational problems related to involving salespeople in forecasting (lack of forecasting incentives, or rewards for producing accurate forecasts, see also Reese, 2000). Moon & Mentzer (1999) have compiled a set of guidelines for overcoming the barriers that hinder companies from fully benefiting from sales force involvement in forecasting. They suggest that companies should:

- Make forecasting part of the salespeople's job by including forecasting as part of their job descriptions, creating incentives for high performance in forecasting, and providing feedback and training.

- Minimize game playing by making forecasting accuracy an important outcome for salespeople and clearly separating sales quotas from forecasts.
- Keep it simple by asking salespeople only to adjust statistically generated forecasts rather than producing forecasts from scratch and by providing them with adequate tools that enable them to complete their forecasting work as efficiently as possible.
- Keep it focused by having the salespeople deal only with the products and customers that are truly important and where their input can significantly affect the company's supply chain.

This way, we would expect a higher involvement and commitment of top management in the forecasting process (see Sanders & Mandrodt, 2003) and support the forecasting initiative throughout the company.

Indeed, the screen size of smartphones makes it necessary to think how reports and charts are configured. The solution could provide a customer view, with the ability to get other slices of information on demand. A mobile forecasting solution could be extremely useful to be able to access up-to-date information on a customer or prospect immediately before meeting with them. This is especially true when meeting several different clients in a day. Finally, our results suggested that mobile forecasting does not substitute for other FSS products, but may offer an additional option providing value for users in new situations.

From a managerial point of view, our results provided important implications by suggesting that the competitive advantages of mobile services were due to its ubiquitous service access and ability to react to demands posed by different use contexts. The developers of new mobile services should build on the benefits of mobility: it is important to determine situations where the service is likely to be used and provide features that are valuable for users in those situations. Successful mobile services will provide users with timely services that are easily accessed and tailored to the needs of specific users and their location. Finally, mobile services must be widely applicable and compatible with users' past behavior. It's not too hard to identify who might need m-forecasting capabilities: employees who spend a good portion of their time away from a desk and need to check data several times a day is a good candidate for a mobile forecasting application. Traveling salespeople, executive managers and operational users are good candidates, since they need timely information to manage forecasts and demand. Operational workers also offer fertile ground for m-forecasting. In this respect, mobile dashboards applications could be designed for two types of users, one for executives and one for workers. The executive dashboard could enable to monitor key forecast performance indicators across their organization, while the operational dashboard may enable operational workers to monitor forecast activity and gauge their own performance compared with colleagues. Both types of dashboards can display performance status according to business plan and enable users to drill into detailed data and view time series charts that reflect past and future trends. The data for mobile dashboards usually comes from a data warehouse or ERP system and consists of both summary and detail data loaded on a daily or weekly basis. On a tablet computer or smartphones forecasting application, users can *modify* data in columns, *explore* data in any direction as well as a*ct* on information via a variety of mechanisms, most notably email and annotations.

6.1. Limitations

The research reported in this project has two main limitations that are important to acknowledge. The first limitation is that the review is largely based on research literature from human-computer interaction and mobile human-computer interaction and does not survey the many business intelligence and financial mobile interventions that have been developed in recent years. One reason for this choice is that, unlike for research literature, there is no systematic way to get a comprehensive overview of commercial products. The other reason, however, is that our goal was to provide an overview of the design space of mobile interventions for forecasting, and that in the commercial products we found we did not identify any user interface (UI), scenarios or guidelines that were not also represented in the research literature. Of course, given the sheer number of commercial systems in the area of business intelligence/financial systems, it is certainly possible that we overlooked products that may be relevant to forecasting applications despite our efforts to be comprehensive.

The other limitation is that the large majority of scenarios we identified during this research are intended to be used by users or other stakeholders by providing the right information to the right people in a timely manner, and their benefits for collaboration. We did not assess mobile-based FSS that help users and managers to make better decisions and provide better customer service -–only assumed they will do-based on timely information and better knowledge of the local context.

Moreover, due to time and resource constraints, this research did not generate and evaluate a set of prototypes for m-forecasting applications. As indicated by Schusteritsch et al. (2007), "for most mobile usability studies, enabling natural interaction with the device can be more challenging than in a desktop-based environment because mobile phones come in a diverse range of shapes and run a variety of operating systems. Depending on study goals, an observation system can be customized to a specific phone model or it may need to be flexible to accommodate a variety of phones. But this is only one aspect of mobility. When we want to evaluate how users will use the services and applications in a natural context, another approach must be put in place. The use of diaries (Rieman, 1993), log files, traces and periodic interviews may be used. Diary studies are used to capture activities that occur in real environments with a technology, application or service. Lastly, it is believed that not all scenarios that explicate m-forecasting designs have been identified. Since this is the first investigation in the area, there is no significant body of literature on which to base justifications of the user factors of this study's propositions.

6.2. Future prospects

These insights can be used to diagnose the strengths and weaknesses of existing m-forecasting innovation capacity in specific settings as well as to guide investments and interventions to strengthen this capacity. The common attitudes, routines, practices, rules, or laws that regulate the relationships and interactions between individuals and groups largely determine the propensity of actors and organizations to collaborate. Some organizations have a tradition of interacting with other organizations; others tend to work in isolation. Some have a tradition of sharing information with collaborators and clients, of learning and upgrading, whereas others are more closed in this respect. A central challenge in designing m-forecasting systems is to overcome this asymmetry -in other words, to discover how to bring those possessing locally specific knowledge (sales people of clients) closer to those possessing generic knowledge (users or marketing experts in the organization) with access to business plans and large-scale initiatives of the organization. Future research should examine the value of m-forecasting innovation using Roger's (1995) diffusion of innovation attributes of innovations (e.g. relative advantage over desktop FSS, compatibility, complexity, observability, and trialability) in experimental settings and through designing interactive mobile prototypes.

6.3. Best practices for designing engaging m-forecasting user experiences

Mobile users are different, and forecasting is no exception. They demand experiences that are more engaging than what desktop FSS offer, but are constrained by limited screen real estate, time, and capabilities. Software vendors must compensate for these limitations with functionality that creates a compelling mobile environment that will engage and convert users. The combination of a small screen and the expectation that information will be instant means that vendors must design features to streamline the user experience to capture users' attention and demonstrate the value of the new service for individual and collaborative forecasting practices. When users engage with the mobile channel, they have a different set of needs than those using a desktop FSS. In any case, these users are in a rush and easily distracted. They are easily frustrated by interruptions, awkward keyboards, and slow performance. There are many obstacles to overcome in the mobile channel, so vendors should attempt to provide users with the tools to find what they want quickly and control their experience. Mobile devices provide a totally new opportunity to engage in an ongoing dialogue with users and to build new relationships with customers and stakeholders in the forecasting process. For those vendors considering mobile forecasting solutions or services, here are five best practices for designing applications and/or services with a mobile audience in mind.

1. Design interactive dashboards
2. Write to a smaller form factor
3. Consider an audience on the go

4. Account for new mobile scenarios
5. Leverage mobile's natural process of collaboration

We will briefly describe each of these practices.

6.3.1. Design interactive dashboards

Mobile forecasting services would benefit from the design of interactive dashsboards through an "author-once, distribute everywhere" approach: plan to create FSS dashboards once or adapt existing dashboards, and make them available on all relevant devices. For example, the software must detect different devices and provide touch-optimization for mobile devices. If the FSS solution requires building a new dashboard for mobile usage, vendors will never be able to reap the benefits of reuse. This way, it may be possible to see the forecasting process at a glance. Combine all the data users need, from multiple data sources, into personalized real-time dashboards. Interactive forecasting dashboards may allow users to filter, drill to detail, and analyze information right in a browser. An intuitive dashboard makes it easy to see the data users and stakeholders need. Filter any product information or forecast metric to support users in better understanding the data. Simple check-boxes, sliders, and radio buttons make filtering easy, interactive and visually appealing. Real-time alerts may also alert mobile users for significant events or promotions that impact current forecasts. Forecast reports emailed, or alerts pushed, to users' phone or iPad increase the possibilities for collaboration and share information with stakeholders in the forecasting process.

6.3.2. Write to a smaller form factor

The display size of tablets, while more generous than a phone, is smaller than what people have at their desk. This difference in form-factor has a big effect on how people may use m-forecasting services. Here are some tips for publishing content in the constrained space of a mobile device:

- Put the most important forecast information at the top left. It's where your users' eyes will naturally start.

• Limit the dashboard to 2-4 main views. Overcrowding the screen will make the dashboard much less usable on the go.

• Use large marks to make sure people can select them with their fingers. Use large font sizes so that people can read explanations and titles.

6.3.3. Consider an audience on the go.

Another major difference between publishing forecasts for mobile versus FSS desktop use is that users will most likely be browsing for high-level forecast reports or trying to find a very specific piece of information. As vendors evaluate their dashboards with mobile users in mind, they should consider these small but important changes:

• Allow drill-down: dashboards should be launching-off points for getting more specific forecast or product data. Make sure the tool provides the ability to drill down into different slices of data so people can follow their natural train of thought. For example, a forecast report or customer satisfaction across the supply chain should allow users to drill into warehouses or specific products and accounts at a specific location. Otherwise, users won't be able to diagnose problems while doing their forecasts or forecast reviews.

• Offer filters appropriate to on-the-go users: Authoring a view for a sales person who will be visiting customers? Add a customer search filter instead of forcing them to browse by industry or location to find a customer. But don't overdo it: providing exactly the right set of filters, no more and no less, will help your employees make better use of mobile forecasting.

• Provide content search: Getting the right information in a dashboard is important, but none of that maters unless users can find the right dashboard in the first place. Most organizations have dozens, if not hundreds of forecast reports. Make it easy for users to search for different content by product, location, data, and other facets. Finally, consider whether users will need training: if they must learn a new interaction paradigm to engage with a new mobile service or application, the adoption might be lower adoption and reap fewer of the benefits of mobile.

6.3.4. Account for new mobile scenarios.

While we've been emphasizing an author-once, distribute everywhere approach to mobile forecasting services, occasionally there will be a big payoff in designing new views specifically for the mobile environment. For example, consider creating a dashboard for sales people or users to use on-site with customers or manufacturers that have information about the products, new events, or upcoming promotions, and schedules all on one dashboard. Or, build a line-of-business dashboard that contains all key forecast metrics. This makes it easy for users to rapidly get answers about key business trends in the middle of long business planning sessions.

6.3.5. Leverage mobile's natural process of collaboration.

Mobile applications are naturally social. They are used in meetings, at customer sites and in the organization. Tablets are particularly social: they are convenient to carry around, they start up instantly and they are easy to hand back and forth. FSS vendors may take advantage of this with their mobile forecasting applications.

• Provide interactive filtering, sorting, panning, and zooming so that users can walk through data live over the course of a forecasting review meeting.

• Allow commenting on views so that questions and observations aren't lost.

• Make sure the mobile solution is fast enough that it can keep up with the pace of a discussion. People will move ahead to forecasts and decisions without the necessary information if the dashboard or the application fails to load quickly.

Aviv (2001), used a two-level supply chain model to compare a situation termed collaborative forecasting, where the retailer and the supplier develop and employ a joint forecast, to a situation termed local forecasting, where each party developed and employed its own forecast. Assuming that the forecasting strength of the collaborative forecasting process is always at least as good as the best individual forecasting strength, the author demonstrates that collaborative forecasting is beneficial. Based on a numerical study, the research concluded that forecasting collaboration results in an average cost reduction of 10% in the supply chain. Forecasting collaboration is also shown to be more beneficial when retailer and supplier forecasting capabilities are diversified, i.e. when they have access to different information and look at different explaining variables. In a more recent paper, Aviv (2002) further developed his model and the forecasting processes used in it. The study showed that the value of information sharing increases when the explainable portion of demand variability increases and that the best inventory control approach - centralized inventory control or different types of decentralized inventory control - depends on whether the retailer or the supplier has more explanation power. Zhao et al. (2002) use a more complex model including one supplier and four retailers, several different demand patterns, several forecasting models, capacity restrictions, and three different levels of information sharing: sharing of retailers' orders only, sharing of both retailers' orders and retailers' forecasted net requirements, and sharing of both retailers' orders and retailers' planned orders. The authors showed that regardless of which forecasting model is used, sharing of retailer forecast information is beneficial. An interesting observation is that retailer forecast accuracy does not have a substantial impact on supply chain performance if the information is not shared. However, if forecast information is indeed shared, it increasing retailer forecast accuracy becomes valuable. The conclusions concerning the allocation of benefits between supply chain members and the impact of production capacity on the usefulness of information sharing are similar to conclusions presented in the context of demand information sharing; the supplier benefits more than the retailers and information sharing is most valuable when the capacity utilization rate is neither high nor low.

McCarthy and Golicic (2002) presented one of the very few case studies available on collaborative forecasting. They criticize the CPFR process model for being too detailed and comprehensive and examine three companies engaged in alternative kinds of forecasting collaboration with their trading partners. Based on the cases, the authors conclude that forecasting collaboration can be very beneficial, resulting in such improvements as increased responsiveness, improved product availability, as well as inventory and cost optimization. They recommend that companies develop collaboration practices that require less investment in human or technological resources than the CPFR process model does. The authors do not, however, suggest any concrete practices, they only recommend that companies establish regular meetings for discussing forecasts with their supply chain members and that they develop one shared forecast. Småros (2003) also examines forecasting collaboration using a case study approach and concludes that streamlined collaboration approaches are needed since retailers often seem to lack forecasting resources and processes. The author suggests that collaboration needs are different in different situations and presents a hypothetical life cycle model outlining potential collaboration opportunities in the different stages of a product's life cycle.

Overall, m-forecasting solutions may support collaboration models in forecasting by enabling connection of data and people to help them make better decisions. This may be possible by facilitating discussions and making forecasting data and product content easy to share among supply chain partners. For example, users may simply a copy of a forecast report or dashboard menu to share information wherever it's needed. Designing applications which, in addition, allow for annotations to a forecast report has also been suggested as a useful capability to help identify events that gave rise to a particular trend in the data. Finally, report commenting may allow users and stakeholders to easily engage in conversation about key forecast metrics or results.

Conclusion

The current project explored the design of m-forecasting applications and solutions to inform operational, day-to-day forecasting and collaboration. One of the main issues identified in previous research is lack of information sharing, lack of market data, and general delays in alerting key users and decision makers to critical information. M-forecasting may support provision of information to users when and where it's needed and encourage forecasting collaborative practices. The project contributes to the understanding of how usability of mobile forecasting critically depends on carefully balancing individual and organizational requirements. Moreover, we have outlined a set of guidelines that may be used to design effective m-forecasting solutions. However, this research also demonstrates the need for research in m-forecasting design solutions to embrace both individual and organizational concerns in order to grasp the complexity and range of forecasting scenarios in a collaborative manner.

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