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DESIGNING AN E-MAIL PROTOTYPE TO ENHANCE EFFECTIVE COMMUNICATION AND TASK MANAGEMENT: A CASE STUDY

Adi Katz, Irit Berman

Abstract. This paper deals with communicational breakdowns and misunderstandings in computer mediated communication (CMC) and ways to recover from them or to prevent them. The paper describes a case study of CMC conducted in a company named Artigiani. We observed communication and conducted content analysis of e-mail messages, focusing on message exchanges between customer service representatives (CSRs) and their contacts. In addition to task management difficulties, we identified communication breakdowns that result from differences between perspectives, and from the lack of contextual information, mainly technical background and professional jargon at the customers' side.

We examined possible ways to enhance CMC and accordingly designed a prototype for an e-mail user interface that emphasizes a communicational strategy called *contextualization* as a central component for obtaining effective communication and for supporting effective management and control of organizational activities, especially handling orders, price quoting, and monitoring the supply and installation of products.

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1. Introduction. Computer supported cooperative work (CSCW) and computer mediated communication (CMC) are most crucial in the activities of today's organizations. Organizations need to achieve goals that one person cannot accomplish alone, and knowledge that is collected by individuals should be reserved for the general use of the organizational community. Now, organizational workers need more than ever to share knowledge, and are involved in joint activities that require the support of information systems. Communication between individuals is to a large extent in the form of computer mediated cooperation, and computerized applications ascribed as groupware (group support systems) include shared environments, whiteboards, electronic group calendars, chat rooms and more. Groupware systems support people who work together by facilitating communication between them and by improving coordination. The overall success of organizations is certainly dependent on CMC that need to be designed to achieve a high level of mutual understanding and minimal communication breakdowns.

Although e-mail is the most widespread mode of CMC at work, e-mail client software is poorly suited to support the collaborative quality of the organizational tasks and project management, which results in a pernicious problem of people suffering from "email overload" [2], [34]. Rohall et al. explain why users are so frustrated with their e-mail. They feel overwhelmed by the high volume of messages, and it seems that current structures within e-mail clients, such as folders, prove inadequate, especially for high-volume e-mail users. There is a need for reinventing the e-mail client, moving it from the current electronic analog of physical mail to a tool that allows users to manage all of their digital communications. New visualizations of the information contained within e-mail inboxes are a key piece of the solution [26].

Communication Breakdowns. In this research we focus on task-oriented communication. Communication problems are potentially present in organizational processes, which involve cooperative work between groups of workers coming from different occupational backgrounds. Differences in language and knowledge deriving from their different backgrounds eventually create a situation of distance between individuals who need to communicate in order to complete their tasks successfully. Therefore, the organizational process could be facing a problem of miscommunication that might lead to its failure.

Research has shown that communication is more efficient when people share greater amounts of common ground. Collaboration between workers who come from diverse functional backgrounds is not only common but essential in today's complex organizations [10]. Communication processes that involve indi-

viduals who come from different organizational occupations, domains or methodologies and hold different kinds of knowledge impose certain demands and requirements on the form of messages exchanged between them [27], [30]. In the area of collaborative work, one of the challenges is achieving integration between individual member contributions. However, achieving integration will be more challenging if group members start from different practical realities—e.g. come from different functional backgrounds. Common to all situations requiring the communication of contextual information is the likelihood of being misunderstood because of information the speaker possesses but the listener does not. Such situations are more likely to occur in computer mediated team work than in face-to-face teams [4]. While beauty might be in the eye of the beholder, the meaning of an e-mail message is in the eye of the e-mail author [29]. To prevent communicational breakdowns and to enhance mutual understanding between communicators that may be distant due to differences in their knowledge, experiences, terminologies, attitudes and perspectives, it is important that e-mail authors send messages that minimize the sender-receiver distance [17].

Contextualization. Current communication theories suggest that misunderstanding and communication breakdowns may be reduced by contextualization, i.e., an adaptive communication behavior of providing the explicit addition of contextual information to a core message to ensure effective communication. In other words, contextual information is the information that the message sender has and whose sharing with the receiver may affect the latter's interpretation of the core message [17]. Communicators are engaged in contextualization behavior in order to overcome communication difficulties arising from perspective differences. The lack of contextualization has been named as one of the most frequently occurring problems in communication between distributed workers [4] [15]. We metaphorically treat contextualization as a bridge built above the cognitive distance between communicators. The decision to contextualize involves trade-offs between the benefit of gaining better communication and the costs in terms of the cognitive resources it requires. The cognitive effort required for the act of contextualization is particularly heavy on the e-mail author in CMC, because information transfer, especially the transfer of complex information, is less efficient than in richer media [23]. The author of a message must assess the potential contribution of contextualization to mutual understanding before engaging in contextualization, and must invest effort in building and transmitting the contextual information. The listener must invest effort in reading the message and in comprehending it [17]. Although the degree of context required in an e-mail message depends on the e-mail recipient, it is the author who must

determine the context that the message provides, as well as its depth. Hence, the adaptive behavior of contextualization is at the sender's discretion. A message sender who senses a problem in communication and attributes it to differences in perspectives has motivation to contextualize in order to gain reduction of the likelihood of misunderstanding [12].

It has been reported that the impacts of contextualization on mutual understanding and on performance are contingent on whether communicators share their perspectives or differ in them: contextualization increases mutual understanding and performance in cases of different perspectives, but it does not increase mutual understanding and even decreases performance in situations of shared perspectives. In other words, contextualization is only effective when needed and counterproductive when not needed [17]. However, message senders are not always effective communicators, and are not always aware of the difference in perspectives with their recipients and therefore may use contextualization inappropriately.

Perspective Taking. In order to contextualize appropriately, a speaker needs to be engaged in an additional communication behavior, *perspective taking*, which is metaphorically depicted as the act of stepping into the shoes of the addressee. A *perspective* is a person's point of view, including his beliefs, opinions, attitudes, knowledge, frames of reference, or roles [21], [22]. The phenomenon that speakers attempt to ensure the listener's comprehension by taking his perspective into account is well-known in the literature (see overview in [25]). In task-oriented situations, one's ability to orientate to the perspective of the other person enables an individual to assimilate and integrate information using the other individual's frame of reference and leads to higher mutual understanding [31].

Clearly, taking the perspective of others lies at the heart of shared understanding and successful communication, but it is a cognitive skill that varies among individuals and requires cognitive effort [5]. The well known argument that task demands may exceed our limited cognitive resources [24] can be applied to organizational tasks that depend on CMC. People tend to rely on their own perspective when communicating because it requires less cognitive effort [20], or overestimate the degree to which others' perspectives mirror their own [21]. In a spatial perspective task, speakers tend to prefer egocentric expressions. Although speakers find messages from egocentric perspectives easiest to produce, addressee-based perspectives are easier to comprehend [28]. Information integrated in speech planning is influenced by cognitive availability rather than the information needs of the listener, and the knowledge involved in taking the lis-

tener's perspective might be too costly for the (cognitive) system to incorporate routinely [16]. It was found that cognitive load has a detrimental influence, as it disrupts monitoring and adjustments and leads to rather standard messages that are not adapted to the perspectives of the addressees. This is common especially in processes that are related to reference, in which the speaker is required to make a relatively complex evaluation of whether terms in his message will have to be supplemented by additional information, and conditions of high cognitive load may be at the expense of this evaluation [25] [16]).

In a customer service situation, there may be a deliberate attempt to hide the personal identity of the customer service representative (CSR), who may use fixed, predefined messages to present a generic corporate image to those outside the organization [1]. This makes it difficult for strangers to develop shared understanding of context, which is crucial for communication effectiveness [5]. In addition, customers are sometimes unable to take a CSR's perspective because the CSR refers to things outside the customers' experiences. In such cases, sessions can break down and end without resolution.

Contextualization in e-mail Communication. We looked at previous work in CMC that stress the need for reinventing e-mail, and put our focus on contextualization as a central component for enhancing effective communication. We now present two features that we borrowed from previous work, embedded links and visualization of message threads. Additional features will be introduced in the design section.

Contextualizing with embedded links. Knowledge organization deals with issues of how to best store knowledge so that it can be retrieved when relevant. Users need to get to the right knowledge at the right time, and must be aware of the relevant knowledge that is available to them at each task. The idea of tying knowledge to action arises from the fact that knowledge workers do not have the time to actively seek organizational knowledge, and therefore it would be far more effective if the knowledge could find them [29].

KMail, a knowledge-enhanced e-mail, is a tool that ties organizational memories (OM) effectively to organizational actions using contextualization [29]. KMail is a URL-based OM that enables the linking of knowledge to ongoing communication, and therefore serves as a window to OM, to achieve successful communication. KMail is a remarkable example for an e-mail client designed to enhance computer mediated collaboration by helping its users to appropriately adapt to communication by assessing perspective differences. In kMail, each time a user authors an e-mail message, the system creates a new OM view that consists of OM concepts relevant to the concepts typed in the e-mail, related to

the context of the user's activities. The system first presents the author with this view, in the form of links to knowledge items from his message, for the purpose of confirmation, validation, or modification, and then sends the validated view to the kMail recipient along with the kMail message.

Contextualization with message threads (conversational trees). Collaborative tasks are not discrete but iterative. As a task evolves, users have to combine task related information in incoming messages with prior relevant information. Prior messages are important because they contain context that is critical for interpreting the current message [34]. Messages should be viewed as elements of a conversation rather than as independent or solitary. An e-mail conversation, also known as a *thread*, is typically defined as the tree of related messages that arises from the use of the *reply* operation [33]. This interconnectedness of e-mails is not fully exploited in conventional e-mail clients. Kerr [18] claims that conversation threads in e-mail allow users to see a greater context of the messages they are reading, remind users that a conversation is in progress, record the state of a discussion, collate related messages automatically, and reduce messages displayed in inboxes. A full visualization of a message thread, in a way that clearly displays a message along with all its previous related messages, provides better context for understanding the meaning of the current message. Therefore we treat threading as a form of contextualization, since it adds layers of information about the communication's history.

Threading is useful for both recipient and author. At the recipient's side, contextual information reduces the likelihood of misunderstanding the meaning of messages. For both, contextualization by thread visualization reduces cognitive demands on memory by eliminating the need to recall past issues, arguments and other conversational elements. At the author's side, threading serves as reference of the common ground achieved in the conversation until the current point, and allows him to expend less effort in building the current message. The author assumes that the recipient already possesses prior information or has access to it and therefore he can choose not to contextualize, sending only the core message and drawing the recipient's attention to relevant context whenever necessary. This allows a relatively parsimonious and economical mode of message exchange for authors, which resembles a communication pattern that is high on Hall's "shared-context dimension", in which "most of the information that needs to be transmitted is already [assumed] in the person, while very little is in the explicit, transmitted part of the message." Other communication patterns, which are low on the shared-context dimension are just the opposite, "i.e., the mass of the information is vested in the explicit code" ([14], p. 79). Threading allows a

communication pattern that is high on the shared-context dimension, because most of the information that needs to be transmitted is already presented in the thread.

Venolia and Neustaedter go beyond the limited context preservation by threading that appear in widely used e-mail programs and that are embodied to varying extents in a variety of conversation systems and visually handle common situations in which a message receives multiple replies, creating a complex branching reply tree [33]. Their working prototype presents a mixed-model conversation visualization that simultaneously presents two existing models to characterize a conversation; a chronological sequence of messages and a tree based on the reply relationship.

Remail [19], an innovative and integrated e-mail client, copes with the problem of limited context for new messages by using visual separators in the Inbox list in a way that lets users see each message within its context using "pivoting" and threads. Remail chunks the date information into days with date separators that make it easier to see messages from a given day as a group. E-mail is often time sensitive and chronology is important; a valuable attribute is the time when a message was received. E-mail threads are often read backwards starting with the most recent message because the last message sent often determines the thread's "conversational status" by summing up the current state of the conversation or by containing questions or tasks that are still outstanding [18]. Rohall et al. combined a tree based model with a timeline model to produce a useful tracking of conversations. Threading messages on a timeline helps users to better manage their tasks and relationships [26].

The current study is about designing effective CMC to enhance good communication. Our objectives were to first evaluate communication processes between CSRs and their business clients, with special attention to communication breakdowns to find the types of contextual information that help resolve breakdowns and miscommunications. Then we examined possible ways to enhance effective CMC and finally we implemented our ideas in the design of an e-mail prototype.

We now present our case study of CMC in Artigiani.

2. A case study of CMC difficulties.

Case Study Steps. We examined communication in Artigiani, a company that specializes in designing and manufacturing affixing (metal fixtures or accessories), such as handles, hooks, hangers and bathroom accessories. To evaluate the existing communication processes in Artigiani, we conducted the following activities in a time range of about two months in the summer of 2009:

a) observations;
b) one-to-one interviews;
c) collection and text analysis of 60 e-mail messages.

At the first phase of our study, we conducted observations at Artigiani and did one-to-one interviews, to firsthand capture how e-mail is used within the organization. Our interviews consist mainly of questions that we borrowed from an earlier study that dealt with understanding e-mail communication [3]. For example, we asked how e-mail was being used instead of other forms of communication; to what extent tasks are completed as expected or on time; to what extent incoming e-mails are easy to understand; how long it takes to read and process incoming e-mails; etc. These questions were designed to highlight any defects or efficiencies in the way that e-mail is used. During several observations, we borrowed the idea of the "Wizard of Oz" (WOz) method, as we elaborate below.

Findings. The first meeting between a customer service representative (CSR) and a customer is face to face; the following communication between them is usually via e-mail. Although CSRs are in contact with customers and business clients via telephone and face to face encounters, there is a massive activity of e-mail message exchange going on in Artigiani. E-mail is the preferable communication channel to handle various organizational activities (e.g. negotiating with suppliers, orderings products, quoting, scheduling the supply and installation of products, etc.), especially because of its ability to document and to maintain written proofs. We were interested in the exchanging of messages between CSRs and their clients which are the customers, but also professional workers such as carpenters, contractors, architects, interior designers, suppliers. Inasmuch as profitability of businesses depends on maintaining current customers and attracting new ones, customer service is an important part of every business organization. Customers are satisfied when they receive personal and prompt service. The likelihood of a business losing customers due to bad experiences with CSR reinforces the goal of achieving good communication between the two parties. Although important, this study is not about developing and refining effective customer service skills, but about designing effective CMC to enhance good communication between CSRs and business clients.

We now describe the difficulties of task management and communication in Artigiani.

CSR's Task Management Difficulties. One of the most commonly performed activities in e-mail is management of pending tasks. A *pending task* is any activity that is to be performed in the future [13]. CSRs in Artigiani are

involved in various parallel activities related to customer service and handling orders, such as management and documentary of customer files, responding to telephone calls, monitoring orders, negotiating with suppliers, quoting, scheduling the supply and installation of products and so on. Artigiani CSRs are under great pressure to respond quickly to e-mails, and the activity of managing their tasks is perceived as a stressful one, because of the high volume of incoming messages. They are constantly involved in deciding about priorities of activities, and in addition they tend to lose important items when they need them (such as previous message exchanges that help them in decision making, and items that they wish to attach to outgoing messages). They are required to manage ongoing activities over time and need to handle numerous schedules and reminders. The time range for an order is thirty days on average, and during this range communication regarding an order or a customer is not continuous. CSRs need to quickly associate items, events, files or messages to ongoing orders or certain clients and customers. This makes the task of managing orders and treating clients and customers cognitively demanding.

For the sake of tracking and managing customer orders, important information is filed into physical office folders. The process of collecting and filing in physical folders is inconvenient, tedious, and requires the investment of time and consistency. Thus, workers tend to neglect this activity and as a result information can be lost. In addition to arranging information in physical folders, CSRs constantly arrange files in metaphorical desktop folders on their computers and in their e-mail folders. Mentally retrieving the location of needed information is cognitively demanding on the long term memory, and constantly searching for information in e-mail inboxes, outboxes and other folders is tedious and time consuming. For example, when a CSR wishes to attach an image of model 126, he needs to open the "products" folder appearing on his desktop, and then open the "door handles" folder, and in it he needs to choose the specific file that is saved with about 160 other model figures. At best, information is found, but not in a timely manner. In worst cases, existing information is not found, or CSRs accidentally assign the wrong file to an e-mail message. It is clear that CSRs in Artigiani have problems of maintaining and effectively using various types of knowledge, thus the value of the information is lost. CSRs do not have a clear and immediate visualization of all the parties involved in a conversation, nor do they have easy access to the content exchange in the conversation by each member. Clearly, difficulties in reaching information in a timely manner affect work quality, especially the quality of customer service. Because e-mail communication is a synchronic in its nature and not continuous, it is difficult to keep track of

orders and to effectively handle them.

An example for basic technical knowledge that is used quite often is whether a certain product can be manufactured in various sizes. Another example is information regarding the complexity of manufacturing processes of each product that is needed to offer an appropriate quotation depending on the amount of manufacturing hours needed. The process of deciding on appropriate quotations is cognitively demanding because many products can be produced custom-made according to customer requirements and therefore can have a vast number of variations.

An e-mail system that supports easy access to contextual information items that are related to pending tasks can be of great help for managing the overwhelming high volume of incoming messages and activities.

Communication Difficulties. To examine and evaluate CSRs' communication processes and breakdowns, and to find the types of contextual information that help resolve these breakdowns, we borrowed only the idea of the "Wizard of Oz" (WOz) method, which is usually used in the realm of HCI especially for supporting the evaluation of incomplete computer prototypes. In HCI research, people commonly emulate part of an interactive system with this WOz method for shortcutting the prototyping process for novel user interaction techniques, including speech, gesture, multimodal, context-aware, and location-based applications [6]. On a much earlier stage, we used WOz's idea of intervention without the user's awareness. We observed CSRs while they exchanged e-mails. We identified occurrences of communication breakdowns (focusing on breakdowns derived from misunderstandings), and we identified contextual information that is likely to build the bridge over the cognitive gap between communicators and encouraged CSRs to contextualize this additional contextual information. Thus, we became involved in the exchange of e-mail messages without the awareness of other communicators (besides CSRs) to examine the types of contextualization acts that may solve communication breakdowns. At this point, we also collected sixty e-mail messages that were not affected by our intervention for further reference, to conduct text analysis for identifying the main categories of communication interests in Artigiani, and the main activities of CSRs.

Observations, interviews and text analysis revealed that the main activities of CSRs are handling orders facing customers and suppliers, stock checking, price quoting, and answering technical questions. We discovered that the vast majority of miscommunications occur in communication between CSRs and customers, and that the main source of communication breakdowns is the differences between the perspectives of CSRs and customers, deriving especially from the

lack of technical background and jargon at the customers' side. In terms of Hall's shared-context dimension [14], we found that communication between CSRs and professional contacts such as designers and carpenters is more parsimonious than with customers, because they have a communication pattern that is high on the shared-context dimension while CSRs need to include a mass of contextual information in the message when communicating with customers, because they are situated low on the shared-context dimension. Often, it is necessary for CSRs to communicate with customers via telephone over cases in which communicators fail to overcome breakdowns that emerge in e-mail exchanges. In some cases, communication failures were so severe that they damaged the ability to effectively treat an order, and the whole deal was canceled by the customer. Such cases undoubtedly harm the organization's profitability.

On the one hand, text analysis revealed that CSRs tend to use egocentric and standard expressions when communicating with clients. Keeping in mind the cognitive effort required for contextualization and the fact that it is time consuming, we claim that the aforementioned cognitive overload of CSRs influences their little tendency to contextualize (this is in line with [16] [23] [25]).

On the other hand, we also observed effective communication adapted to the addressee, as demonstrated in the following e-mail message exchange, in which a CSR takes the perspective of the customer and contextualizes appropriately:

Customer: *Is it possible to produce the banister from stainless steel?*

CSR: *No, it is not possible for two reasons: 1) Stainless steel does not pour, just bend; 2) the banister would be too heavy to install. But we can produce iron casting rail, and then coat him in chrome nickel that has the look of stainless steel. If you want we can send an example to you and if you like it we will give you a quote.*

Instead of simply delivering only the core message (e.g. not possible), the CSR adds layers of context about the reasons for the inability to produce a stainless steel banister, and offers a suggestion that he considers satisfactory for the customer's desire. Also, he offers to send a sample to the customer. This proposal requires the organization to invest time and money, but constitutes good customer service. In our perspective, this proposal ensures mutual understanding and coordination between the parties and may prevent a situation of manufacturing a product that does not meet the customer's desires.

3. Design. We were interested in examining possible ways to enhance effective CMC, and then in implementing our ideas in the design of an e-mail prototype to receive initial feedback from potential users, before establishing a working prototype. In this section we present our prototype of an e-mail user interface designed for CSRs in Artigiani.

Our e-mail design reflects an attempt to follow an avenue for reinventing e-mail, which was suggested by Ducheneaut & Watts after a survey of a vast body of work accumulated over the past three decades in the e-mail literature. The survey retrieved three perspectives that need to be assembled simultaneously to support activities in the design framework of future e-mail clients: individual, communicative, and socio-organizational [8]. When we describe our e-mail features, we will refer to those three perspectives, but because of our focus on contextualization, we choose to present our e-mail prototype features using a distinction between two purposes for contextualizing: supporting task management and enhancing effective communication, as we now explain.

Schwartz & Te'eni state that contextualization must rely on organizational knowledge for two components: 1) Knowledge to provide the additional context layers around action; 2) Knowledge to identify the conditions in which to contextualize messages [29]. Accordingly, our e-mail prototype design roughly distinguishes between two purposes for contextualizing: supporting task management and enhancing effective communication:

1) **Task management**: Contextualization for improving the user's ability to effectively manage his organizational activities and tasks, and to improve related decision making.

   We dealt with design issues of how to best implement the idea of tying knowledge to action; how to help users get to the right knowledge at the right time; in other words, how to best organize and display knowledge so that it can be easily available for retrieval at each task.

   This purpose is closely tied to the Ducheneaut & Watts individual level reflected in the *e-mail as file cabinet* metaphor, in which e-mail design can extend human information processing capabilities [8]

2) **Effective communication**: Contextualization for achieving a high level of mutual understanding and minimal communication breakdowns.

   We dealt with two questions regarding contextualization:

   a. ***When?*** We designed an e-mail prototype that would help users to identify the conditions in which contextualization is necessary and that would encourage them to do so.

   b. ***What?*** We designed an e-mail prototype that would help users to identify what the types of information need to be delivered so that the message receiver will understand the message. In other words, a

> message sender should be able to easily build the contextual bridge above the cognitive distance between him and his addressee.

This purpose is tied to the Ducheneaut & Watts communicative and socio-organizational levels, which are respectively reflected in the *production facility* and *communication genre* e-mail metaphors. The *e-mail as production facility* metaphor puts emphasis on collaboration and work coordination and on the exchange of information between several parties. The *e-mail as communication genre* metaphor is concerned about how e-mail could fit into chains of business communication and into the socio-organizational context by focusing on the malleability of the medium, for supporting various social and organizational purposes [8].

We now present the screens and the main features that are designed to achieve effective task management and effective communication. For convenience, we separated these two different purposes, but it is important to note that some features support both.

1) Task management: knowledge to provide the additional context layers around action. Figure 1 presents a screen layout of our e-mail prototype. The layout is divided into four panes: 1) incoming messages (inbox list); 2) message content; 3) OM related to the message; 4) thread view. When a message is selected in the inbox list (pane 1), different contextual information about that message appears in the three remaining panes.

A. Incoming messages (inbox list). The incoming message pane resembles current e-mail programs such as Microsoft Office Outlook. Messages are separated according to arrival dates, and only the basic information about each message is presented (arrival time, sender and subject).

Three icons may appear next to messages: an icon of a message thread for messages that belong to a message thread, the familiar attachment icon, and flag icons expressing urgency. We previously mentioned the management of pending tasks, and that CSRs are required to make decisions about task priorities. We added the feature of flagging selected messages to use them as external representations of most urgent pending tasks. Messages that contain urgent expressions and punctuation marks (e.g. “critical”, “urgent”, “ASAP”, “quickly”, “!!” , etc.) and that are identified by the program as related to more urgent activities (such as orders) are most likely be considered high priority. The e-mail program will parse incoming messages to find “urgent expressions” and will flag messages that satisfy certain conditions of urgency. Of course, the user can remove message flags or switch from on flag to another, if he does not agree with the urgency set

by the e-mail program. Flags and priorities are considered as a design component of the communicative level in the Ducheneaut & Watts framework for reinventing e-mail [8].

B. Message content. The message content pane resembles current e-mail programs. The full message is presented, that is to say: header information (sender, receiver, and subject), the typed message, and icons to click on for opening attached files. We refer to the message's hypertext links in the following pane.

C. Organizational memory (OM). Our prototype borrowed the main feature of kMail, which is the creation of OM views. The idea of tying OM to e-mail messages resembles a design component related to the socio-organizational level in the Ducheneaut & Watts framework: "contextual data", which consists of organizational documents that could be made accessible from within one's e-mail, as a context for the interpretation of e-mail exchanges [8].

We elaborate Schwartz and Te'eni's idea of associating OM views to outgoing messages, and propose the creation of OM views also for *incoming* messages. For example, in Figure 1, an incoming message from a customer was parsed, and the words "item number 126" were associated with a memory item of a figure of a door handle, and therefore were hyperlinked to an OM view. Implementing the idea of tying knowledge to action, our new addition will help CSRs manage the numerous pending tasks which arrive with the overwhelming high volume of incoming messages. Though we differentiated between two different purposes, effective task management and effective communication, it is important to note that this feature supports both. In addition to helping CSRs to better handle their tasks, the probability of mutual understanding is raised by the fact that incoming messages are associated by hyperlinks to the relevant information needed for the CSR to understand their meaning.

We describe the feature of creating embedded links to *outgoing* messages in the section that deals with contextualization for effective communication.

D. Message threads. It is ideal for users to be able to access the complete task history of a conversation from a current message [34]. Thread visualizations are considered as a design component of the communicative level in the Ducheneaut & Watts framework for reinventing e-mail [8]. Following previous work related to message threads, we designed graphical representation of the message threads to highlight the relationships among the people involved in each conversation. Selecting a message presents its thread, and at a glance, users can clearly see all parties involved in a conversation, and have easy access to the content exchange in the conversation by each member. The nodes of a message on

a thread are colored for immediate recognition of all communicators. Since some threads involve many individuals, if each is presented in a different color, then too many colors may overload the user. Therefore, we used different colors for different professional groups (CSRs, carpenters, contractors, architects, interior designers, suppliers and customers). To produce a useful tracking of conversations, our threads are located on a timetable, following the work of Rohall et al. [26].

When a user selects a message node in the thread view pane, this selection is seen along with a preview of that message. Kerr found this possibility for users to navigate quickly to other messages in the thread by clicking on nodes without having to use their inbox list, to be one of the most useful aspects of the visualization's interactions [18]. In addition, in the bottom of the message preview, we inserted a button to access the sender's profile for more details. This encourages the user to take the perspective of that contact before replying or before making relevant decisions. Of course, this button will appear only if a profile was defined for that sender. We will refer to profile cards in the next section.

In designing message threading, we adopted from Kerr's list of key qualities four characteristics that are most relevant and useful for effectively managing CMC and organizational activities at Artigiani: chronology, relationships, compactness and attribute highlighting [18].

Chronology: Our design presents the arrival sequence of messages which create a thread, illustrating the evolution of a thread, including which messages came first, and which is the most recent message.

Relationships: Users see the direct relationships of a particular message to all others in a thread. CSRs should be able to examine a particular message, and trace back through the thread of earlier messages which lead back to the root (the first message in that thread). Also, we allow users to identify all the people involved in a conversation.

Compactness: Since threading visualization will be competing with other space required for e-mail client functionality, it is necessary that its visualization be small in size without compromising clarity.

Attribute Highlighting: The preliminary phase of text analysis of a message's contents helped us expose important communicational attributes that are extremely useful for quickly finding particular messages or aids in assessing the state of a thread. We highlight specific message attributes, including all thread messages that were sent by a particular person, sent in a particular time range (day, week, month), or ascribed to a certain milestone (distinguishing stages such

as orderings, production and supply).

We previously described the task of managing orders and treating clients and customers as cognitively demanding. CSRs are required to manage ongoing activities over time. Customer care usually begins with quotes and goes beyond supply. Each stage or milestone in customer care is characterized by a different process and by different documents. For example, in the order phase, CSRs are involved in setting the desired sizes, collecting sketches and required technical details, and preparing specifications of the ordered items. During the production phase CSRs communicate with suppliers more than with customers. Organizing information by categorization of the main milestones of customer care in Artigiani is an important feature for lowering the cognitive complexity sensed by CSRs. If a CSR is looking for a specific message that he received from a customer, and he recalls that it arrived during the production phase, he will be able to easily and quickly find that message.

Throughout the design, we used colors to group and to distinguish between certain messages, contacts, and milestones, for a quick and simple identification. Using identical colors for elements groups them into collective entities (the well-known "Law of Similarity" of Gestalt psychology), hence, helps reduce cognitive load. Highlighting attributes by coloring nodes and locating threads on a timetable saves the need to click on messages on a thread to see who communicated, when, and at what stage.

As customary, throughout the design, when any visualization is larger than its allocated space, scrolling is provided.

2) Effective communication: knowledge to identify when and what to contextualize. We seriously consider the aforementioned findings that contextualization is only effective when needed and counterproductive when not needed. We are also aware of the fact that message senders are not always effective communicators and are not always aware of the difference in perspectives with their recipients. Therefore, our prototype includes two main elements that are aimed to ensure appropriate contextualization.

A. Organizational memory (OM). Our prototype borrowed the main feature of kMail [29], which is the creation of OM views that consist of OM concepts relevant to the concepts typed in e-mail messages. Whenever a CSR composes a message, the system will retrieve all the relevant information from the OM and will offer hypertext links to the OM for the CSR to confirm, validate or modify before message transmission. At the recipient's side, the message will arrive with the hyperlinks that were approved by the CSR, and each link-click will open a new window that will show the OM view, in the very same manner as in

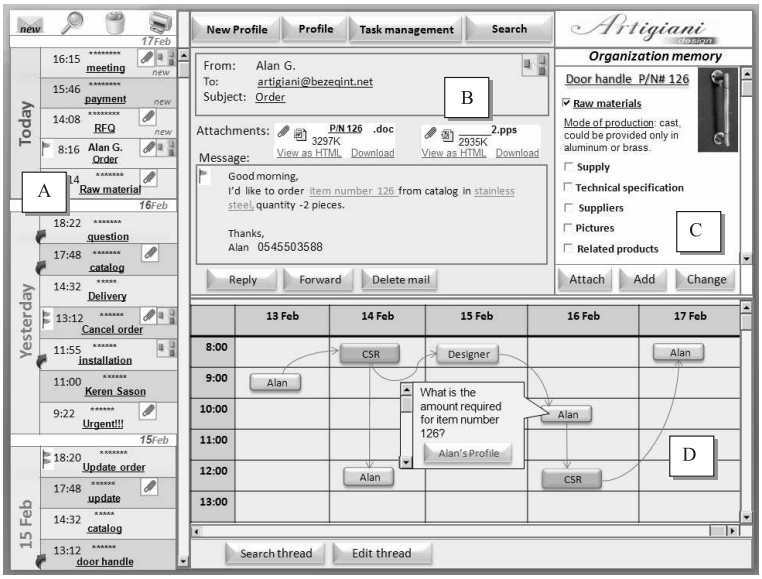

Fig. 1. Contextualization with Embedded Links and Threading Visualization

clicking on any other hyperlink. As in kMail, there is use of metaknowledge about senders and receivers to match their profiles and estimate their distance. Embedded links in outgoing messages are automatically created by the program based on the distance detected. The idea of embedded links is consistent with Hall's [14] aforementioned shared-context dimension. When calculations of sender-receiver distance find similar profiles, in Hall's terminology, communication is high on the shared-context dimension and mutual understanding can be achieved with a relatively economical message exchange, with very few if any embedded links. Embedded links to OM not only encourages the use of contextualization (i.e. helps users contextualize *when* necessary), but also help them build the contextualization bridge (i.e. helps users to contextualize *what* is necessary).

B. Profile Cards. "Profiles" can offer in-depth information about each individual an e-mail user corresponds with, to enrich e-mail users' understanding of whom they are dealing with [32]. We implemented *profiles cards* to minimize the distance between communicators. Users can create and view contextual information about contacts, and this information serves as an important reference in order to dispel ambiguity around their perspectives when reading their e-mails or when composing a message to them. Profile cards can be created in the first

meeting (usually face to face) between the CSR and his clients. This face to face encounter is suitable for an extensive and painstaking filling of all the contextual details that will be useful. Of course, profile cards can be updated at any later stage. Unlike embedded links, which are system generated and therefore formed automatically (though they can be eliminated or changed by the user), profiles enable the user to actively seek for relevant information about his contacts, and then to consciously decide on what to contextualize to whom.

Figure 2 presents two print screens (a, b) of the profile card of a contact, which opens when the user clicks on the profile button. The upper section in both screens presents basic information about the contact such as telephone numbers and addresses, and a place for typing additional information such as *situational context* [29] (e.g. a comment saying that the customer is now building a house along with a suggestion to contact him again at a particular month).

In the lower section of the screens, the profile card contains three tabs:

1) The *category* tab shows all the categories that the user checked in the "categories of interest" list in the upper section. The CSR can use this information effectively as common ground for smooth and efficient communication, and for providing customer-centered service; for example, he may identify the preferred design style of the customer and offer him complementary products (see Figure 2a).

2) The *contacts* tab presents the contacts of a customer (e.g. carpenters, contractors, architects, and interior designers) that often accompany him to give him advice. Occasionally, those contacts are in direct communication (by phone or by e-mail) with the CSR. Therefore, it is important to send them copies of e-mails (using the CC option) and to keep them posted when it is needed (see Figure 2b).

3) The *files* tab shows all the files that were gathered for this contact.

Figure 3 presents a search option for quick access to information about contacts, communications, and organizational processes. The search screen is divided into four panes: A) search area: a text box for typing the request and a search button. The user typed "Ronit Sason" and the program identified her as a designer; B) a brief summary about the contact presented along with a list of radio buttons and checkboxes for choosing additional requested information.; C) area for manipulation of display characteristics. The user can choose between a graphical or textual display of information. He can switch resolutions of detail from a daily to a weekly, monthly or yearly view. The user can also choose to present a specific time range. D) The display: presents the information requested in the layout and form that were chosen by the user in panes 1–3. In the figure,

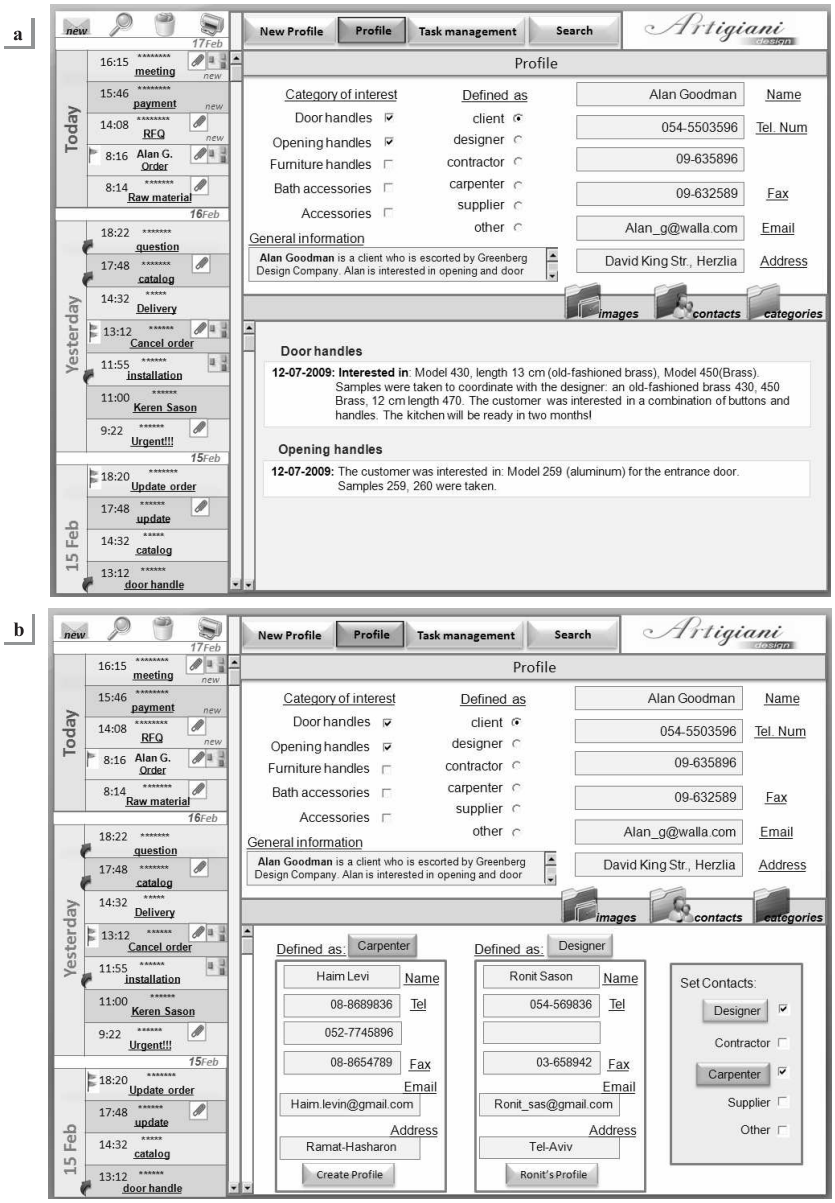

Fig. 2. Profiles: Contextualization of Contact Information

the screen shows a graphical display of Ronit Sason's customers in the year 2009, a monthly at view. When a user clicks on a customer as in the fourth pane (D), a popup window appears, showing a preview of important information regarding that customer at different stages of his contact with the designer.

Fig. 3. Search Option: Contextualization of Contacts (Designer's Clients)

Figure 4 presents a user request to see a more "drill down" presentation of Ronit Sason's customers. From the list of "stages to display" in pane B, the user can choose to display several documents that belong to different milestones, and this changes pane D in a way that for each customer, there is a list of all documents that were saved: quotes, orders, manager approvals, manufacturing and supply documents. This arrangement of documents into distinguished milestones enables an immediate and convenient retrieval of important items, and improves the ability to quickly handle various pending tasks. Sorting documents by themes that are derived from critical organizational activities (milestones) in Artigiani is in line with the notion of "Thematic components" that connect communicative and socio-organizational levels (contexts) [7], [8] and with "Workflow systems" that are appropriate for organizational tasks that have a predictable structure [34].

Figure 5 presents a user request to display message threads that are related to a customer named Alan Goodman. Consistent with the act of choosing information regarding a designer or any other contact, choosing information for a

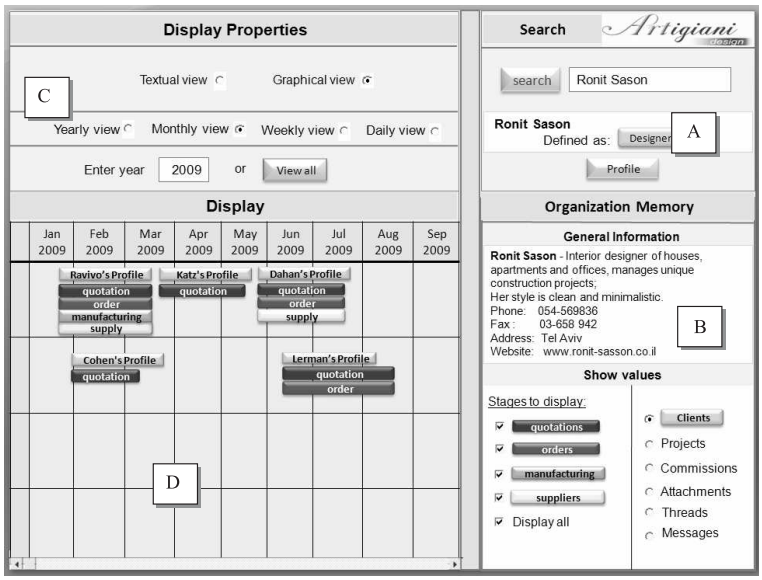

Fig. 4. Search Option: Contextualization of Contacts (Designer's Clients with Relevant Documentation)

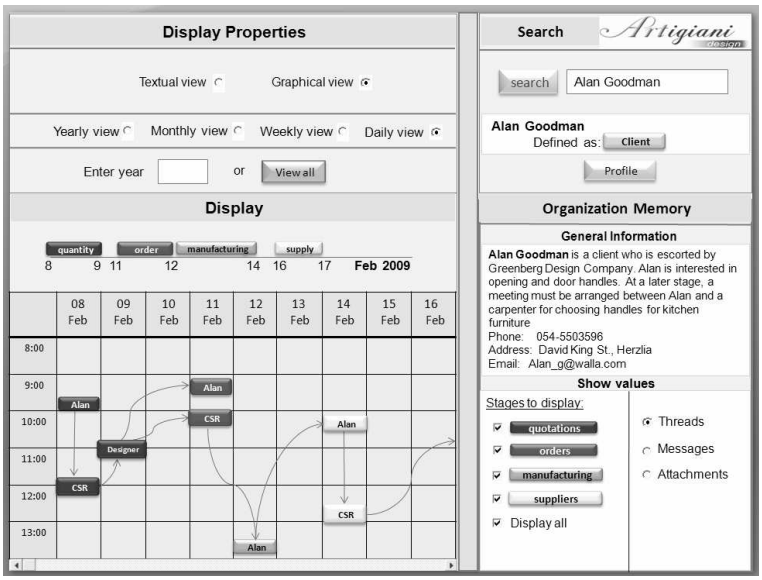

Fig. 5. Search Option: Contextualization of Contacts (Customers)

customer is seen in pane B, where the user can choose different types of information, such as threads of e-mail conversations, messages and e-mail attachments. In the figure, the user chose to display all messages on a thread, highlighted by the milestones that they belong to.

We presented our prototype to CSRs in Artigiani to get initial feedback from potential users. CSRs were very excited about the ability to have a clear visualization of message conversations and to have a quick and convenient access to information that is helpful for performing their tasks. They expressed satisfaction by the features and said that the ideas are highly relevant to their daily work. In particular, most respondents estimated that the visual presentations of conversations will save valuable time and will organize the knowledge accumulated during the communication. Others noted that the mechanism of message threading and the convenient access to information that is helpful for performing the various activities should be implemented in each department in the organization. They were also very satisfied by the visual appearance of the screens.

3. Conclusions. The current study focused on gaining a better sense of the various contexts relevant for effective communication and on designing effective CMC in the form of an e-mail to enhance communication and better task management. Our first objectives were to evaluate communication processes between CSRs and their business clients, and to find the types of contextual information that help resolve breakdowns and miscommunications. Then we examined possible ways to enhance effective CMC and finally we implemented our ideas in the design of an e-mail prototype. Since we were interested in receiving initial feedback from potential users prior to establishing a working prototype, our prototype is in an initial stage and therefore not yet a functional one. An additional limitation to our prototype is derived from the first we did not implement a threading algorithm (such as the algorithms existing in Netscape Mail [11], [18]) or message parsing for creating embedded links [29].

We presented the prototype to potential users and received very positive feedback. CSRs stated that the e-mail is most relevant for their daily work. They were particularly excited about presenting conversations visually and about the embedded links to OM that ties needed context to the current task. They expressed their enthusiasm for the ability to do things faster and more conveniently and satisfaction by the attractiveness of the design.

Our ideas are not limited only to the realm of customer service, but can be implemented to the tasks and e-mail exchanges of other organizational roles and areas, such as purchasing and manufacturing. We conclude that our e-

mail prototypes allows a more complete and general perspective on any business process conducted with a number of partners.

The e-mail prototype follows an avenue for reinventing e-mail, which was derived from a survey of a vast body of work accumulated over the past 30 years in e-mail literature (see survey in [8]). Prototype features that we implemented, such as profiles, thread visualization and embedded links to OM connect components from three levels at which e-mail operates: the individual, communicative and socio-organizational.

4. Future work. We recommend that future framework on e-mail design follow a comprehensive approach that simultaneously supports activities at three levels: the individual user, the communicative, and the socio-organizational level. We believe that a multi-level approach will support a variety of organizational tasks performed using e-mail. We plan to establish a working (interactive) prototype and continue with a follow-up study.

The tasks that we analyzed in the current case study are relatively structured, explicit, and have a certain order. When dealing with activities that are more diverse, we suggest following an additional path of developing e-mail systems that include Artificial Intelligence (AI) learning techniques. Such a path was undertaken with the design of RADAR, a multi-agent system to help office workers cope with e-mail overload [9].

In the current study we were interested in task-oriented communication and therefore focused on contextualization, which is one communicational behavior, but there are others such as showing emotion and empathy in the communication. We recommend that future design of e-mail systems take into account affective strategies aimed at improving relationships.

REFERENCES

[1] Adria M., S. Chowdhury. Centralization as a Design Consideration for the Management of Call Centers. *Information & Management*, **41**(2004), No 4, 497–507.

[2] Bellotti V., N. Ducheneaut, M. Howard, I. Smith, R. E. Grinter. Quality Versus Quantity: E-Mail-Centric Task Management and Its Relation with Overload. Human-Computer Interaction, **20** (2005), No 1/2, 89–138.

[3] Burgues A., T. W. Jackson, J. Edwards. The Effectiveness of Training in Reducing Email Defects. New Approaches to Software Quality. In:

Software Quality Management (Eds D. Edgar-Nevil, M. Ross, G. Staples), British Computer Society, Canterbury, 2004, 345–354.

[4] Cramton C. D. The Mutual Knowledge Problem and Its Consequences for Dispersed Collaboration, *Organization Science*, **12** (2001), No 3, 346–371.

[5] Dickey M., G. Burnett, K. Chudoba, M. Kazmer. Do You Read Me? Perspective Making and Perspective Taking in Chat Communications. *Journal of the Association of Information Systems*, **8** (2007), No 1, 47–70.

[6] Dow S. P., M. Mehta, B. MacIntyre, M. Mateas. Eliza Meets the Wizard-of-Oz: Blending Machine and Human Control of Embodied Characters. In: Proceedings of CHI 2010, April 10–15, 2010, Atlanta, Georgia, USA.

[7] Ducheneaut N., V. Bellotti. Ceci n'est pas un objet? Talking about Objects in email. *Human–Computer Interaction*, **18** (2003), 85–110.

[8] Ducheneaut N., A. L. Watts. In Search of Coherence: A Review of E-Mail Research**.** *Human–Computer Interaction*, **20** (2005), 11–48.

[9] Faulring A., B. Myers, K. Mohnkern, B. Schmerl, A. Steinfeld, J. Zimmerman, A. Smailagic, J. Hansen, D. Siewiorek. Agent-Assisted Task Management that Reduces Email Overload. In: Proceedings of IUI'10, February 7–10, 2010, Hong Kong, China.

[10] Fischer D. Communication in Organizations. West Publishing Company, MN, 1981.

[11] Fisher D., P. Moody. Studies of Automated Collection of Email Records. Technical Report, University of Irvine, UCI-ISR-02-4, 2001.

[12] Fussell S. R., R. E. Kraut, J. Siegel. Coordination of Communication: Effects of Shared Visual Context on Collaborative Work. In: Proceedings of the CSCW2000, ACM Press, New York, 2000, 2–6.

[13] Gwizdka J. TaskView – Design and Evaluation of a Task-based Email Interface. In: Proceedings of the CASCON 2002, IBM: Toronto, Canada, 2002, 136–145.

[14] Hall E. T. Beyond Culture. Anchor Press/Doubleday, Garden City, NY, 1976.

[15] Hinds P. J., D. E. Bailey. Out of sync: Understanding conflict in distributed teams. *Organization Science*, **14** (2003), No 6, 615–632.

[16] Horton W. S., B. Keysar. When do Speakers Take into Account Common Ground? *Cognition*, **59** (1996), 91–117.

[17] Katz A., D. Te'eni. The Contingent Impact of Contextualization on Computer-Mediated Collaborati. *Organization Science*, **18**(2007), No 2, 261–279.

[18] Kerr B. Thread Arcs: An Email Thread Visualization. In: Proceedings of the IEEE Symposium on Information Visualization (INFOVIS 2003), October 2003, 211–218.

[19] Kerr B., E. Wilcox. Designing Remail: Reinventing the Email Client through Innovation and Integration. In: Proceedings of the CHI 2004, April 24–29, 2004, Vienna, Austria, 837–852.

[20] Keysar B., D. J Barr., J. A. Balin, J. S. Brauner. Taking Perspective in Conversation: The Role of Mutual Knowledge in Comprehension. Psychological Science, **11** (2000), No 1, 32–38.

[21] Krauss R. M., S. R. Fussell. Perspective-Taking in Communication: Representations of Others' Knowledge, *Social Cognition*, **9** (1991), 2–24.

[22] Krauss R. M., S. R. Fussell, Y. Chen. Coordination of Perspective in Dialogue: Intrapersonal and Interpersonal Processes. In: Mutualities in Dialogue (Eds I. Markova, C. G. Graumann, K. Foppa), Cambridge University Press, Cambridge, 1995, 124–145.

[23] Kraut R. E., S. R. Fussell, S. E. Brennan, J. Seigel. Understanding Effects of Proximity on Collaboration: Implications for Technologies to Support Remote Collaborative Work. In: Distributed Work (Eds P. J. Hinds, S. Kiesler), MIT Press, Cambridge, MA, 2002, 137–162.

[24] Rasmussen J. Information Processing and Human-Machine Interaction: An Approach to Cognitive Engineering. New York: North Holland, 1986.

[25] Rossnagel C. Cognitive Load and Perspectives-Taking: Applying the Automatic-Controlled Distinction to Verbal Communication. *European Journal of Social Psychology*, **30** (2000), 429–445.

[26] Rohall S., D. Gruen, P. Moody, S. Kellerman. Email Visualizations to Aid Communications. In: Proceedings of the InfoVis 2001, IEEE, 2001, 12–15.

[27] Schein Edgar H. Three Cultures of Management: The Key to Organizational Learning. *Sloan Management Review*, **37** (1996), 40–51.

[28] Schober M. F. Spatial perspective-taking in conversation, Cognition, **47** (1993), No 1, 1–24.

[29] Schwartz G. D., D. Te'eni. Tying Knowledge to Action with kMail, IEEE Intelligent Systems, **15** (2000), No 3, 33–39.

[30] Sommerville I., T. Rodden, A. Dix. Systems Development and Cooperative Work: Methods & Techniques (SYCOMT). CSCW Symposium, March 1996.

[31] Tan M. The Effects of Verbal and Nonverbal Behaviors on Mutual Understanding: An Empirical Study. In: Proceedings of the SIGCPR, ACM, 1992, 268–276.

[32] Tyler J. R., J. C. Tang. When Can I Expect an email Response? A Study of Rhythms in email Usage. In: Proceedings of the ECSCW2003 European Conference on Computer Supported Cooperative Work. New York, Springer-Verlag, 2003.

[33] Venolia G. D., C. Neustaedter. Understanding Sequence and Reply Relationships within Email Conversations: A Mixed-Model Visualization,In: Proceedings of the SIGCHI2003, **5** (2003), No 1, Ft. Lauderdale, Florida, USA, April 5–10, 2003, 361–368.

[34] Whittaker S. Supporting Collaborative Task Management in Email, *Human-Computer Interaction*, **20** (June 2005), No 1 & 2, 49–88.

Adi Katz
Irit Berman
Department of Industrial Engineering and Management
Sami Shamoon College of Engineering
Israel
e-mail: adis@sce.ac.il

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