

# The Impact of Computer Mediated Communication on Information Overload in Distributed Teams

Heike Franz

*EDS Information Technology and Services (Germany),  
Brunel University, Uxbridge (UK)  
heikefranz@mailexcite.com*

## Abstract

*This paper investigates the impact of Computer Mediated Communication (CMC) in distributed teams on real or perceived Information Overload (IO).*

*Typically, these organizations rely on CMC for communication because teams working on joint projects are spatially dispersed and have to communicate across space and time zones. Many of the problems observed in virtual teams seem to be related to communication in general, and it is unclear, at this stage, how this is affected by the communication medium used. Two general and surprisingly contradicting statements from users of these systems are:*

- I do not have the necessary information to do my job*
- I am swamped with information..*

*The intent of this paper is to extract cause - effect relationship, based on established theories. Supporting theory and literature used to analyze the topic of this paper can be grouped into three areas:*

- Media Choice Theories.*
- Media Consequence Theories*
- Information Overload Literature.*

*There is surprisingly little overlap of these research domains. Prior research on information load neglected the impact on organizational infrastructure, particularly the computer information systems environment. However, this is an area where more or less severe degrees of overload are experienced or perceived by users.*

*In the second part of this paper, reviewed literature and theories are summarized and expanded into a research model.*

*Part three reports on a survey conducted within EDS, an IT service provider and its major customer to perform a preliminary test of the model. Based on the*

*empirical data appropriate modifications of the model were made and areas of interest for further research identified. The paper finally discusses practical implications of the research results.*

## 1. Introduction

This paper investigates the impact of Computer Mediated Communication (CMC) in distributed teams on real or perceived Information Overload (IO). The article is structured as follows: the introduction section highlights the three key subject matters "Distributed Teams", "Computer Mediated Communication" and "Information Overload". Then the next chapter reviews literature pertinent to the problem in this context. After a brief introduction that includes a model of the structure of this section, media choice and media consequence theories are reviewed, followed by literature relevant to the domain of IO. Throughout the review the focus remains on research that will help to explain the phenomenon of IO in computer mediated settings. The chapter ends with a modified overview model to serve as a roadmap from theory to a research model. Chapter 3 will then continue to develop and discuss the research model. In Chapter 4 I shall report on progress and preliminary findings of empirical research conducted to test the model and discuss the results. Finally, the last chapter will briefly summarize preliminary conclusions to be drawn from the paper, the practical implications this has for the organization and give recommendations for future research.

The intended outcome of this article is to reveal determinants of IO and to hypothesize cause - effect relationship of these variables, deduced from established CMC theories. Since the phenomenon has

not yet been extensively researched, the project is of rather exploratory nature.

### 1.1 Distributed Teams and Virtual Organizations

Computer based information technologies and the communication they facilitate are the essential foundations for creating and managing distributed teams or virtual organizations, organization forms that are increasingly common in today's global marketplace. The rise of virtual teams is a relatively recent phenomenon and has been brought about in part by the invention of groupware. The entire communication in these teams depends on technology [42]. They are connected by all the modern tools that are taken for granted in the 1990s' workplace [26]. However, as a call for papers of the Journal of Computer-Mediated Communication indicates, only few scholarly and academic publications have explored the topic of communication in the distributed or virtual organization, in spite of an extensive body of research in CMC [8].

Thus, many organizations install communication technology for first-level efficiency reasons, but the second-level system effects are likely to be more important [52]. These second-level effects are the social and organizational changes that are manifested as organizational problems and challenges. Typically these are not anticipated. Information Overload is one of these phenomena that was certainly not intended!

### 1.2 Computer Mediated Communication (CMC)

Though there seems to be a deficiency of research focusing explicitly on the virtual organization or distributed teams, much research has been performed on CMC and groupware. The term CMC in its broadest sense covers any kind of human communication involving the transmission of electronic signals between computers [47]. This paper focuses on what Culnan and Markus ( p. 422) define as electronic media and narrows this broad definition to

*“Interactive, computer-mediated technologies that facilitate interpersonal communication among several individuals or groups.”*

Individuals who communicate via electronic media often are geographically dispersed. This dispersion can be as close as the office next door, but typically is more distant and can be as far as another continent. The communication can take place synchronously, which means members are communicating at the same time, or asynchronously. In the latter, participants can send and receive messages at times convenient to them. Since this paper focuses on Virtual Organizations, geographical and temporal dispersion can be assumed.

Aside the ability to overcome remote locations in different time zones, the new electronic media have capabilities and functions that differentiate them from unsupported face-to-face communication and traditional manual information storage systems:

- The number of communication interactions within an organization is significantly increased.
- Information gathering and storing are getting more and more powerful [11].

CMC Systems are most frequently approached as a medium of communication, but they are simultaneously a type of computer-based information system [28]; therefore, the information storage and access capabilities should not be ignored in this context [3].

### 1.3 Information Overload (IO)

Later in this paper a more detailed analysis is performed and IO is explicitly defined. At this point, I shall use the definition advanced by Wilson (p. 45) to better understand the relevance of variables discussed, that are pertinent to CMC. He defines information overload as *“being presented with more information than can be absorbed, being burdened by a large supply of information, that can not be assimilated due to a lack of time.”*

The phenomenon of IO became apparent in the late 1980s, when electronic information systems became frequently used in organizations [1] and a correlation seems to be obvious. Currently, users of CMC report of increased overload as a direct result of the medium [9; 10]. Some of the issues and problems observed seem to be related to communication in general and it is unclear at this stage how severe this is affected by the communication medium used. Two general and surprisingly contradicting statements are:

- I do not have the necessary information to do my job.

- I am swamped with information and can not absorb all information I receive [33; 36]. Does this imply that the information received via CMC or accessible in the system is junk? In the following chapter, I shall analyze which explanations theory has to offer to shed light to this observation.

## 2. Review of Relevant Literature

The following figure represents the structure of this literature review:

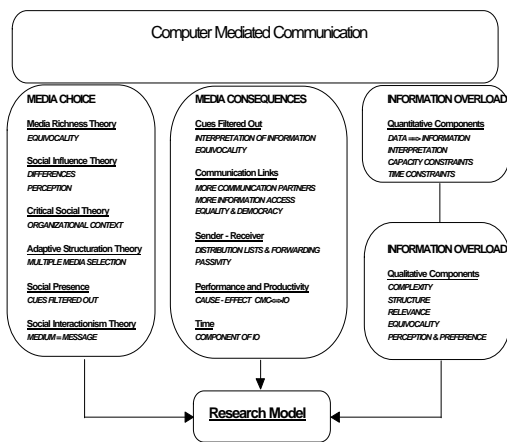


Figure 1: Literature Review Structure

The review can be broken down into three areas:

- Media Choice Theories (left side), where the medium used for communication is the dependent variable and which explains how users choose a certain medium to communicate. Although in this research one assumption is the restriction to use certain media, these theories help to analyze ramifications.
- Media Consequence Theories (middle), where the medium is the independent variable that influences behavior and outcomes in organizations and focuses on how CMC differs from face-to-face communication. This part will be limited to variables that help to explain IO.
- Information Overload Literature (right side), where the term is clearly defined and the focus is on volume of information. In a subsection, literature examining the qualitative dimensions of the phenomenon is reviewed. Recurring themes as well as

links to Media Choice and Media Consequence theories are elicited.

In sum, the Media Selection and Media Consequence theories are intended to explain why individuals select a particular medium for communication and its consequences. These theories at the same time help understanding the outcome if the media choice is restricted, such as is in virtual organizations.

The second part will delineate Information Overload and deduce determinants of this phenomenon. Some of these determinants are also found to be a result of selecting a certain medium for communication, thus are recurring themes in this paper.

As a result of this review, relevant variables are defined and will be included in a research model later in this paper. At the end of the section, Figure 1 will be modified to reflect preliminary findings and concepts derived from this review. Potential interdependencies and structures will be briefly discussed. These conceptions will then be continued in Chapter 3 and evolve to a research model.

### 2.1 Media Choice

From the previous section, it is posited that individuals in multinational organizations, who are separated across time and space zones, primarily communicate via CMC [4; 26; 57]. Thus, although the media choice is limited, Media Choice Theories can help to analyze the ramifications.

One of the most influential and predominating theories in this area for years is the Media Richness Theory (MRT) [12; 13]. This work declaims equivocality and views media selection as a rational process to match characteristics of a medium and message content in order to reduce equivocality. Daft and Lengel suggest that media can be ranked according to their richness, with face-to-face considered to be the richest and written communication as the leanest medium. It is proposed that effective use of a medium occurs when the richness of this medium matches the information requirements or equivocality of the context [13]. Following MRT one can deduce that, if the media choice is restricted, as is the case in distributed teams, equivocality can be expected to residue. As will be discussed later, equivocality in turn can constrain the interpretation of information and this might contribute to IO.

Social Influence Theory [20], seen as complementing or opposing MRT, proposes media selection as a process based on an individuals' perception, preference of a particular medium and social context. All these factors can determine how richness of a medium is perceived, thus richness is not an inherent property of the medium, but depends on the context and the user of the medium. Thus, residual equivocality will vary accordingly between individuals and could explain differences in the perception of the degree of IO.

To overcome potential weaknesses of Media Richness Theory and to build on the approaches of Social Influence Theory, Ngwenyama and Lee's Critical Social Theory (CST) was developed. The key point of CST for this research is the consideration of communication partners in an organizational context. They formulate and reformulate their communications to achieve specific outcomes in actual situations. The degree of richness highly depends on individuals' perception and is not inherent in the medium used, an argument that has been brought up before in Social Influence Theory.

Adaptive Structuration Theory (AST) [43] posits an appropriation of technology, for example, the medium chosen and the social context of the group. Although AST is intended to explain structural changes in a broader sense, it can be applied to explain observations, where individuals use more than one medium to offset perceived shortcomings of the medium used [5]. This can result in a decrease in equivocality, but also in information redundancy.

Social Presence Theory [48] proposes that those media which transmit greater amounts of varied information simultaneously (including non-verbal information, also termed as "cues") are said to possess greater social presence. In other words, they are more friendly, more emotional and personal and permit users to perceive others as being psychologically present [21], but they also increase complexity. Information complexity in turn might obscure the interpretation of information [9; 18] and thus contribute to IO. This ties into "Cues Filtered Out" Theory and will be discussed in the next section.

Social Interactionism Theory [56] postulates that the medium itself is a message, since the medium has a symbolic meaning. This view will be used to discuss information complexity later in this paper.

## 2.2 Media Consequences

A second domain of research in the area of CMC deals with the consequences of using certain media. Computer technologies in general significantly increase the amount of information that can be accessed by individuals, thus theoretically should help in performing their tasks [11; 51; 52]. No statement is made about the quality of this added information as well as the effort required to retrieve relevant information [55]. Both components can be significant when discussing Information Overload.

"Cues filtered out" theory [51] discusses the effects of less social information transmitted in CMC, because any non-verbal information is omitted. Less social information or a low social presence can equalize status differences [52] and thus lead to communication on more equal terms with more communication partners. On the negative side, the absence of cues not only affects users' perception of the communication context and the communication partners, but, more generally, constrains users' interpretation of the messages exchanged [59]. As will be discussed later, problems in interpreting information is one of the determinants of Information Overload.

Asymmetry between sender and receiver of information discusses distribution list and forwarding options [35; 52]. The receiver of messages might be passive and receive unwanted information, the sender has no control of who finally receives their message. The key issues in this context are "unwanted information", "undesired communication," and "lack of control", which are potential determinants of IO [10; 34; 52].

CMC is particularly helpful to groups confronting physically dispersed members, where the added burden of communication tend to counteract performance and productivity [19; 22]. It is hypothesized that CMC not only helps to improve group communication, or make it possible in the first place, but also exchange information more efficiently, schedule group activities and partition work, thus help to increase productivity [19]. It is also proposed that CMC improves productivity by drawing the users' attention to the task at hand and exchanging purely task related information [37; 45]. Productivity losses that can be observed in face-to-face communication [17; 23] are eliminated or reduced in CMC groups [39]. In spite of all arguments proposing an increase in productivity in CMC, findings in empirical research investigating performance, productivity and related variables are

inconsistent and often not comparable. In the context of this research productivity is expected to be negatively impacted by IO [40; 41; 54] and the direct causal relationship between the variables has to be validated in empirical research.

Time is considered an important factor because in CMC it takes less time to access significantly more information [11; 51; 52], but more time is needed to arrive at joint decisions [39; 52]. Concurrently, time is one of the recurring determinants of IO [9; 10; 50; 62; 65].

### 2.3 Information Overload

To explain these phenomena, one should start with a definition of information. Information refers to a status when meaning can be derived from data or a stimulus [15; 44]. The dissipation of this information is the process of using the information [44]. If information generation exceeds information dissipation, information overload will occur [44; 54]. The reason for this might be limitations in either the individuals' capacity [61] or time constraints [9; 10; 50; 62; 65], that makes it impossible to process data or interpret the information. Thus, beside the pure volume of information, that certainly is an important point [9; 10], it is the problem of interpretation of data.

The second aspect focuses on the qualitative attributes of information that might help to explain obstacles in interpreting information and thus lead to IO. So far this area has been neglected in many studies [9; 10; 50]. Looking at the qualitative domain of IO, there are recurring themes that can also be linked to Media Selection and Media Consequence Theories, as discussed earlier.

Information complexity is one of these variables and can be further divided in the dimensions presentation format and information content [30]. This idea in turn can be related to the richness associated with a particular medium [49]. Complexity can also be associated with information cues to be transferred [53] and thus be linked to the Cues-Filtered-Out Theory [51] and Social Presence Theory [48] brought forward earlier in this paper. If fewer cues are transmitted, it is posited that information is less complex [53], a hypothesis that yet has to be supported in the context of CMC. Information structure is closely related to complexity. Koniger and Janowitz analyzed the topic in depth and posit that new media inherently lack structure or give no longer information about the

message they transmit. Thus, Social Interactions' Theory postulation [56] of the medium being the message no longer holds in CMC.

Information relevance is a further concept in the context of IO. Due to the large volume of information accessible for individuals, eminently in organizations using CMC [3; 28; 51; 63] it is increasingly difficult to filter which information is relevant for the organization in general or the task at hand [30]. On the other hand irrelevant information, in the senses of information not needed at this point in time, should not be discarded: it might increase the individuals' effectiveness and generate awareness of the organizations' broader environment [58].

Equivocality was discussed in the context of Media Richness Theory (MRT) and is defined as the multiplicity of interpretation of information [31]. It repeats the idea of obstacles in the processing of data to information [15] and serves as a link to MRT [12]. There equivocality was the result of a less than optimal match between the medium used and the task at hand.

There also seem to be differences between individuals: some people seem to be able to handle significantly larger volumes of information than their colleagues [9; 10; 40; 54]. O'Reilly made the observation that often individuals seek more information than is required for the particular situation. This might be explained with differences in the cognitive response to a message, an idea that was brought forward by Stohl and Redding. Differences between individuals were also mentioned. It was, for example, postulated that people might have different preferences in terms of the medium they want to use for communication, discussed in the Social Influence Theory [20]. This can also lead to distinct perceptions about the richness of the medium used (which might be restricted to CMC), and effect the interpretation of the message.

### 2.4 Research Question

This paper investigates the impact of CMC on real or perceived IO in teams that are working from various locations. Spatial and temporal dispersion are important assumptions in this context because the media used for communication are limited and, at the same time, CMC makes this form of organization possible. Although face-to-face communication is imaginable, it can not be done spontaneously, because typically it requires travel [47].

The problem of information overload, at this stage, is broken down into two major sub-problems or questions expected to be answered by performing empirical research, based on this papers' research model:

- What effect, if any, does CMC have on information and communication overload in distributed teams? Is the experience of day-to-day communication in distributed teams being restricted to certain media alleviate or exacerbate information or communication overload? If it is alleviated by using CMC, is IO purely related to today's highly complex and information-rich environment? If it is exacerbated,

which features of the medium are responsible for the overload?

- Are there differences in reported and perceived IO between individuals? If IO would be real it would be possible to quantify the problem and define a limit for the volume of messages to be circulated. Observations indicate that it is perceived and varies between individuals. Therefore, factors others than volume must have an impact.

The following figure presents theories and topics in the order as they were discussed, "reading" it from the left to the right side. Computer Mediated Communication is the setting under which these theories are evaluated.

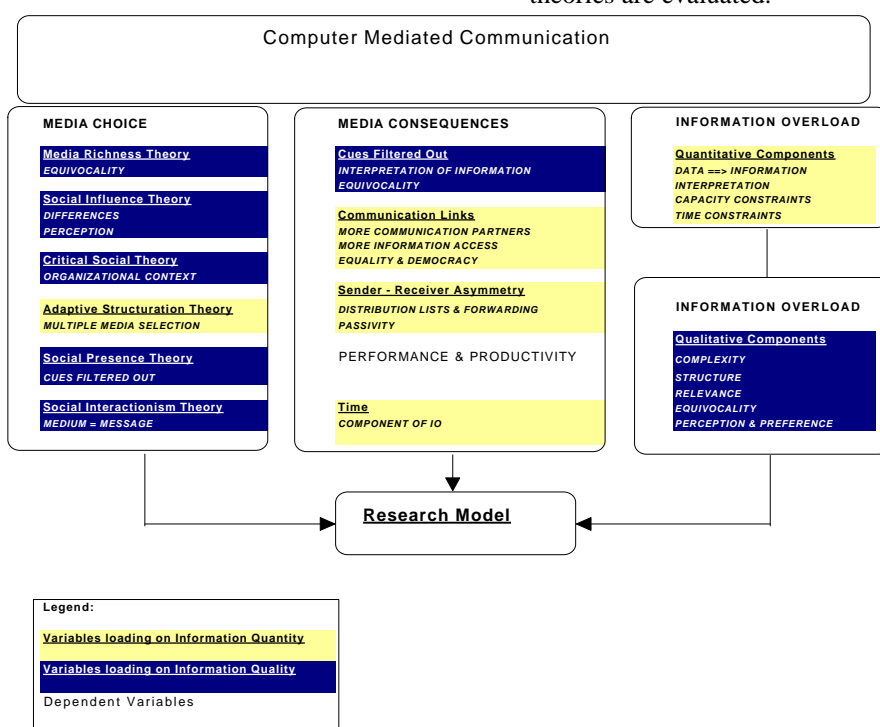


Figure 2: From Literature Review to Research Model.

The first dependent variable of interest in this paper is "Information Overload". In the review "Information Overload" was defined and potential determinants presented. It was hypothesized that information overload occurs as a result of high information quantity, a statement that is generally accepted as a cause of IO, and information quality, supported in more recent research. These two sections in turn are related to and can be explained by theories discussed in the first part of this review.

Topics associated with the volume of information in CMC are "More communication links" and "Sender-receiver asymmetry", the latter focusing on passivity of the receiver of information. Both theories were discussed under media consequence theories. Adaptive Structuration Theory illustrates the usage of additional media used, that can contribute to information volume. This theory was considered under Media Choice Theories. "Time" was discussed under Media Consequence Theories. This variable can be seen as information processing capacity constraint and is acknowledged to be a determinant of IO.

Information Quantity

Information Quality

An important theory contributing to the concepts of information quality is the cuelessness conception, that is closely related to Social Presence Theory and Media Richness Theory (MRT). These theories suggest either an obstacle in interpreting information or a reduction of complexity. Information equivocality was an independent variable in Media Richness Theory, where it was assumed to determine the selection of an appropriate communication medium. In this research it is suggested to impact the interpretation of information and implicitly advance Information Overload. Information relevance (or irrelevance) is proposed to contribute to IO. Irrelevance can be a result of either more communication links or access to more information which in turn is a result of using CMC. Information complexity has been delineated as a result of the multiple dimensions of information and likewise can be related to more communication links. Complexity can also be the result of the mutated presentation format of information when using computer for communication.

Performance is suggested to be influenced by Information Overload and hence becomes the second dependent variable in this research.

### 3. A Research Model of Information Overload

Considering theories reviewed in the previous section, the following research model has been developed:

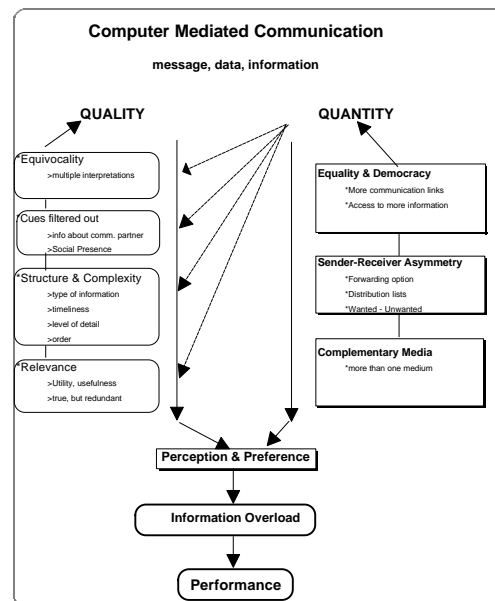


Figure 3: The Research Model

The four boxes on the left side of the model represent qualitative aspects of information and the three boxes on the right hand portray information quantity. These two factors are hypothesized to cause Information Overload. As was also outlined in the previous section, variables discussed are associated to either quality or quantity of information. Consequently, these two concepts can be seen as a set of common, underlying dimensions, known as factors or latent variables [27]. The manifest or indicator variables to advance these latent variables are derived from the Literature Review, being aware that the common factors at this stage of the research are hypothesized and have to be confirmed by empirical data. The indicator variables are the variables that will actually be observed or measured.

Variables expected to load on information quality are:

- Equivocality
- Cues filtered out (Social Presence)
- Complexity & Structure
- Relevance

These variables can result in IO concurrently or independently. For example, a message received can contain relevant information for the organization, but is redundant. It is ill-structured, therefore the redundancy is not absolutely clear for the receiver. The communication partners' name and hierarchical position might be known from previous contacts, but

he or she is not present and, thus further feedback or clarification has to be obtained. All this leads to equivocality. For the receiver there are multiple options how to interpret and how to act on this information.

The quantitative branch of the model is conceptualized by

- Equality and democracy
- Sender - receiver asymmetry
- Complementary media

Equality and democracy focuses on individuals' options for obtaining more information, either by contacting other partners or by accessing databases in the system. This can be seen as an active process and is desired. Sender - receiver asymmetry focuses on distribution lists and forwarding options, thus is correlated with the previous point, but can be an active or passive process of acquiring information. Thus the information might be wanted or unwanted. Complementary media represents additional sources for information and, according to a strict delineation of the context, should not be included here. However, from observations in the field it was felt that it is important and in the context of CMC it might be used to overcome restrictions of this communication medium (see also the previous section, in which complementary media were explained with AST).

The research framework indicates interdependencies between the qualitative and quantitative components. These interdependencies are symbolized by the dotted arrows. An increase in volume in messages received, whether desired or undesired, is likely to be correlated with qualitative factors (even if the impact on IO can differ, depending whether information is wanted or not). If, for example, more than one medium is used it is conceivable to receive more redundant information. If somebody is a member of a distribution list and receives frequent messages from this list, it is possible that he or she does not know from which person it is coming and whether or not any action is required. Thus, the information becomes equivocal.

As was posited previously, the ability to process information and to interpret messages as well as the preference for a higher volume of information varies between individuals. In the model this is reflected by the arrows directing to "Perception and Preference". This in turn has an impact on how (and whether) IO is perceived. In the model the assumption is made that IO inevitably has an impact on performance.

## 4. Empirical Research

### 4.1 Research Method

An on-line survey was conducted within Electronic Data Systems (EDS), an IT Service provider, and its major customer. The problem of IO in the context of the communication system used was addressed from this customer with the expectation that EDS as an IT Service Provider should help to analyze and alleviate IO. From the customers' point of view it is expected and anticipated that this will have an impact on the IT strategy and might help to reduce costs for computer hardware, software, data transmission as well as increase productivity. The organization under discussion uses Lotus Notes primarily, a client-server application, as communication and information access tools. Lotus Notes was used to conduct the survey and so the medium itself was used as a vehicle to study its use. Data that are pertinent to answer the research problem were collected in two ways:

- Measurements were taken from the communication system directly to collect any volume related information, such as number of messages exchanged and mailfile size. This method of data collection provides unobtrusive data and has advantages in terms of validity and reliability [64]. This type of information also allows for comparison between individuals.
- A questionnaire was used to measure the variables deduced from the Literature Review. This survey was conducted via Lotus Notes, using tested instruments [9; 14; 25; 46; 48] to investigate the variables.
- The survey form allowed respondents to make additional comments they felt were important.

To analyze potential bias, system measured information was also collected from non-respondents<sup>1</sup>. As an interesting by-product, the research itself was performed by a widely distributed team that relied primarily on CMC to exchange results and coordinate the work:

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<sup>1</sup> Individuals could click on a button in the survey form expressing their wish not to participate. The form was then automatically returned to the database, collecting system measurements. Due to privacy concerns this type of information was not collected from individuals not responding at all.



- The Lotus Notes database to conduct the survey and collect the data was developed in Beijing, China. From there the mailing and follow-up of the questionnaires was administered.

- Technical support was provided by the Lotus Notes group in Germany.

- The research was coordinated and results analyzed in Sao Paulo, Brazil.

- The research was supervised by Henley Management College, UK.

A total of 870 questionnaires were mailed online to randomly selected Lotus Notes domains around the world. 300 completed questionnaires were returned to the mailbox, a response rate of 34,48%. 175 respondents rejected the survey using the appropriate button in the form. Their mailfile size information could be collected. Moreover, 395 forms or 45.4% of all mailed questionnaires were not returned. The typical respondent in this survey were middle age males, North American, white collar GM employees with more than one year Lotus Notes experience.

## 4.2 Results

An independent samples t-test was performed to analyze differences between respondents and rejections, using mailfile size (KB) and number of memos as variables, since this information was collected for both groups. The purpose of this analysis was to test for response bias, since it was anticipated that individuals who feel overloaded, as a result of a high message volume, might not respond. Results from the t-tests indeed indicate a significant difference between both groups, however, the direction is rather unexpected.

Respondents had less memos in their mailbox ( $t=-3.626$ ,  $p=0.000$ ) and their message volume in KB ( $t=-2.420$ ,  $p=0.016$ ) was lower than that of those who did not wish to participate. For the variable "memos" the mean was 131.85 for rejections and 282.76 for respondents, the means of "size in KB" were 9275.34 and 13,520.68.

Descriptive statistics of the construct measuring Information Overload were also rather surprising: on a seven point Likert scale ("not at all overloaded" - "extremely overloaded") the range of responses was between 1 and 6, with a mean of 3. A cumulative 69.2% rated their degree of overload resulting from Lotus Notes between 1 and 3 ("not at

all" - "a little"), 30.8% felt a fair amount of overload and higher.

ANOVAS were performed to test for differences of perception on the variables "equivocality" and "number of memos", using the perceived degree of overload as a factor. For the first variable the results suggest a difference between degrees of overload ( $F=10.598$ ,  $p=0.000$ ): a higher degree of perceived overload is correlated with a higher level of equivocality. Other for the number of messages ( $F=1.295$ ,  $p=0.268$ ): an individual who feels very much overloaded might receive the same number of messages as somebody who does not perceive to be overloaded at all.

The core part of the data analysis was structural equation modeling (SEM), using Amos as a software tool to test the Research Model. In a first analysis the initial research model, as displayed in Figure 3 was tested. The results were as follows: the number of degrees of freedom is high with 53. The number of distinct sample moments, that is, parameter values given, is 78. This leaves 25 parameters to be estimated. A parsimonious model, however, with a Chi Square of 360.39, the relative Chi square is 6.8, and thus exceeds the acceptable level. RMSEA is calculated at 0.17, and thus does not fall in the range between 0.05 and 0.1. The same applies for AGFI. The value of 0.67 is lower than the recommended 0.9 threshold, that shows that the high Chi square statistics more than offsets the high degrees of freedom. The Amos output model further indicated that the sample data do not support the measurement model. In other words, factor loadings rejected the hypothesized common factors "Information Quality" and "Information Quantity". For "Quantity of Information" only two variables had sufficient loadings with 0.76 for "memos" and 0.98 for "Size in KB". The two variables "Complexity" (0.78) and "Relevance" (0.62) indicated significant loadings on "Quality of Information". This leaves 6 variables with non-significant loading on any of the common factors. From this observations it can be concluded that latent factors other than those hypothesized are existent and not reflected in this initial model. The initial model had to be rejected, based on the indicators calculated.

Since the analysis indicated significant problems with the measurement model, an exploratory factor analysis was performed to investigate latent factors. Principal component analysis, using oblimin rotation with Kaiser

normalization revealed four common factors: Factor One is termed “Uncertainty Reduction”, with loadings of the variables “Communication Links” (-0.775), “Information Relevance” (0.786) and “Information Complexity”(0.747). The second factor is called “Information Redundancy”: “Distribution Lists” (0.741) and “Additional Media (duplication of information)” (0.692) are loading on this construct. Factor three is called the “Social Presence” factor: the two constructs “Equivocality” (0.822) and “Cues Filtered Out” (0.516) are strongly loading on one common factor. The last factor represents the physical information volume (0.658) and different media used (0.779) and thus seems to represent variables which can be unobtrusively measured. This factor is labeled “Physical Volume”.

These findings were analyzed and resulted in a modified research model. Although minor problems with measurement and structural model persist, the new research model achieved acceptable Goodness-of-Fit measures and was accepted on a preliminary basis. The modified Research Model looks as follows:

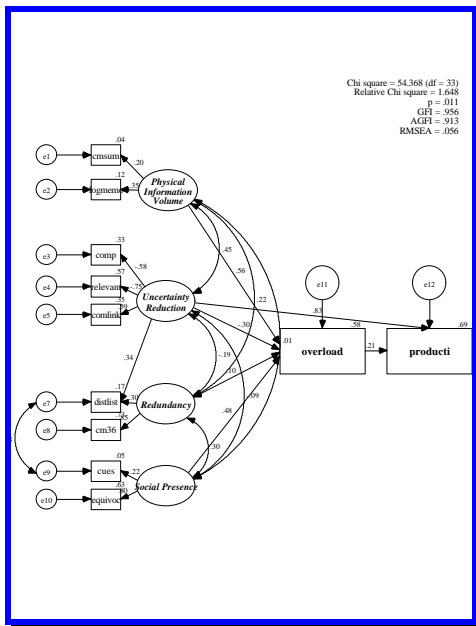


Figure 4: Modified Research Model

The path coefficients for the latent factors “Physical Information Volume” (0.560) and “Social Presence” (0.477) indicate the existence of a causal link on IO. Remarkably, the model suggests a direct and statistically significant path of “Uncertainty Reduction” to “Productivity”, but not to “Overload”.

The factor “Redundancy” does not seem to impact any of the dependent variables. The multiple coefficient of determination  $R^2$  for “Productivity” reveals that 69% of this constructs’ variation is explained by its predictors however, the explanatory power of “Uncertainty Reduction” is higher than that of “IO”. The regression weight of “IO” on “Productivity” is at a moderate 0.21, but statistically significant at  $\alpha=0.01$ . In addition, 58% of the dependent variable “IOs” variation can be explained by the variables in the model. In turn this reveals that 42% must be related to indicators not yet included in the model.

## 5. Discussion and Conclusion

### 5.1 Findings

The exploratory factor analysis, which used the constructs identified throughout the literature review as input, revealed more complex structures than hypothesized and identified four common factors:

Factor One was labeled “Uncertainty Reduction”, and suggest that with more communication links accessible, information becomes more complex. At the same time irrelevant information might be collected. Individuals, however, seem to favor more information sources, since an increase in productivity is associated with this factor.

The second factor is called “Information Redundancy”: by receiving forwarded information or being member of a distribution list, it is inevitable that some of the information is redundant. The same information might be sent by various people or the person is on more than one distribution list. The data however, suggest that this does not result in Information Overload.

Factor three, the “Social Presence” factor can be interpreted as equivocality to increase when other non-verbal cues are reduced, as a result of the communication partner not being physically present. As expected, this construct eventuates overload.

The last factor represents the physical information volume and number of different media used. It seems to restrict information quantity to objectively measurable properties of information and can result in Information Overload.

The modified model supports the two constructs "Information Volume" and "Social Presence" that have an impact on "Information Overload".

For the first factor this is in line with mainstream research, but was perceived as not being sufficient to explain IO [9; 50].

The second construct suggests "Cues Filtered Out" as having an impact on the interpretation of information. If the communication partner is not physically present, information might become equivocal and thus interpretation is obscured. This in turn can result in Information Overload.

The survey, however, was not designed to give any information about the type of communication; whether it is purely task related communication, where difficulties in interpretation have more serious consequences or whether communication is of more socio-emotional nature. There might be a difference in perceived overload depending on the purpose of communication.

Unexpectedly, the latent factor "Uncertainty Reduction" affects the second dependent variable "Productivity" directly and does not result in Information Overload. Variability in "Productivity" is more impacted by this factor than by Information Overload. In other words, performance is more positively influenced by information in general and variety of information in particular than negatively by Information Overload.

Analyzing the respondents' comments, it seems that people are actively looking for more communication partners, information sources and access to other systems. Of 95 individuals who put comments on their questionnaire, 22 expressed this wish. The majority wanted to have access to external e-mail systems or the Internet, having access to more databases, communicate with people outside the company or simply have access to worldwide address books of Lotus Notes users.

Individuals might see this as an active process they can control [52] and thus do not perceive IO as a result of having more contacts. This would also explain why the "Redundancy" factor does not cause overload: people often want to be included in a distribution list to receive information of more general interest. They see it as "a window on the corporation"[52]. Typically distribution list information does not require an action and is of more general nature.

It might also be a mechanism to cope with uncertainty by obtaining more information and feel more confident [48] or to triangulate by obtaining

information from more than one source [16]. A further explanation suggests that CMC has been used for some time and individuals have learned to selectively use it.

## 5.2 Limitations

As with most field studies, external validity is at the cost of internal validity. In such a setting variables can not be controlled and extraneous factors might cause changes in the dependent variable.

Moreover, the research was limited to Lotus Notes and this is only one medium to be classified as Computer Mediated Communication. Information Overload however, can be the result of a sum of factors, a variety of media or simply the consequence of nowadays lifestyle with technology impacting everybody's life 24 hours a day.

The research was also limited to intra-organizational communication and thus does not reflect the growing interconnection of electronic mail systems across businesses and the increasing number of Internet users. Although the desire to have seamless interfaces to other e-mail or communication systems was expressed by several respondents, it is questioned whether they are prepared to live with the consequences.

Developing a research model in general and developing one of exploratory nature in particular requires simplification and abstraction. At that stage it does not provide a deeper understanding of what is actually happening [32]. In the context of this research, this limitation was indicated for some of the variables observed and some of the rather unexpected results.

Ideally, in the next step this would result in qualitative approaches for obtaining this knowledge, that in turn could be used to further refine and modify the instruments used or the research model.

When developing the research model, it was realized that there are variables with potential impact on Information Overload not included in the model. Subsequent inclusion of such variables certainly increases the insight into the phenomenon.

## 5.3 Implications

The implications of this study are valuable for practitioners and academics alike.

The previous section discussed limitations of this research. Some of those can be related to the rather exploratory nature of this research and require further investigation.

Further research should be conducted using various methodologies to serve the different purposes:

Qualitative approaches can be applied to obtain a deeper understanding of some of the constructs in this research as well as to better understand some of the rather unexpected findings.

Unstructured interviews are suggested to obtain the appropriate insight, answer "why" questions and to identify factors that might have been overlooked.

Quantitative approaches can be pursued and additional variables subsequently be added to the research model. Potential variables, that would also build on previous research in the IT area are gender [24], management level [9; 10], as well as the area of motivation in IT, covering flow [60] and the Technology Acceptance Model [24]. A fascinating area to be included is the variable "culture" and could build on Hofstede's work or recent IT research performed in various countries [6; 7].

The implications for the organization are significant and should not be overlooked.

To reduce equivocality, the implementation of an information policy, for example structuration of information according to the dimensions of Koniger and Janowitz might help. Further, training can be provided to creating messages in a way that avoids misinterpretation or misunderstanding.

To compensate for missing non-verbal cues, the provision of face-to-face meetings at certain stages in a project should be scheduled and budgeted for. This is to ensure that participants know each other and thus have background information that makes it easier to interpret future message exchanges.

Information of common interest, but not related to a particular task should be placed on bulletin boards, rather than distributing it directly. In this way individuals would have the opportunity to scan for information at times convenient for them and would know where to look for information of more general interest. At the same time this would free system resources and cut costs for circulating and storing messages.

The wish to communicate with individuals outside their organization, outside the company and across various e-mail systems, was expressed by a high number of respondents. This requires easier interfaces and more user friendliness. Data security

might be an issue when communicating across organizational boundaries, but with the technology in place these problems can be solved. For individuals it seems more important to be in control and to have the option to select the communication partner.

As discussed previously, distribution lists and forwarded messages obviously do not result in IO, but the topic was addressed by respondents. Receiver of these type of messages consider them rather a nuisance than a serious problem and this might be related to the type of information circulated. Pragmatic steps might help to alleviate the problem:

- The individual names to whom such a messages was sent should be visible to avoid duplications in sending.
- Distribution lists should be limited to a certain number of receivers.
- Distribution list should "expire" automatically after a certain time period to enforce regular updates.

A very pragmatic problem in this context is the unavailability or inaccessibility of equipment, whether computer or other media, due to technical problems. Often this is the culprit for unproductivity or waste of time.

The situation becomes even more severe when individuals are traveling, having to deal with different standards of equipment, and, for example need to dial into their home server to access their Lotus Notes box.. Although portable computers are getting lighter, the cabling, adapters and plugs needed to use foreign telephone equipment occupies more and more space in the individuals' baggage.

Ideally, there would be a seamless interface between most of the media used and information could be easily switched and then be retrieved using the preferred medium.

Although this is possible with existing technology, reality in the field tells a different story.

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