

Information Inadequacy: Some Causes of Failures in Human, Social and Industrial Affairs

Miranda Kajtazi¹, Darek Haftor² and Anita Mirijamdotter¹

¹Linnaeus University, Växjö, Sweden

²Stockholm University, Stockholm, Sweden

miranda.kajtazi@lnu.se

dh@fek.su.se

anita.mirijamdotter@lnu.se

Abstract: In this paper, we develop a conceptual model for understanding human-related information practices and their behavioural activities. Our focus is on forging new possibilities to explore and improve the contemporary dilemma when human activities fail due to the lack of the needed information, which is here understood as information inadequacy. More precisely, information inadequacy is defined as vulnerable and inadequate information, composed by the dichotomy of information lack and/or of information overflow, which imposes complexities and unexpected behaviour on human, social and industrial affairs. By exploring the lack of needed information in human, social and industrial affairs, we conducted an inquiry into different empirical situations manifesting information inadequacy, subsequently examining the various theoretical bodies that relate to information inadequacy. The key question was: Which theories may explicate the key human behavioural patterns that cause information inadequacy? To answer this question, our paper presents initial guidance with a systematic approach that focuses on evaluating and further improving research and practice in terms of information relevance. The empirical cases are largely based on major human, social and industrial dysfunctions: the Lehman Brothers' bankruptcy 2008, and the Enron bankruptcy 2001, the disasters of the Columbia space shuttle in 2003, and the Challenger in 1986. The analyses are examined through theories of information behaviour that influence communication processes where two or more different actors are required to engage in activities of communicating information. The results include the identification of four information exchange patterns: influenced, intentional, hindered, and unaware. Furthermore, we discuss the implications of the model for practice with information. The paper concludes by reviewing the role of information inadequacy in economic, social and political contexts that remain challenging.

Keywords: Behavioural activities; communication processes; information behaviour; information overload; information lack.

1. Introduction

One of the basic activities in any human-related dilemma is to explore its causes and consequences in human, social and industrial affairs. This paper presents some findings from ongoing research related to the phenomenon of the lack of needed information, understood here as the dilemma of information inadequacy. We define information inadequacy as vulnerable and inadequate information, composed by the dichotomy of information lack and/or of information overflow, which impose complexities and unexpected behaviour on human, social and industrial affairs. This is here understood as a phenomenon that is manifest in behavioural activities that influence the lack of needed information. The objective of this paper is to develop a conceptual model that introduces the causes of information inadequacy related to failures and fatalities in human, social and industrial affairs. The model intends to illustrate how numerous situations in the world undergo different motivational states of human behaviour that are caused by the lack of needed information. The latter is described as an unbalanced mode of communicating information between actors that share information with others (Isaacson 2009; Akerlof 1970). Our attention has two focuses. On the one hand, we give an overview of the analysis of the conducted review in relation to information behaviour theories whereby we intend to explain some key aspects of human-related information practices and human's motivations to behave in different ways. On the other hand, we focus on dramatic situations such as the financial failures of the Lehman Brothers' bankruptcy 2008, and the Enron bankruptcy 2001, the disasters of the Columbia space shuttle in 2003, and the Challenger in 1986, where information inadequacy has clearly shown a pattern in presenting the lack of needed information. It is typical to understand that those situations have evolved together with the latest movements of societies, economies and technologies (Castells 2009).

The diversity of these challenges presents numerous problems with regard to communication of information that remain affected by information inadequacy. Very few theories discuss how to manage a situation where information plays the key role (Romito et al 2007). In practice, as yet there is no

clear standardisation of information exchange (Isaacson 2009). This shows the dialectic nature of the subject matter and the key question investigated here: *Which theories may explicate the key human behavioural patterns that cause information inadequacy?*

We argue that this question helps to reveal some important behavioural patterns that have potential for explaining what triggers information inadequacy. Hence, with this study we present a phenomenological challenge, while many other flourishing theories have tackled behavioural aspects of human-related information practices in terms of phenomena, however, only partially. Such theories explain that there are several interferences that restrict standardisation within communication processes (Bandura 1977).

The rest of this paper is structured as follows. We first present the conceptual challenge related to the dilemma of information inadequacy. Then we present the research approach. Thereafter, we discuss selected information behaviour theories that have deep theoretical implications for what is referred to here as information inadequacy. This is followed by empirical analyses of those selected situations where information inadequacy took place. We highlight initial results of these analyses by first presenting the conceptual model, which is derived from the empirical cases and information behaviour theories. This model describes the way in which information inadequacy affects information exchange in communication processes, which is analytically supported by each of the identified theories. Finally, we discuss implications of this model for future challenging matters in relation to information management.

2. Conceptualising the Challenge: the Dilemma of Information Inadequacy

It is important to consider briefly at this point the need to investigate the dilemma of information inadequacy. As a conceptual challenge, the understanding of this dilemma is guided by theories of human-related information practices. The dilemma of information inadequacy seems to be predominantly caused by human activities, very much supported by the use of technologies. The explanation of this dilemma, however, is not only theory dependent but also empirically dependent. In practice, in the context of those situations presented in the previous section (e.g. the Lehman Brothers' bankruptcy) several critical questions remain challenging. Consider the following. How can we ensure that information inadequacy can be managed successfully? How do we design more precise information and communication technologies to generate, transport or receive information sent between sources and destinations? Will we become aware in time of the many harmful problems that are caused by information inadequacy? Theorists have failed to tackle the issue comprehensively so our approach to explaining information inadequacy focuses on inter-disciplinary information behaviour theories. With a combination of such theories we intend to obtain a systematic and holistic understanding of the human behavioural patterns related to information practices. We elaborate on these situations by considering their relation to information and communication technologies, regarded here as mediators of communicating information. Many consider such technologies critical to the understanding of emerging human behaviour patterns. As we analyse it here, technology is important for describing these patterns. The inclusion of technology as a mediator draws on recent theories that identify how human cognitive and social behaviour have experienced fundamental shifts with regard to communicating information via technology (Castells 2009).

Accordingly, it is also argued that many problems in communicating information often arise through technology (Olivera et al. 2008). Surprisingly, the issue of human-related information practices using technology is raised within the area of information management, most often in the context of information relevance. This may indicate why there is a great tendency to ignore problems such as those raised by the dilemma of information inadequacy. First, it is proved that technology provides comfortable ways to handle information while in a communication process. This is so that information can be transmitted from anywhere to everywhere and at any time (Haseloff 2004). Second, technology represents a subjective nature of its application among humans' needs that ultimately affects its use (Orlikowski 1992).

As we theorise on information and communication technologies as mechanisms that facilitate communication of information, it is argued that such technologies affect human-related behavioural activities by their impact, be it positive or negative (Olivera et al 2008; Orlikowski 1992). In accordance with this argument, we introduce several situations related to technologies that confront the debate on information relevance versus information inadequacy. Few consider that problems with information in relation to technologies are a sensitive matter (Romito et al 2007).

This suggests that attention has largely been focused on information relevance, in parallel with certain other issues:

- Organisations use technology to communicate and share information to reduce expenses (Lucian et al 2007).
- Most world societies, e.g. Australia, have become keen adopters of technologies as a means to improve and enhance communication (Burton-Jones and Gallivan 2007).
- Individuals use technical mediums for information provision, which may allow designing, shaping and maintaining their personal identities (Floridi 2006).

Resembling those conditions to perhaps extreme situations, how for example a single trader uses technology to scam customers or for money laundering, can best describe how the role of technology can undeniably impair the subject of the situations above. This brings us back to what is mentioned earlier regarding the debate on information relevance versus information inadequacy.

As a consequence of the issues mentioned above, we are all addicted to technology. Consequently, we often neglect such counterproductive situations. Nevertheless, research of the last decade suggests that problems similar to that of information inadequacy are in fact expanding dramatically (Creese 2007; Romito et al 2007). This also informs us just how little we know about the counter-effects of technology in terms of information provision in human, social and industrial affairs.

3. Research approach

The explorative nature of this paper focuses on two frontiers. First, we examine the role of information inadequacy through selected information behaviour theories. This selection is based on a comprehensive literature review, where more than fifty publications have been analysed for their approach towards explaining human behaviour when engaging with information. Those theories have mostly focused on a variety of activities that involve information practices, such as issues of information exchange, information retrieval, information search, or information processing. Our selection comprises five main theories of an inter-disciplinary and systemic nature, which have strong implications for understanding of the investigated dilemma. Second, we examine various possible causes of information inadequacy. This has been achieved by studying a set of more than a hundred collected empirical cases. Approximately fifty-five of those cases are particularly interesting, resonant with similar human behavioural patterns, and allow us to express the essential causes and consequences of the dilemma of information inadequacy.

This research approach presents a combination of practical and theoretical implications for the dilemma. It motivates our analyses to guide the development of new models and patterns of how we communicate information in current environments. The risk of experiencing information inadequacy is persistent, which increases various problems in communicating information between our social global structures (Harford 2005).

In analysing and interpreting such a crucial dilemma, it is important that we address the limitations of this research approach. Primarily, the information behaviour theories are selected on the basis of human behaviour dealing with information, and socio-psychological, economic, communicational, and technological factors are of primary interest. The empirical cases also have a very dramatic nature in terms of their causes and consequences. Thus, we intend to elicit from those empirical cases the core of what appears to be information inadequacy. Also, we mainly focus on situations where technology plays an important role, which is mainly viewed as a mediator in the communication of information. Thus, the collected empirical cases are particularly depicted as situations that occurred during the last century and the beginning of this century, the period when technology also evolved. Another important limitation is that information and communication technologies are regarded here as mediators. But their representation of information may relate to information sources or information receivers, and not only the transport of information. Our technology references in this paper, however, are tailored to its role as mediator in the communication of information.

Accordingly, the next section first introduces selected theories based on information behaviour, which have implications for the dilemma of information inadequacy. Second, we present several cases where information inadequacy has had destructive results. Furthermore, we introduce the possible causes of information inadequacy based on the presented cases.

4. Theoretical basis of information inadequacy

There are numerous theories that address different problems of human-related information practices. The selection of only five information behaviour theories challenges us to address the dilemma of information inadequacy in a distinctive way. According to our literature review and selection, theories comprising characteristics that strongly influence problem-solving activities are particularly able to manifest different human motivational states that shape information inadequacy. Theories of that kind are of great interest in this inquiry. They show several similar characteristics through which human-based interactions are examined in an inter-disciplinary way. This is achieved by analysing their role in diverse disciplines and approaches that are essentially integrated in a systemic view. Following a systemic approach, these theories are based on a single unity. They tend to explore human problem-solving activities in relation to their information practices. This may not be the easiest way to describe the dilemma of information inadequacy, but the description is tailored to our scientific explanations.

Table 1 below introduces the five main selected information behaviour theories. It is evident that those theories derive from different disciplines, allowing us to call for a transdisciplinary approach to investigate the dilemma of information inadequacy. These theories are independent of each other, but they do have basic features that overlap. For example, social network theory focuses on sociological aspects of human activities in terms of exchanging information. Social cognitive theory, derived from psychology, is focused on behavioural aspects of human activities in exchange of information. Similarly to these two theories, the theory of information asymmetry is focused on economic transactions in which human activities are emphasised when information is exchanged. Further, information theory is concerned with communication processes that happen between humans who exchange information with one another. Finally, the social construction of technology focuses on how humans exchange information through the use of technology.

These theories may be regarded as independent. In spite of this, they have very similar implications for information inadequacy when the communication of information is particularly taken into consideration.

Table 1. Interdisciplinary theories that affect individuals/social groups with information practices for problem-solving activities.

Taxonomy of interdisciplinary theories that focus on the process of communicating information.
<p><u>Sociology</u></p> <p>Social Network Theory (Barnes 1954)</p> <ul style="list-style-type: none"> • Social systems i.e. individuals/collectives gather information for exchange purposes.
<p><u>Psychology</u></p> <p>Social Cognitive Theory (Bandura 1977; Wilson 1995)</p> <ul style="list-style-type: none"> • Cognitive and behavioural aspects of individuals or collectives determine information meaning and information exchange in social interactions.
<p><u>Economics</u></p> <p>Theory of Information Asymmetry (Akerlof 1970)</p> <ul style="list-style-type: none"> • In economic transactions, individuals/collectives influence the inclusion of imperfect information for personal/group benefits.
<p><u>Communication</u></p> <p>Information Theory (Shannon 1948; Wiener 1954)</p> <ul style="list-style-type: none"> • In communication processes, individuals/collectives trigger behavioural changes in any system through the use of information and the feedback process during communication.
<p><u>Information Technology</u></p> <p>Social Construction of Technology Theory (Pinch and Bijker 1986)</p> <ul style="list-style-type: none"> • In the process of interactions, individuals/collectives make use of IT as a tool for human activities, determining how information is created, collected and distributed.

We briefly introduce each of these theories below in order to explain their benefits, similarities and implications for the dilemma of information inadequacy.

Social Network Theory was first coined by Barnes in his study of social groups in a Norwegian community (Barnes 1954). His idea was to introduce the many positions of an individual in different social groups. Barnes also specified the role of technological developments, which push social groups to develop along with them. This study, however, was conducted in a Western society, and this suggests the results may differ in a different context. Still, his arguments on theoretical implications, regarded social groups as flexible entities that are able to develop and change through time together with evolutions in societies. The introduction of this theory is intended to act as a practical guide to the study of social relationships of individuals related to aspects of information behaviour. We bring into focus the ties of individuals with information. In this level of analysis the theory is used to explain how individuals have different motivational states towards different information when they happen to be in a social context. In this way, social network theory may generate some important theoretical findings in terms of understanding why and how individuals interact with and influence each other through different forms and implications given to the meaning of information. This suggests that in many cases the original meaning of information is diverted on purpose and generates false information. The theory examines informal connections related to human behavioural activities. Those connections are affected when real-world phenomena engage in social contexts. This explains partially how information inadequacy emerges.

Social Cognitive Theory derives from Albert Bandura's studies on cognitive concepts. This theory shows how individuals operate on the basis of their cognitive activities. It examines how individuals influence behavioural change and developments in social groups when they are engaged in forms of social experience (Bandura 1977). The use of this theory here is intended to act as a practical guide to the study of humans' cognitive and emotional aspects that are largely influenced by the environment where action takes place, and by individuals involved in the situation. Those are two basic aspects that can affect an individual's behaviour. In situations where information inadequacy occurs, this theory clearly denotes that most of the evolving information has changed the original meaning; this implies the misuse of information, which is constructed according to the individual's cognitive and emotional change.

Theory of Information Asymmetry, introduced by Akerlof in 1970, discusses the role of asymmetric information in economic transactions. He explains this theory in terms of dishonesty in economic markets that is triggered by individuals alone or individuals involved in social groups when any transaction-related information is of interest (Akerlof 1970). This theory is of our interest to explain the lack of needed information for the following reasons. It explains the use of asymmetric information in economic transactions, communication processes, or production processes. The analyses of this theory suggest that information asymmetry explains the presence of imbalance in the flow of information in any economic transaction (Kajtazi 2010). This informs us how and why information inadequacy shows a large presence in human industrial affairs.

Information theory has developed since Shannon's model of mathematical theory of communication. His idea was to show how information messages could be transmitted in a linear engineering form, through two entities: sender and receiver. He introduced the model to explain how every communication process has a channel in which information flows in binary digits, technically using a speed limit through the channel (Shannon 1948). This theory is introduced here in order to show the importance of communication of information. Today, technological developments have shown great potential to take over information generation, distribution and reception. It has become evident that technological failures have already played a crucial role in the phenomenon of the lack of needed information. Communicating information means that information is delivered and can be used for the needs of individuals. Failures have shown, however, that often information has been lost, has not been transmitted or has been deliberately censored. These may be actions that are directed by human involvement or that describe how technology has failed to act according to its regular procedures.

Social Construction of Technology Theory focuses on technological developments and artefacts, on which social groups are concerned with their role and meaning in relation to individuals or organisations. Moreover, it specifies how problems and solutions in technology are both developing matters of social groups for the purpose of reaching certain standards for their application in human,

social and industrial affairs. The standardisation process related to technological developments grows in different degrees in the different artefacts. In principle, the use of technology represents different needs in different social groups (Pinch and Bijker 1986). The theory has very interesting implications for this study. It explains how the role of technology and its use in human, social and industrial affairs has become socially constructed. This signals to us that situations where information inadequacy takes place varies in terms of how humans misuse the original meaning of information. Some individuals or social groups tend to reject the use of technology, which allows easier access to construct a specific meaning of information; some may reject the use of technology in order to gain more freedom in playing with information and so on.

The use of these theories triggers new ways of identifying patterns that explain how we communicate information when two or more actors interact. This is what most of these theories refer to as the involvement of individuals in social interactions. The basic implication of these theories for the understanding of how information inadequacy develops relates to human motivation activities that contribute to generating information inadequacy. Thus, the effects of transdisciplinary use of such theories, through which the motivational forces engage, are necessary to explain what triggers problems in information inadequacy. Motivation is in fact related to behavioural patterns through which individuals formulate different thoughts and actions when engaged in communicating information (Wilson 1995).

5. Possible causes of information inadequacy

The central argument related to the empirical situations presented in Figure 1 is to introduce how the pattern of the lack of needed information evolves. Two theoretical bases are critical to understanding this pattern and its related causes: the key element that generates such situations, the concept of information; and selected information behaviour theories. We depict theoretical investigations related to the concept of information, its power and control. Such investigations help us to specify human-related activities that are based on individual motivations. Those information behaviour theories explain why humans decide to act in situations where personal benefit is critical.

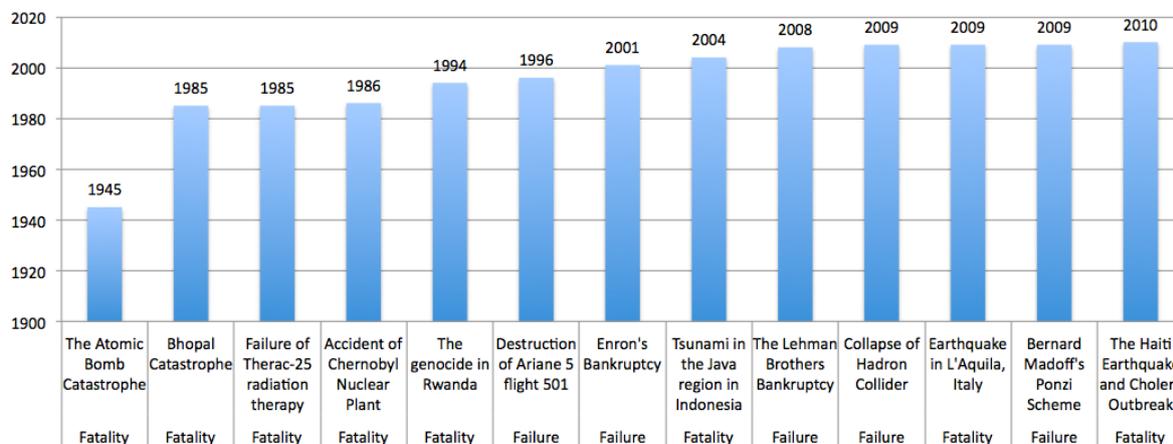


Figure 1. The presentation of cases and consequences of failures and fatalities in human, social and industrial affairs generated by the lack of needed information. The trend line marks those failures and fatalities that happened mainly during the last century and the beginning of this century.

Human motivational forces involve a variety of behavioural activities related to their social and cognitive nature. We draw from theories of information behaviour to identify the social and cognitive tasks that are carried out to formulate different motivational acts that generate information inadequacy. Here we introduce several empirical situations that present our everyday experiences, where the lack of needed information contributes to information inadequacy. Such situations are presented in Figure 1. The approach to explaining what causes these situations to happen so frequently depends on one central argument as mentioned earlier: the lack of needed information is central to the composition of those different situations. Our everyday experiences manifest numerous instances in which information is the key that generates various consequences that are experienced as failures and fatalities in human, social and industrial affairs.

The composition of these situations as presented in Figure 1 is intended to build a practical theory that introduces some of the possible causes of information inadequacy. More concretely, this approach presents a sociological understanding of how the lack of needed information causes failures and fatalities. Some of the possible causes that trigger information inadequacy have been identified during our analyses on the collected empirical cases. The main causes are typically related to behavioural activities. Some of the main causes are presented below:

- The needed information does not exist.
- The needed information is not sufficient.
- The needed information is censored.
- The needed information exists but cannot be found.
- The needed information exists but cannot be delivered.
- The needed information is not transmitted to the desired destination.
- The needed information transmission is delayed, intentionally or otherwise.
- The needed information is prevented from being delivered, intentionally or otherwise.

These are, however, only some of the causes of information inadequacy. Examining what actually happens when such causes are grounded in empirical situations, we further theorise about their effects in those cases where we see technologies as the mediators that characterise and influence information inadequacy.

Such causes have deep implications on technology use as mediators for communicating information (Romito et al 2007). A deep understanding of these causes within the stream of situations affected by the dilemma of information inadequacy could result in a diagnostic tool for understanding or enhancing the level of human behaviour in contributing to the dilemma of information inadequacy. In terms of technological implications, we conceptualise possible inconsistencies generated by misusing information that have to be prevented, primarily focusing on human behavioural activities.

6. Motivational states contributing to information inadequacy: the identified patterns

For identifying the motivational states of human behavioural activities the cases of information inadequacy introduced earlier are regarded as having important theoretical features. First, human behavioural activities that motivate interaction and communication are analytically dependent on causes of information inadequacy. So, the engagement of humans in communicating information shows sufficient evidence of information inadequacy. This is so pronounced that for the information receiver information is not as it has been originally generated. It is apparent that the presented cases involving human behavioural activities engage in cognitive efforts that boost individual motivation to communicate information in a certain way. In many cases, information owners' personal needs may generate ambiguous meaning of information or even hinder the delivery of information. These sorts of information may or may not be delivered by information owners. For example, the representation of information generated from an egocentric perspective is the main input for the information that emerges from the information receiver's feedback. Simply consider two or more actors involved in any process of communicating information. Usually the information owner develops a representation with a pre-planned meaning of information, preventing the receiver from accessing the original meaning. All such situations are analytically independent of one another. Still, the protocol of communicating information remains the same, and during the process of communication, information inadequacy is manifested.

This study suggests that diverse situations involving actors in communicating information emphasise the imbalance between those actors, stating that there is always one actor who benefits more than the other (Akerlof 1970). This informs that such situations suffer from intense problems with information inadequacy in general. Conversely, if all produced and transported information is to be truly useful and transparent, current technological trends and movements must ensure the ability easily to access, analyse and transport information (Brynjolfsson and Hitt 2000).

On the basis of analyses examined in those cases, our examination relies on theoretical considerations related to information behaviour theories introduced earlier (Bandura 1977; Pinch and Bijker 1986; Shannon 1948; Wilson 1995; Wiener 1954). These scholars have introduced theories that orient the necessity to focus research on how to understand the needs of humans in order to deliver adequate information. Even more, the theories focus on sociological, psychological, communicational, economic and technological accounts, which explain the capability of humans to provide inadequate information on purpose, usually influenced by the different circumstances involved in the situation. The conceptual model presented in Figure 2 below builds upon these theories. The theories have guided our explanations of the motivational states of two or more actors who are engaged in the process of communication. The idea of our model is to illustrate how the motivations of both actors (the information owner and the information receiver) engage in the process of formulating inadequate information. As a result, we have identified four key patterns that happen to be influenced by human behaviour activities that motivate information practices. The reason behind such motivations, i.e. that the original information has a different meaning before transmission, happens as a result of the possible causes of information inadequacy presented in section 5. The four dominant patterns that emerge are as follows:

1. *The original input of information is influenced.* The motivation to specify information is also influenced; e.g. the status of an object, such as a car, influences the original information to become intentionally transformed and kept from the information receiver. The car can be described as being in a good condition or in a bad condition, depending on the individual who owns the information, and can be described with restricted information. In economic terms, such situations has been described by the theory of information asymmetry.
2. *The original meaning of information becomes intentionally false.* The motivation to deliver information becomes intentional. The information owner falsifies the original information for personal benefit. The sociological and psychological condition of the human to intentionally play with the original meaning of information has been described in terms of social network theory and social cognitive theory.
3. *The information receiver is unaware of the falsified information.* The motivation of the information receiver to engage in exchanging information is of personal interest, but the individual is unaware of what information will be delivered. Information transmission is explained in terms of the information theory and social construction of technology theory, whilst the engagement of the actors in the process of communicating is explained in terms of the theories that deal with sociological, psychological and economical implications.
4. *The original information is kept from the information receiver.* The motivation of the information owner to benefit personally hinders the original information from reaching the information receiver. This illustrated the psychological condition when humans react in certain ways in order to benefit personally.

Figure 2 illustrates these four key patterns, which are fundamentally dependent on the composition of the theories introduced earlier. The four patterns (influenced, intentional, hindered, unaware) are intended to function as forms in communication processes between actors that happen to be engaged in the process of communicating information. These activities generate the motivational states of humans that represent both the evolving information within the process of exchanging information and the four patterns of motivational acts. The motivations of individuals are cognitive activities that largely depend on the human-related behaviour activities with information. Information is in fact an intermediary of communication between two actors, usually intended for their interests (Wilson 1981, 1995). Moreover, the motivations of the information owner ('motivation to specify' and 'motivation to deliver') are activated consciously. This happens only if these two forms of motivation satisfy the objectives of the individual when s/he generates information. In such cases, it becomes clear that the 'motivation to specify' information is influenced by the state of e.g. the goods that are involved in the economic transaction, except that the 'motivation to specify' is constructed under the 'motivation to deliver' information, during which, the original information is intentionally shifted to false information. This usually happens when the original information does not allow the information owner to benefit from communication, e.g. when buying something, and in contrast allows him/her to satisfy personal desires and objectives.

lack of needed information that causes unpredictable failures and fatalities in human, social and industrial affairs.

The results show the identification of four motivational states of human behavioural activities: influenced, intentional, hindered, unaware. These motivational states seem to be quite irresistible in the current environments of global economic and social structures, where rapid technological developments increase unpredictability of evolving changes during communication of information. The implications are that the dilemma of information inadequacy introduces a new phenomenon to the research and practice related to information activities, which shows how essential this has become in causing problems in human, social and industrial affairs. Hence, our intention is to make this dilemma more prominent. In principle, this relates to many issues that remain largely unexplored in the area of information management.

Finally, the problem of information inadequacy remains a profound challenge in need of further research that could facilitate future human endeavours to gain access to the needed information at the right time.

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