

Paper presented at the 65th Annual Meeting of the American Society for Information Science & Technology, Nov 18-21, 2002, Philadelphia, PA.

Information failures and catastrophes: What can we learn by linking Information Studies and disaster research?

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The genesis and context of catastrophes and mishaps raise a set of topics that are of interest for Information Studies; namely, the contributions of information failures as precursors to, as opposed to outcomes of, disasters. There is much to be learned by relating the research in three key areas: disasters, information use environments and behaviours, and culture (i.e., cultural knowledge, and information, safety, and organizational cultures). Patient safety failures in hospitals provide both a timely context and practical examples to illustrate these connections. This paper highlights the linkages and raises questions for information professionals and for future research.

Introduction: Which comes first, catastrophe or information failure?

The ASIS&T 2002 annual meeting call for papers states that "the ability of our institutions to react to cataclysmic events has been shown to be dependent on an information infrastructure that is stable, secure, and adaptable, highlighting the roles of disaster preparedness and preservation." Catastrophes can severely disrupt "the free flow of necessary and time-sensitive information", making recovery capability crucial. But let's consider the inverse of that situation as well: disruptions or failures in the free flow of information can contribute to catastrophic events. Moving further upstream to consider the genesis and context of catastrophes and mishaps raises a set of topics that are of interest for Information Studies; namely, the contributions of information failures as precursors to, as opposed to outcomes of, disasters.

There is much to be learned by relating the research in three key areas: disasters, information use environments and information behaviours, and culture (i.e., cultural knowledge, and information, safety, and organizational cultures). The goal of this paper is to highlight the linkages and implications for

practice and research. Patient safety failures in hospitals provide both a timely context and practical examples to illustrate these connections (MacIntosh-Murray, 2001).

Information failures have been cited as a significant contributing factor and precondition in studies of organizational disasters and accidents (Reason, 1997; Toft & Reynolds, 1994; Turner & Pidgeon, 1997; Vaughan, 1996). In these studies, examples abound of missed or ignored warning signals and failure to handle information in ways that could have prevented catastrophic outcomes. This research, in particular the work of Turner and Pidgeon (1997), Westrum (1992), and Vaughan (1996), raises the interesting possibility that there may be underlying ways of shared thinking or culture and related information practices which may make it more difficult for an organization to handle information about errors and failures effectively. This thinking fits well with studies of *information use environments* that suggest that aspects of the workplace influence the way people think about and use information (Taylor, 1991). The elements can include, for example, the types of problems staff have to deal with and how they solve them; the availability of different kinds of information; the structure and past experience of the organization; and formal and informal procedures for making decisions. In a health care setting, for example, the way clinical professionals and managers think about patient safety and make sense of adverse events or errors may influence the flow and use of such information for prevention and learning. These processes are affected by the potentially different ways of thinking, frames, and contexts within which players interpret events and make sense of their work situations. *Culture* provides a useful portmanteau concept which bundles up the "baggage" people bring to sense making: the different values, beliefs, norms, frames, and cognitive structures which influence sense making, filter information, and mediate the construction of organizational meaning.

There is considerable variation in definitions of culture in the rather wide-ranging organizational, safety/disaster, and information studies literatures. What is included in the portmanteau depends on what facet the author has chosen to emphasize. Sackmann's (1991; 1992) categories of *cultural knowledge* (dictionary, directory, recipe, and axiomatic) provide a helpful anchor while sorting through the various definitions and representations of culture. The aim is to identify possible elements of what DiMaggio (1997) refers to as institutional processes and cognitive schema that maintain or suppress information as part of culture.

Combining these concepts provides a platform from which we can identify the practical implications for information professionals and questions for further research.

Information failures and disasters

The late Barry Turner's insightful observations about the origins of disasters lay the foundations for understanding the important role of information failures. Because of the unique contribution of his work we will review his theories and model in some detail. The 1978 edition of Turner's remarkable *Man-Made Disasters* was ahead of its time in presenting a socio-technical model of system vulnerability that was not fully appreciated for a number of years. (An updated second edition by Turner and Pidgeon was published in 1997.) He emphasizes the significance of individual and organizational cultural beliefs and the social distribution of knowledge related to safety, hazards, and the adequacy of precautions. Turner's elegant formula summarizes disaster as a combination of misinformation and the release of some form of energy: chemical, kinetic, geophysical, or biological.

One of Turner's key observations is that disasters result from a failure of foresight and an absence of some form of knowledge and information amongst the groups and individuals involved. Sense making can be complicated by a "variable disjunction of information", which refers to "a complex situation in which a number of parties handling a problem are unable to obtain precisely the same information about the problem, so that many differing interpretations of the situation exist" (Turner & Pidgeon, 1997, p. 40). Weick (1998) also points out that the tendency of people to make do with the information they have at hand and to simplify interpretations creates collective blind spots which obscure problems which may be brewing.

Turner's model proposes multiple stages of disaster development which can unfold over long periods of time (Table 1). The model suggests that disasters involve an element of great surprise for the

majority of individuals involved or affected because of the inaccurate beliefs in stage I that a.) adequate safety precautions are in place; b.) no untoward events are occurring; and c.) the appropriate individuals are fully aware of any information that would indicate otherwise.

Table 1. The sequence of events associated with the development of a disaster. Turner & Pidgeon, 1997, p. 72.

Stage I	<i>Notionally normal starting points: Initial culturally accepted beliefs about the world and its hazards. Associated precautionary norms set out in laws, codes of practice, mores and folkways.</i>
Stage II	<i>'Incubation period': the accumulation of an unnoticed set of events which are at odds with accepted beliefs about hazards and the norms for their avoidance.</i>
Stage III	<i>Precipitating event: brings attention to itself and transforms general perceptions of Stage II.</i>
Stage IV	<i>Onset: the immediate consequences of the collapse of cultural precautions becomes apparent.</i>
Stage V	<i>Rescue and salvage – first stage adjustment: the immediate post-collapse situation is recognized in ad hoc adjustments which permit the work of rescue and salvage to be started.</i>
Stage VI	<i>Full cultural readjustment: an inquiry or assessment is carried out and beliefs and precautionary norms are adjusted to fit the newly gained understanding of the world.</i>

Turner emphasizes that disasters can have a prolonged incubation period, during which events that are at odds with those existing beliefs begin to occur in the environment. During the "pre-disclosure" incubation period in stage II, the events may be ambiguous, unknown, or misunderstood, resulting in vague or ill-structured problem situations, replete with information difficulties. Post-disclosure, after a transfer of information, the situation appears to be quite different, and presents as a well-structured, recognizable problem, with the benefit of hindsight vision. Hind-sight bias can pose major problems during the efforts to piece together the events after the fact. The ambiguity of situations facing individuals in the incubation stage is minimized, and the interpretation of events may be unwittingly (or deliberately) incomplete. In an ideal case, the transformation from the problematic pre-disclosure state to the well-structured post-disclosure state

would be accomplished with the transfer of appropriate warning information.

In the many ostensibly different disasters he reviewed, Turner identified common features and similarities which form the basis of the man-made disasters model, including:

1. Rigidities in perception and pervasive beliefs in organizational settings which include cultural and institutional factors that bias members' knowledge and ignorance;
2. Organizational exclusivity, which causes the organization to ignore outsiders' warnings;
3. Information difficulties:
 - Relevant information may be buried in a mass of irrelevant information
 - Recipients may fail to attend to information because it is only presented at the moment of crisis

- Recipients may adopt a 'passive' mode of administrative response to an issue
 - Recipients may fail to put information together creatively
4. Failure to comply with existing regulations
 5. Minimizing emergent danger

Turner's view of the information difficulties is particularly interesting. The information in question is some form of danger signs, signals, or warnings, or information about potentially hazardous energy sources; in general, information which could prevent a disaster. The information difficulties summarised in Table 2 can arise at any point: during the pre-disclosure incubation phase, during the information transfer, and post-disclosure.

Table 2. Information handling difficulties during stages of disaster development.
Based on Turner & Pidgeon, 1997.

STAGE:	INFORMATION HANDLING DIFFICULTY:
Pre-disclosure:	Danger signals/information may not be perceived or available to anyone
	Danger signals/information may be available to someone, but they may <ul style="list-style-type: none"> ▪ misinterpret them; not recognize the significance ▪ have a false sense of security; not be able to pass it along in time ▪ may not know exactly where it is needed ▪ may lack the authority or resources to handle the information ▪ assume someone else will handle them ▪ overlook them because people are rushed and distracted
	The danger signals/information may be <ul style="list-style-type: none"> ▪ ambiguous; buried in a mass of detail; a source of disagreement ▪ dispersed among several individuals or organizations ▪ outside prevailing ways of understanding
Transfer:	Wrong or misleading information may be sent
	Information may be sent to the wrong people
	Too much reliance on informal networks
	Ambiguity re what information is to be transferred; roles; motives of actors
	Information may be deliberately withheld
	Transfer inhibited due to poor relations between potential initiator and recipient
Post-disclosure: (once information is received it may not be used)	Relevant information may be buried in mass of irrelevant information
	Recipient may be preoccupied with other matters
	Information may only be presented at the moment of crisis
	Recipient may adopt passive mode of administrative response
	"FYI" label may not prompt action
	Failure to creatively assemble information
	Failure to convince those in power of the validity of the information
	Difficulty transmitting adequate information about appropriate actions and precautions to the public/strangers

The information handling difficulties appear to be of mixed description. Some relate to the nature of the signals and information itself; some involve the characteristics of the people involved; some involve

the context or environment; and yet others relate to the process steps of information flow. Culture is a common influence shaping all of the information handling difficulties. Turner suggests that

organizational culture affects the use and transfer of information, by creating assumptions about what is given value as information and how it is to be communicated, and what can be ignored. "A way of seeing is always also a way of not seeing" is Turner's apt synopsis (Turner & Pidgeon, 1997, p. 49). Organizational failure of perception and collective blindness to issues may be "created, structured, and reinforced by the set of institutional, cultural, or sub-cultural beliefs and their associated practices" (p. 47). Internal and external environmental conditions can change, creating a discrepancy between the assumptions and the environment. This implies a need for environmental scanning to identify signs of hazards: a form of organizational early warning information system to support organizational intelligence and sense making (Choo, 1998).

Avoidance of such disasters requires improvements to the information flow to reduce uncertainty, and changes in assumptions about the environment, how it works, and what constitutes hazard potential:

In studying the origins of disasters, therefore, it is important to pay attention, not just to the aggregate amount of information which is available before a disaster, but also to the distribution of this information, to the structures and communication networks within which it is located, and to the nature and extent of the boundaries which impede the flow of this information. Of particular interest are those boundaries which, by inhibiting the flow of this information, may permit disasters to occur. (Turner & Pidgeon, 1997, p. 91)

Turner's seminal work points out the need and the direction for further study of information handling in organizations and corroborates the important role of beliefs, values, and norms. The examples of the types of information difficulties and how they relate to possibly dysfunctional information behaviours and the patterns of hazard information distribution and disclosure could be instructive in the analysis of the flow and use of information about adverse events in health care, for example. It could be quite revealing to map the information flow and the boundaries which act as impediments, with identified cultural and environmental constraints. The concepts developed and the methods applied in information studies research on information use environments and context, combined with the concept of cultural knowledge, could be very helpful in this endeavour.

Taylor's information use environments

Taylor describes the information process in terms of problem recognition and search for solutions in pursuit of sense making (MacMullin & Taylor, 1984). He defines information behaviour as the sum of activities through which information becomes useful for resolving problems through clarification, alteration or actual solution (Taylor, 1991, p. 221).

Taylor delves into the context of information use, studying the information use environments (IUE) which affect the flow and use of messages into, within, and out of defined entities (Taylor, 1991). He includes six broad categories of elements to describe IUEs; people, problems, settings, resolutions to problems, how people perceive information, and processes of decision. Taylor shows that information behaviours of different sets of people (in his studies, engineers, legislators, and physicians) are influenced by the assumptions they make about their work; how they see the problems they deal with; the constraints and opportunities in their environments; and the assumptions they make about problem resolution and usefulness of information. He is able to make generalized observations about each of those sets of people, highlighting differences in the information behaviour of each group. Given that teams (for example, care teams in health care organizations) will often involve multiple people and groups from diverse backgrounds, one may have to accommodate multiple views of the information use environments to understand their influence on the flow and use of information about adverse events. Culture provides a complimentary and related vantage point from which to explore their assumptions.

Components and levels of culture

Denison (1996) sorts through wide-ranging definitions in his survey review of organizational culture and climate research. He describes culture as "the deep structure of organizations, which is rooted in the values, beliefs, and assumptions held by organizational members. Meaning is established through socialization to a variety of identity groups that converge in the workplace" (p.624).

Denison points out that researchers have described three levels of cultural phenomena: a surface level, which includes artifacts, symbols, and practices; an intermediate level, which includes values and traits; and a deep level, composed of assumptions. The notions of "identity groups", "socialization", and "assumptions" present in Denison's definition share roots in Schein's (1992) much quoted definition of the culture of a group: "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked

well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (p. 12).

Schein's emphasis on shared ways of thinking about and patterns of problem solving is consistent with sense making theory, and relates well to information seeking and use. Taylor (1991), MacMullin and Taylor (1984), and Dervin (1992), for example, all describe a problem-based or gap-driven view of information seeking and use.

Assumptions are part of the third, deeper level of culture, and tend to be the unquestioned beliefs that filter their perceptions and unconsciously guide actions. Schein points out that behaviours may be ambiguous and it may be hard to decipher the underlying meanings, assumptions, and values from them. Sackmann's (1991; 1992) "cultural knowledge" provides a more specific framework we can use to study the nature of the assumptions, beliefs, and values and how they relate to information and adverse events.

Cultural knowledge and cultural artifacts

Sackmann (1991,1992) defines *cultural knowledge* as mechanisms for collective sense making. She focuses on the shared cognitive components of culture, which include beliefs, values, and meanings. Sackmann describes four categories of cultural knowledge: dictionary, directory, recipe, and axiomatic, as summarized later in Table 3.

Sackmann's categories are particularly helpful because they provide a more specific way to organize thinking about the shared values, beliefs, and norms which could influence information behaviours, specifically those related to use of information about disasters and mishaps. The visible expression of those beliefs, values and norms may be evident in the physical artifacts produced, and in the practices and behaviours of organizational members. For example, Feldman and March (1981) observe that reports and memos are often requested and produced (and then ignored in decision making) as part of information "rituals" in organizations.

The addition of the categories will serve as an organizing device for considering professional, safety, and information cultures, as will be discussed in the next sections.

Professional cultures and subcultures

As individuals are socialized to various identity groups multiple subcultures may develop (the differentiation perspective of cultures), rather than one, unified or homogenous organizational culture (the integration perspective) (Martin, 1992). Health care organizations are the work place for many

occupational communities, which can result in a kaleidoscope of distinct and overlapping work cultures. The work environment of particular nursing units, for example, may be influenced by the tone set by the unit manager, which may in turn influence willingness of staff to report errors (Edmondson, 1996).

West (2000) suggests that the increasing specialization of health care professionals over time has contributed to compartmentalization of knowledge and information (which Vaughan (1996) refers to as "structural secrecy"). This is compounded by her finding that "nurses and doctors rarely discuss important professional matters informally with each other.... These boundaries, around medicine in particular, could be a barrier to communication with, and monitoring by, other professional groups" (p. 123) . The norm of hierarchical organization among health care professionals can result in reporting relationships impaired by over-adherence to the authority gradient. Nurses and junior medical staff may not raise information that may challenge physicians' erroneous judgement calls. Davies, Nutley and Manion (2000) observe that "health care is notoriously tribal", as reflected in the rivalry, competition, and discordant subcultures found in some organizations (p. 113). Given these factors, team work in health care may at times seem like an oxymoron.

Physicians have traditionally been seen as independent contractors and the "captain of the ship", and have perpetuated a myth of infallibility, according to Sharpe (1998). She traces the historical roots of this view of the medical profession in North America, which portrays error or failure as the technical and moral shortcoming of individuals. As a result, Sharpe notes that the litigating public has been quite willing to embrace this view and hold individual physicians accountable through law suits for adverse outcomes they have suffered. The physicians become more wary of litigation and less likely to engage in the open reflection required for learning, for fear of producing information which may be used as evidence against them. Consequently, root causes analyses and learning may not be pursued, adverse outcomes continue, and the cycle goes on.

These examples of beliefs, values, norms and practices, or cultural knowledge, may affect information behaviours and use of adverse event information in a health care organization.

Safety culture

The industrial safety culture literature is a useful source of concepts which may be applicable to identify cultural knowledge related to adverse events

and disasters. Safety implies preventing adverse events, and the occurrence of adverse events is used as a safety indicator; the one being the converse of the other (Flin, Mearns, O'Connor, & Bryden, 2000).

Turner (1991) describes safety culture as "the specific set of norms, beliefs, roles, attitudes and practices within an organization which is concerned with minimizing exposure of employees, managers, customers, suppliers, and members of the general public to conditions considered to be dangerous or injurious" (p. 241). Turner's definition fits within Sackmann's cultural knowledge categories. Beliefs, roles and attitudes relate to dictionary and directory knowledge, and norms fall within recipe knowledge. Sackmann considers practices as manifestations of culture.

In a study of a construction project, Gherardi, Nicolini, and Odella (1998) found that there can be as many safety cultures as there are groups or communities or practice, which as suggested earlier, may be the case in health care organizations as well: "Dispersed communities have diverse and non-overlapping organizational information, world-views, professional codes, organizational self-interests, and different interpretations of what is happening, why it is happening, and what its implications are" (p. 211).

Flin, Mearns, O'Connor, and Bryden (2000) state that the dimensions of safety culture and climate that tend to be included in published studies focus on beliefs and norms related to management and supervision, safety systems and arrangements, risk, work pressures, competence, and procedures. Several more specific themes within these dimensions are described below.

Responsibility and blame

Safety researchers point out that the most common reaction in an organization is to focus on the actual event itself and the immediate response is to find responsible culprits to blame (Berwick, 1998; Cook, Woods, & Miller, 1998; Reason, 1997, 1998). This is in keeping with anthropologist Mary Douglas's wry observation that the culture of the organization will govern what will count as information, and that "blaming is a way of manning the gates through which all information has to pass" (Douglas, 1992, p. 19). If the prevailing hospital values are perceived to favour learning and future prevention of mistakes through human factors analysis of error, then this may influence how staff may expect to be treated when adverse events happen and how they react to information about mishaps in the future. If the prevailing values and practice lean towards holding individuals accountable and placing blame, then mistakes may be seen as an occasion for

fear and less open communication (Hofmann & Stetzer, 1998).

Vulnerability or resilience?

Theories about high reliability organizations have developed from studies of the culture and interactive processes of groups working on exemplary aircraft carriers and nuclear plants. Using the example of operations on the flight deck of an aircraft carrier, Weick and Roberts (1993) explore the concept of collective mental processes and focus on the connections between behaviours amongst individuals who work together as an interdependent system.

When the collective behaviours are combined intelligently, purposefully, and carefully, this is described as "heedful interrelating" (Weick & Roberts, 1993, p.361 and 364), akin to what Sonnenwald and Pierce (2000) called "interwoven situational awareness". The more developed the heedful interrelating among the members, the greater the capacity to deal with information about non-routine events.

Weick has described reliability as a "dynamic non-event" (Weick 2001), because organizations have to continuously manage and adapt to a changing and uncertain environment, while producing a stable outcome, the avoidance of accidents. Weick, Sutcliffe, and Obstfeld (1999) highlight key characteristics which allow reliability-seeking organizations to achieve this end. Weick (2000) suggests that the same characteristics may apply to hospitals. For example, reliability-seeking organizations are preoccupied with failure, constantly anticipate that problems will occur, and remain vigilant to the possibilities. They learn as much as possible from near-misses and reward staff for reporting them. As well, because the task environment can be ambiguous and problems ill-structured, they foster diverse viewpoints and interpretations, building "conceptual slack" to avoid blind spots.

Weick, Sutcliffe, and Obstfeld (1999) elaborate further the concept of reliability and collective mindfulness, and emphasize the need for ongoing readjustment in the face of unusual events. "Continuous, mindful awareness" means knowing how to keep track of and respond to such variations in results "that generate potential information about capability, vulnerability, and the environment" (p. 88). "If people are blocked from acting on hazards, it is not long before their 'useless' observations of those hazards are also ignored or denied, and errors cumulate unnoticed" (p. 90). A hospital "grapevine" may well carry such information but the organizational cultures may not support its effective

use. When the variations are ignored or are internalized and simply become accepted, Vaughan describes this as the normalization of deviance, which, for example, ultimately contributed to the failure of the Challenger launch (Vaughan, 1996).

The role of human error versus systems thinking

Reason refers to the gradual erosion of margins of safety in a system due to various causes, for example, the pressure managers may feel to take short cuts (Reason, 1998). Because safety tends to be equated with the absence of negative outcomes, “the associated information is indirect and discontinuous” (p. 4) so the erosion is not evident until a catastrophic event occurs. The same pattern may well be occurring in cash-strapped hospitals, as support staff cuts take place and more work is expected from fewer people and nurses may be carrying more responsibilities. Ironically, this is happening in the context of a serious nursing shortage, so experienced nurses are in great demand and short supply. The new recruits have less practical experience and may have less access to adequate orientation and mentoring, and so may be in a vulnerable position. If learning, knowing, and collective mindfulness are the products of social construction and interaction, then it is possible that cutbacks may disrupt occupational social networks and erode knowledge of safe practice (Fisher & White, 2000). Reason’s systems approach to the role of human error suggests that these frontline staff at the “sharp end” of the systems may commit errors and violations which he calls active failures, due to the immediately visible adverse effects or outcomes that result. However, Reason emphasizes that these sharp end human failures or unsafe acts occur in the context of the latent conditions of the systems. The latent conditions result from, for example, managerial resource allocation decisions and can include “poor design, gaps in supervision, undetected manufacturing defects or maintenance failures, unworkable procedures, clumsy automation, shortfalls in training, less than adequate tools and equipment” (Reason, 1997, p. 10). The latent conditions build over time and are part of the organizational context and information environment.

The role of latent conditions and systemic causes is important knowledge in the understanding of adverse events, yet hindsight bias tends to foster blinkers and short-sightedness. How well these concepts are understood and how widely they are believed may be a critical dimension of cultural knowledge in a health care organization.

Information culture and safety culture

Toft and Reynolds (1994) refer to a safety culture as the appropriate environment to facilitate

the necessary information flow for learning from adverse events, in keeping with similar suggestions by Reason (1998, p. 294):

In the absence of frequent bad events, the best way to induce and then sustain a state of intelligent and respectful wariness is to gather the right kinds of data. This means creating a safety information system that collects, analyses and disseminates information from accidents and near misses, as well as from regular proactive checks on the system’s vital signs. All of these activities can be said to make up an informed culture – one in which those who manage and operate the system have current knowledge about the human, technical, organizational, and environmental factors that determine the safety of the system as a whole. In most important respects an informed culture is a safety culture.

The information flow they refer to appears to include measurement of quantifiable safety and risk indicators as well as descriptive reports of near misses and actual incidents involving harm or damage. In addition to risk reports, traditional technical safety and risk management has also relied on codified knowledge such as policies and procedures to promote understanding of safety practice requirements. However, Gherardi and Nicolini (2000) imply that it is not enough to have concrete policies, procedures and indicator reports, but rather we have to take into account how organizational members become part of a community, how work is actually done, and how information and knowledge are communicated between members.

An organization's cultures shape assumptions about what constitutes valid information, how it should be interpreted, and transmitted (Choo, 1998; Turner & Pidgeon, 1997). Westrum proposes that the very safety of an organization is dependent on a culture of "conscious inquiry", which supports the early warning nervous system alluded to above with successful information flows. This means that "the organization is able to make use of information, observations or ideas wherever they exist within the system, without regard for the location or the status or the person or group having such information, observations or ideas" (Westrum, 1992, p. 402). This links to the issue of information politics and the power which may be wielded by sharing or withholding information (Davenport, 1997). Perhaps individuals may be disenfranchised in a politicised information environment if they do not have enough clout to persuade those in power of the validity of

their hazard information and their warning signals are not taken seriously (Turner & Pidgeon, 1997).

Westrum (1992) characterizes organizations as pathological, bureaucratic, or generative, according to how well they "notice" information. One could project that generative organizations would be very active in scanning, sensing and interpreting, and may be more successful at using adverse event information than those that are pathological. It would be interesting to know if bureaucratic information cultures are as prone to information failures as pathological cultures may be. Although the behaviours may not be as overtly toxic to constructive sense making, nonetheless catastrophic information failures may also occur due to not-so-benign neglect and passivity, which may be inadvertently nurtured in a bureaucratic information culture.

Marchand, Kettinger, and Rollins (2000) describe information orientation as a composite of a company's capabilities to effectively manage and use information. Information orientation is comprised of three categories of practices: information technology, information management, and information behaviours and values. The information behaviours and values include *integrity*: the absence of manipulation of information for personal gains (which relates to the issue of information politics noted earlier); *formality*: the degree of use of and trust in formal information sources (which is related to Wilson's (1999) source characteristics); *control and sharing*: the degree of exchange and disclosure of information; *proactiveness*: the degree to which members actively seek out information about changes in the environment; and *transparency*: the degree to which there is enough trust to be open about errors and failures (p. 71). The last three information behaviours and values are clearly reflected in Westrum's information culture characteristics.

Davenport (1997) includes information culture and behaviours as one of the elements of an organization's information ecology, which "puts how people create, distribute, understand, and use information at its center" (p.5). He suggests that sharing, handling overload, and dealing with multiple meanings are three behaviours associated with successful information ecologies. Once again taking the obverse view, one might anticipate that a pathological information organization may show evidence of inadequate sharing, overwhelming information overload, and inability to constructively reconcile multiple meanings of ambiguous hazard signals, in keeping with Turner and Pidgeon's variable disjunction of information.

Overlaps in organizational, professional, safety, and information cultures

Based on the previous sections, Table 3 summarizes examples of cultural knowledge that may affect information behaviours and use of adverse event information in a health care organization. There are themes that emerge across the categories of concepts. For example, it will be important to identify how individuals and groups think problem situations *are* defined, noticed, and handled (dictionary and directory knowledge) as compared to how they *should be* defined, noticed, and handled (recipe knowledge).

Definitions of adverse events and near-misses and explanations of their relationship to patient safety may vary by occupational or professional group, or by functional unit. The degree to which systems thinking is understood and shared may also vary considerably. There may be little understanding of the contribution of system causes to adverse events and a predisposition to see individuals as the prime causes. On the other hand, there may be quite advanced appreciation for systems thinking and efforts to incorporate this in improvement strategies. This may influence what information is sought and from what sources.

The notion of blame and punishment as a response to adverse events and negative information is found in the writing on professional, safety, and information cultures. A propensity to blame may affect how actively information is sought and how freely it is communicated.

If there is a preoccupation with the possibility of failure or error this should be evident in the type of topics and information covered in discussions and meetings. Likewise, tolerance, and even encouragement, of diverse viewpoints could be a cultural value and practice. Opportunities and ability to surface contradictory views may influence reliance on informal versus formal information processes.

Implications for practice and research

Given Turner and Pidgeon's observations, perhaps a corollary to Taylor's definition of information behaviour may be proposed in our consideration of adverse event information. *Dysfunctional* information behaviour may be composed of activities through which the potential usefulness of information is eroded, resulting in construction of escalating confusion, accumulating problems, and collective ignorance. Breakdowns can occur at any stage of the information process, including information need recognition, information seeking, and information use.

Table 3. Cultural knowledge that could influence information behaviours related to adverse events or disasters.

Cultural Knowledge (Sackmann, 1992)	Professional / healthcare subcultures	Safety culture	Information culture
1. Dictionary knowledge: Definitions; labels used; the "what" of situations	<ul style="list-style-type: none"> ▪ What clinical errors, adverse events are ▪ What patients' expectations are 	<ul style="list-style-type: none"> ▪ What patient safety means and includes ▪ What constitutes a problem or near-miss 	<ul style="list-style-type: none"> ▪ What constitutes an event that is noticed ▪ What constitutes valid information
2. Directory knowledge: Commonly held practices; cause-and-effect relationships; the "how" of situations	<ul style="list-style-type: none"> ▪ Professional roles and teamwork ▪ Communication practices ▪ People as cause of adverse outcomes vs systems thinking ▪ How error is dealt with 	<ul style="list-style-type: none"> ▪ Preoccupation with possibility of failure ▪ Situational awareness ▪ How diverse view points and conceptual slack are valued ▪ How near-misses are handled ▪ How mishaps happen ▪ Belief in people as (vs systems) causes of error ▪ Blame vs learning 	<ul style="list-style-type: none"> ▪ How information is acquired ▪ How actively information is sought ▪ Who/what are (credible/reliable/appropriate) sources ▪ Information routes ▪ How new ideas are treated ▪ Co-operation and sharing or competition ▪ Degree of reliance on informal or formal sources
3. Recipe knowledge: Prescriptions for repair and improvement of situations; norms; the "shoulds" of situations	<ul style="list-style-type: none"> ▪ How error should be dealt with (blame vs learning) ▪ Standards for proper and improper behaviour 	<ul style="list-style-type: none"> ▪ How problems should be solved ▪ Interpersonal skills - how people should behave and relate ▪ How error should be dealt with 	<ul style="list-style-type: none"> ▪ How problems should be solved ▪ How and when information should be communicated ▪ Whether it is appropriate to control information for personal benefit
4. Axiomatic knowledge: Underlying assumptions; reasons and explanations for situations; "why" events happen	<ul style="list-style-type: none"> ▪ Duty to patients ▪ Individual responsibility ▪ Authority gradient ▪ Occupational/professional control 	<ul style="list-style-type: none"> ▪ Belief in possibility of resilience or that are accidents unavoidable ▪ Production pressure ▪ Value placed on learning and improvement 	<ul style="list-style-type: none"> ▪ Importance of internal or external environment ▪ Belief in importance of information and linkage to organizational performance ▪ Comfort level with degree of environmental ambiguity

The successful search for and use of information may be side-railed at many points. The focus is on individuals, who may not even recognize that they need information in their context or situation in the first place due to all the cultural knowledge dimensions discussed earlier. Warning signals may be ignored because their significance is not understood, so no mechanism is tripped to activate sense making and information seeking, a situation observed by Turner and Pidgeon (1997). Assuming a need is activated, personal or situational intervening variables may act as facilitators of sense making and information use, but also as barriers (Choo, 1998; Dervin, 1983, 1997; Taylor, 1991; Wilson, 1997;1999). An individual may not have the training

to effectively deal with the information as required by his or her role, or competing time demands may undermine attention to the task. Such variables have been identified in the study of human error by human factors specialists (Reason, 1997).

Wilson (1999) and Davenport (1997) suggest that there may be risks or rewards associated with use of information from certain sources, which influence the individual's propensity to seek out some sources more so than others. The research appears to assume that individuals' information behaviour is not usually intentionally dysfunctional, although there is the possibility of deliberate withholding and falsification of information. There may also be questions about

the reliability or relevance of the information source, which may affect the likelihood of its use.

Wilson notes that there has been more research on the situations in which information needs arise and less on the situations in which information is found, processed, and used (Wilson, 1997). Much of the information seeking research assumes an active search mode, which may not be the constant state in a health care team, for example. There may be a dynamic flux of passive attention, passive search, active and ongoing search, depending on how the context and environment are changing. Whether and how this is perceived by the actors involved depends on the sense they make of the situation and resulting information needs. Choo notes that one outcome may be that problems may be suppressed or avoided, resulting in no information seeking (Choo, Detlor, & Turnbull, 2000, p.22). Culture and cultural knowledge may play a significant role in shaping these sense making and adverse event information processes. Perhaps dysfunctional information behaviours interact with the organizational context and create worsening conditions for sense making and increased probability of information failures.

The issues and gaps discussed above suggest that information professionals could play a significant role in assessing and remedying risks of information failures. Information professionals could bring their expertise in information management to the table and collaborate with risk managers. One approach could be to devise an inventory of the risk or hazard information sources and how they are being used in the organization. Questions to consider in mapping the flow of information about adverse events and risks include:

- What are the patterns of information dissemination?
- What are the boundaries that impede the flow?
- What sources are commonly used and by whom?
- Is adequate attention paid to scanning internal and external environment for warning signals/ and hazard information?
- What do the (health care) professionals believe are credible information sources related to adverse events?
- What is the organization's information culture - generative, bureaucratic, or pathological?
- What are the best practices in other organizations?

Understanding one's organization in terms of the cultural knowledge elements in Table 3 may provide insights into information use and behaviours.

These ideas also prompt further research questions:

- What are the specific types of cultural knowledge related to adverse events and do they vary by setting or context?
- What are the implications for design of information systems related to adverse events? Both for
 - gathering "intelligence" about *internal* adverse events (reporting) and from *external* sources
 - learning about events after the fact and risks in preventive or anticipatory mode
- What are the implications for organizational learning from adverse events in various contexts?

Organizational research shows that disasters and mishaps appear to involve more than the simple aggregate of all the lapses in individual information behaviours. Perhaps these questions can serve as a framework for further exploration of these processes and influences, the importance of which Toft and Reynolds (1994) so eloquently underscore (p. xi):

The lessons of disasters arise at great cost in terms of human distress and damage to the living environment. We owe it to those who have lost their lives, been injured, or suffered loss to draw out the maximum amount of information from those lessons, and apply it to reduce future suffering.

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