The Communication Contract and its Ten Ground Clauses

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Communicating effectively under risk: On the need for a communication contract for the global society

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Abstract

The design of procedures for the responsible and effective management of risks to humans and their environment is an important topic in modern environmental engineering. This calls for ethical ground clauses within a communication contract for the global society. How respecting ethical ground clauses of communication may help avoid that the short-term economic interests of a few are placed before the long-term interests of society as a whole is explained on the basis of examples from disaster case studies. The need for rules which ensure that relevant information is effectively transmitted, received, and taken into account promptly is highlighted. Why successfully implementing such rules involves the individual responsibility of all stakeholders, from witnesses or victims to scientific experts and policy makers, is made clear. The ethical ground clauses of a communication contract for the global society provide universal rules for responsible communication. They are defined in terms of general guidelines for sincere, transparent, prompt, and cooperative information sharing, in particular in risk management. Earlier work has shown that implementing such a model for a communication contract in corporate decision making helps promote stakeholder responsibility awareness, and triggers a learning process for initiating and fostering individual and collective behavior that will ultimately lead to responsible decisions and action. These are the prerequisite for avoiding the disastrous consequences of non-action in response to early warnings. They help prevent that relevant scientific data and/or expert knowledge are dismissed or not adequately taken into account. Finally, a communication contract for the global society makes perfect common sense given the fact that faulty communication processes have repeatedly been identified as the major cause of disasters.

Keywords: Environment – Human – Global Society- Risk - Management - Policy making

Introduction

Studies based on qualitative and quantitative analyses of communication in medium size and large enterprises (Huang, 2004) have led to consider the advantages of socially responsible, cooperative, symmetrical, in short, ethical, communication for public relations, marketing and the economic development of smaller and larger organizations. Apart from being politically correct, ethical communication may, indeed, prove a sound management strategy, because it may allow securing long-term benefits that are more valuable to an organization than short-term profits obtained through more or less devious communication strategies. Individual and collective social responsibility defines one of the ground conditions of ethical communication in the corporate world (see Reinsch, 1990, for a review). The fundamental role of individual responsibility in society is sometimes referred to in terms of "individual moral agency" as in Reid's (1843) essays on the active powers of the human mind, or "personal agency" as in Bandura's (2001) social cognitive theory. Communicating ethically with our nearest neighbors and partners ensures that ethical core values are adhered to by all stakeholders in this process. Ethical communication is the *conditio sine qua non* that gives a government, a business, or a small group such as a family the chance to overcome in times of crisis and to

prosper under the best possible conditions. The theoretical concepts on which this project relies stem from the philosophical foundations of social contract theory, speech act theory, and the model of a communication contract for the global society. This includes Reid's essays on moral agency in communication (1843) and Austin's felicity conditions (1962) of successful communication.

A contractarian framework for the global society

The philosopher Thomas Hobbes (1651) argued that societies have evolved as a necessary condition of human survival and prosperity. Without society, we would live in a state of nature without positive rights and unlimited natural freedom, where anyone can do what they like, for themselves and to anyone else. To avoid such a state of *bellum omnium contra omnes*, as Hobbes put it, we agree as individuals within society to adhere to an implicit contract, a so-called social contract. Through this social contract, we gain rights by giving up unlimited freedom and by accepting to respect and defend the rights of others. The idea that all rational beings would inevitably consent to such a social contract because it is in their own best interest was first introduced in theoretical essays by philosophers in the seventeenth and eighteenth century, as in Hobbes' *Leviathan*, and Jean-Jacques Rousseau's *Du Contrat Social* (1762). This philosophical framework is now referred to as social contract theory or contractarianism. Social contract theory has since enjoyed renewed success and been readapted to modern multicultural societies for carving out guidelines on how to live together in the global world (e.g. Ankerl, 1980, Dresp, 2006, Thompson and Hart, 2006). In business ethics, Donaldson and Dunfee's (1994, 1995, 1999) integrative social contract theory has substantially contributed to this success by providing a fresh conceptual framework with a new look on contractarian thinking in ethical management and modern economics. The term "integrative" places the emphasis on the general, all-encompassing nature of the social contract, as a fundamental commitment with binding obligations. This implies adhering to ethical core values and respecting a certain limited number of rules of due process.

Ethical core values

Social contract theory recognizes a general, collective need for adhering to ethical core values. Such core values are, in principle, collectively acknowledged though not always explicitly formulated. They are the reflection of philosophical, political and economic norms which can be considered universal in the sense that they are detached from specific cults, religions or beliefs. Ethical core values are beneficial to society in general, and to any individual who is part of it in particular. Ethical core values are non-negotiable. They are the foundations of ethical standards in society and of an organization's commitment to corporate responsibility. Core values explicitly listed in modern codes of business ethics almost invariably include: responsibility, integrity, honesty, respect, trust, openness, fairness, and transparency. Translating ethical core values into action requires 1) an explicit system of ethical ground rules and 2) principles of due process which ensure that these ground rules are respected. Communication between individuals is the simplest and most fundamental medium when it comes to translating ethical core values into action. According to speech act theory (Austin, 1962; Reid, 1843; Searle, 1969), saying something, an utterance in itself if you wish, is an act, a so-called illocutionary act, with implications and with consequences. Like the hand that brings down the hammer, to close a deal at an auction or to kill, the spoken word can have impacts with similar, more or less dramatic, consequences. The philosopher Thomas Reid, one of the founders of the School of Common Sense Philosophy, was among the first to explicitly state the nature of particular speech acts which involve individual moral responsibility (moral agency). In his essays on the active powers of the human mind, Reid points out that a speaker enters into a social contract, which he is expected to respect, whenever a speech act consists of asking, testifying, commanding, or making a promise. Reid's philosophy clarifies why the notion of a communication contract argued for here in this essay follows directly from that of a social contract. Society and any

group or organization that is part of it can, indeed, be defined as a community of communicating individuals who agree to adhere to an implicit communication contract. Through this communication contract, individuals gain their full right to express themselves. By giving up unlimited freedom of expression or speech and by accepting to respect the needs, freedom and rights of expression or speech of others, they put a clear limit not to their freedom of expression, but to the potentially destructive effects of speech acts that would otherwise consist of saying anything to anyone at any time. In the modern global society with all its complexity, the growing trans-national embedding and interdependence of life quality, environmental safety, economic development, and sustainability has increased our need for individual social responsibility in almost any domain, from family life to businesses and governance. To address the problem of such complexity, sociologists like Bandura (2001) have taken up Reid's concept of individual moral agency by placing human agency at the centre of any future capacity of control over the nature and quality of all forms of human existence within society, from families to corporations. Responsible communication between individuals has undeniably become one of the most urgent of all current social needs, worldwide. Austin's communication theory (1962) offers a perfectly suited conceptual approach to the problem of interpersonal information exchange and individual responsibility. While subsequent theories have failed to develop this, Austin leads the way towards a clear definition of ethical core values and principles for effective and responsible communication. Spoken or written words are more often than not used as a tool to persuade and to manipulate, and modern communication theories have devoted much effort to unravel some of the techniques used in politics, business, or everyday life to achieve such devious goals. What they have failed to provide us with is an operational theory that would help people to understand why devious communication is never a sustainable option. Using the spoken word as a weapon may effectively achieve short-term goals, yet, it does not foster long-term relationships based on building mutual trust and cooperation. In our troubled world of today, there is a growing concern for the question of ethics, and the time is right to re-establish the fundamental link that exists between the philosophy of ethics and communicating individuals. To this end, I have introduced the concept of a psychological speech situation, associated with a certain number of so-called felicity conditions in Austin's sense.

Austin's felicity conditions

Austin's (1962) felicity conditions define critical and interdependent conditions for a speech situation that are supposed to cause a given speech act to succeed when the conditions are fulfilled, and to fail when the conditions are not fulfilled. The felicity conditions are stated as follows:

(A.1) There must be an accepted conventional procedure that has a certain conventional effect and includes the uttering of certain words by certain persons under certain circumstances

(A.2) The particular persons and circumstances must be appropriate for the particular procedure invoked

(B.1) The accepted conventional procedure must be followed by all participants, both correctly and

(B.2) completely

(C.1) When the accepted conventional procedure invoked is designed for persons with certain thoughts or feelings or for the inauguration of certain consequential conduct on the part of any participant, then any person participating in the procedure must indeed have those thoughts or feelings or indeed intend to conduct herself/himself accordingly and

(C.2) actually conduct herself/himself accordingly as a consequence.

The felicity conditions thus prescribe that, whenever we enter a communication process, we implicitly agree to follow certain conventions regarding what is said by whom and when at a first, strictly procedural level (conventionality), to act in a way that ensures that these conventions are actualized as part of the reality of the situation (actuality), and at a deeper level, which is particularly important to the problems addressed here, to formulate sincere intentions according to expectations, and to act subsequently in a manner that respects the intentions expressed (intentionality). Austin pointed out the difference in nature between the felicity conditions indicated by the letters A and B here above, and the felicity conditions indicated by the letter C: non-fulfillment of the procedural conventionality conditions stated in A and B would reflect what he called misexecution of the felicity conditions, whereas non-fulfillment of the intentionality conditions in C would reflect abuse of the felicity conditions.

From misexecution to abuse in communication

The line between ethical and unethical communication in the modern world is often a very thin one. Misexecutions of the felicity conditions are frequent in the real world of today. A typical case of misexecution would be incorrectly assuming shared procedural conventions with regard to who is supposed to say what and when (conditions stated in A) when, in reality, all the participants do not share these conventions, or even know about the existence of such conditions. This has become particularly problematic in public or private communication processes through the internet, as will be clarified and discussed later on in greater detail. Deliberately, that is mischievously, provocatively, or strategically not acting according to actually shared procedural conventions (conditions stated in B) has also become frequent in contemporary societies, where speaking up when one is not supposed to may be exploited deliberately and used, or abused, as a means to a specific end. Austin's notion of abuse originally referred to either insincerely expressed intentions, or to a sincere intention that is not followed by the professed act. There can be no doubt that a promise uttered without the intention of keeping it, or an intention deliberately followed by non-action, or an action that is incompatible with the intention expressed, are straightforward cases of abuse. On the other hand, a sincere intention or promise that is not followed by the professed act may be the consequence of factors that are beyond the control of the individual or social entity who/which expressed the intention or made the promise. Under such circumstances, what would potentially be abuse becomes a case of incidental non-performance due to facts and events that could not be anticipated. Conversely, the seeming misexecution of an accepted convention at the procedural level could well reflect motivated strategic abuse at some deeper level. In such a case, abusers would be aware of the accepted convention, know what they are supposed to say or do and when, or what not and when not, but deliberately violate that convention to ends only they may be aware of. TV footages public events often feature such examples, where members of the public deliberately interrupt a speaker and thereby violate the convention to keep quiet while being addressed. In the light of such examples, it becomes clear why, in the modern world, speech situations and communication processes at small and larger scales, refer to a complex psychological space. This psychological space can be understood only on the basis of knowledge relative to the motivations and intentions which underlie the utterances that are made. Thus, when I speak to you, I am performing a speech act with underlying psychological motivations and intentions. These are not necessarily made clear through my speech act as such. Whether or not felicity conditions are fulfilled, accidentally misexecuted, or deliberately abused in a given situation or communication scenario requires more than an analysis of the logical structure of spoken or written language.

In his writings on existentialism, the French philosopher Jean-Paul Sartre (1945) introduced the psychological concept of good faith, as opposed to that of bad faith, to provide a universal definition for fundamentally ethical human acts, including speech acts, as opposed

to fundamentally unethical ones. Thus, whenever we pretend, in speech or action, to be what we are not, to think or feel what we do not, we are acting in bad faith and, therefore, unethically. Conversely, when our speech or action is true to what we genuinely are, think, and feel, we are acting in good faith and, therefore, ethically. The misexecution of a felicity condition in modern communication may be accidental, in which case it does not involve bad faith. On such grounds, an accidental misexecution is not unethical, but it may cause communication to fail its purpose nonetheless. On the other hand, the misexecution of a felicity condition may be deliberate, such as deliberately provoking a communication partner in a manner that violates an accepted convention, for example. Such deliberate misexecutions are not necessarily unethical, especially when delivered in good faith or, in other words, with the best of intentions. For example, when a hearer in an audience interrupts a speaker against an accepted convention because he or she perceives the speaker's utterances as unacceptable, the hearer misexecutes the accepted convention to keep quiet and listen, but does so in good faith. While such behavior has a disruptive effect on the ongoing communication process, it is not by definition unethical. On the other hand, any deliberate misexecution that involves bad faith, such as interrupting a speaker against an accepted convention with the sole intent to sabotage his communication or, worse, to damage his image in front of an audience is, by definition, unethical. In Austin's original sense, any form of abuse of the felicity conditions involves bad faith by definition and is, therefore, by definition unethical.

The negative effects of unethical communication

Unethical communication is unreliable and therefore inefficient. In the modern world, where conventions in communication are more or less a thing of the past, we need a new approach the problem space initially addressed by Austin's felicity conditions. Whether people we interact with in writing or through the spoken word are communicating in good or bad faith is often difficult to determine. Grice (1975, 1981) studied scenarios where hearers may act in bad faith, taking for granted that a speaker respects the felicity conditions, by assuming the warrant to interpret the speaker's utterances accordingly. Speakers, on the other hand, may act in bad faith by strategically abusing felicity conditions to all kinds of ends. Grice analyzed such kind of devious communication from a structural point of view, but did not offer a solution to the problem as such, probably assuming that there is no solution. Contaminated speech situations where communication appears ethical at the surface, but is in reality devious and essentially dysfunctional, felicity conditions being deliberately abused at all levels, highlight why it is important to attempt to understand the intentions that motivate an utterance in the first place. Attempting such understanding through analysis of the logical structure of language is, as Haberland and Mey (2002) pointed out, like looking for traces in a petrified product. Any seemingly simple sequence of apparently straightforward and innocent speech acts may, in fact, reflect a psychologically highly complex situation, the true nature of which often remains unknown to the uninformed outsider listening in. Modern research on ethics and society has re-introduced the problem of communication between humans under a new light, taking into account social contract theory and recognizing the need to consider what Thompson and Hart (2006) referred to as "psychological contracts". The importance of fully taking into account the psychological forces which drive communication was highlighted in the study by Dresp-Langley (2009).

The ten ground clauses of the communication contract

The communication contract is based on ten ground clauses that are pragmatically binding for all sincere communicating beings (FIGURE 1). They encompass and extend Austin's felicity conditions. It is stipulated that non-respect or deliberate violation of any of these ground clauses incurs an intangible cost, to all individuals engaged in the communication process. The weight of this cost is often incommensurable, but can be anticipated indirectly

on the basis of the level of satisfaction of the communicating partners, and qualitative and quantitative *criteria*, as will be made clear later-on.

The sincerity clause

Communication becomes devious, and is therefore doomed to fail its true purpose, whenever the most essential of the ten clauses, the sincerity clause, is not respected. This major clause for responsible and ethical communication in modern society stipulates that all partners are to honestly communicate according to the best of their knowledge, without deliberately omitting, hiding or falsifying knowledge or intentions that are relevant to the issue of their interaction. It is the *conditio sine qua non* for all of Austin's felicity conditions relating to intentionality. Communication in the global society describes a complex psychological problem space where uncertainty about the nature of truth is most of the time high. Whenever it comes to being sincere with others, we enter a fragile communication space where we often have to find a compromise between what we deem to be the truth, and what we feel we can let on about, which partly depends on our own certainty regarding the nature of that truth. As a consequence, all human communication is contaminated by uncertainties. Our own handling of these uncertainties often produces devious outputs, like the reporting of inaccurate or inadequate information in milder cases or, in extreme cases, the dishing out of whole packs of straightforward lies. Violations of the sincerity clause always engender a heavy cost in a communication process, sometimes leading to a total breakdown of constructive information exchange and thereby severely jeopardizing the future of any project, in the shorter and the longer term. Identifying and preventing violations of the sincerity clause in the communication process is generally difficult, often impossible. Human beings omit letting on about facts or lie about facts and intentions for many different reasons, and often in devious ways, using strategies that are difficult to nail down. Individuals may sometimes not even be conscious of their insincerities. The goal of the communication contract is neither to address all the reasons why people may be insincere, nor to judge who are liars or who are not, but to suggest ways of dealing with information which take into account the information needs of all partners involved regardless of their status, and which make all individuals concerned aware of the simple fact that it is in their own best interest to be sincere and honest when they communicate with others. Insincerity may help sustain specific interests of an individual or a group in the short-term but has negative side effects, leading to mistrust or the full rejection of an individual or a group in the longer-term. Only by communicating as sincerely as possible can partners ever hope to create and reinforce the climate of mutual trust and appreciation that is necessary for building truly effective and lasting relationships. Global society is, maybe more than ever, in need of structures, be they families, businesses, or government entities, that are solid enough to overcome crisis and to hold up in moments of strive and threat.

The relevance clause

The relevance clause stipulates that all statements have to be relevant to the goals, topics and objectives of the communication process. It pragmatically ensures to a large extent Austin's felicity conditions relative to conventionality and actuality, which is particularly important in policy making and to a lesser extent in private exchanges. It helps a group or a team focus on goals and contributes to ensure that relevant issues will not get drowned in, or obscured by, irrelevant information. This involves respecting an agenda. Scenarios where some stakeholders make others waste their time are costly and therefore counterproductive. In interpersonal communication, stakeholders have to make sure that it is clear to all other stakeholders involved why what they say or write is relevant, and to whom in particular. In text designed to be informative, the author has to ensure that what he/she writes is relevant to the potential audience, the topic addressed, and the general context in which the text is delivered.

The continuity clause

The continuity clause stipulates that effective communication is to ensure continuity in contents. Without continuity in contents, it may be impossible for a stakeholder to understand what is at stake in the process. Respecting the continuity clause ensures that communicating parties get connected and will be able to develop a cohesive representation of a topic or a problem. Like the relevance clause, the continuity clause shapes some of the modalities necessary for fulfilling felicity conditions relative to conventionality and actuality. Respecting the continuity clause is making sure that behaviors where individuals express whatever comes to their minds at any given moment are discouraged, not to stifle the individuals freedom of expression, but to ensure that relevant contents do not get drowned in trivia. Letting ego-centered communication take the floor in the process must be avoided because it prevents the group from sharing relevant thoughts and feelings to enable consensus. Effectively monitoring the continuity clause in policy making consists of discarding information that is not "to the point".

The clarity clause

The clarity clause is based on the idea that communication has to be as precise and explicit as possible especially when stakes are high and important decisions have to be made. This clause adds a new dimension to Austin's felicity conditions insofar as these do not take into account the importance of clarity in communication. Yet, lack of clarity, in private conversation or in policy making chains, can make communication fail completely even though all the felicity conditions relating to conventionality, actuality and intentionality may well be fulfilled. The use (and abuse) of jargon deserves particular attention here. Different jargons are used by individuals with different initial training, expertise, general knowledge, age, or social status. Whenever one is using jargon in a communication process, one must be aware that some partners may not be familiar with it. Jargon abuse, the abuse of innuendos, or a general lack of clarity or precision in communication needs to be monitored constructively in a communication process. Younger, less experienced, or non-specialist stakeholders should be encouraged to ask questions and to object whenever they do not understand what is going on. Putting partners in a position where they have to guess, read between the lines, or spend additional time searching for information outside the process when it could and should have been provided during the process is detrimental to effective communication. Respecting the clarity clause helps prevent misunderstandings and their negative consequences. It ensures that every stakeholder in the process is aware of the information needs of all other stakeholders.

The prudence clause

As explained here above, words like actions have their consequences. Thinking about the possible consequences of what one does, writes, or says is not only an important key to ethical communication, but also a key to its success and effectiveness (see also Baron, 1990). The prudence clause extends Austin's felicity conditions by encouraging stakeholders to handle information sincerely but, at the same time, carefully. Perfectly sincere but careless handling of information can lead to the rapid propagation of false data, inaccuracies, or rumors in groups and networks and can engender a heavy cost. On the other hand, not letting on about potentially critical facts or figures under the sole premise of the prudence clause can have similarly damaging consequences, as will become clearer later herein. Although there may be a conflict between the sincerity clause and the prudence clause, it can be resolved by implementing clear criteria in the communication process. The criteria for handling the prudence clause are quite simple. On the one hand, one must not communicate data, events, or claimed facts that cannot be verified without taking the greatest care that all stakeholders are made aware that further verification is necessary. On the other hand, one must not hold back potentially critical and important information, hypotheses, intuitions, or

suspicions on the basis of the sole argument that they cannot be easily verified. Sincere and responsible individuals, be they transmitters or receivers in the process, are to carefully handle non-verified information and make sure that the necessary will be done to gain clarity about its veridicality, especially when stakes are high. When the security of individuals is at stake, the potential damages caused by mishandling the prudence clause gain even more weight and need to be minimized at all cost. Whenever non-verified information freely circulates in groups or networks, a violation of the sincerity clause, where certain individuals deliberately try to manipulate members of the group or the group as a whole, may be suspected. In short, the free circulation of non-verified or non-verifiable information or data in groups and networks is not an option in responsible and sincere communication. Nor is the deliberate holding back of uncertain information that may turn out to be relevant. Whenever there is doubt, there are to be criteria for making sure that additional information and data are provided, as quickly as possible and by sources as reliable as possible.

The tolerance clause

The tolerance clause permits adapting Austin's felicity condition of conventionality to the reality of modern communication by stipulating that individuals or groups must not dismiss sincere and potentially constructive contributions of others, even though they may be considered non-conventional. This tolerance clause therefore encourages handling conventionality in a flexible manner and aims at avoiding that conventionality be used as an excuse for deliberately excluding certain viewpoints. Flexibility in handling conventions has become of utmost importance for communication success in the modern multicultural society. Moreover, seemingly unconventional attitudes and suggestions may help solving complex problems for which no straightforward solution exists. Responsible and sincere communicating beings will consider that younger partners with less experience or status, or individuals from different domains of expertise may not necessarily be able to deal with complexity with the same ease and insight as some of their more specialized or experienced partners. Unconventional or naïve suggestions should be considered constructively, not readily dismissed on grounds of a more or less accepted conventionality. Monitoring conventionality flexibly can open doors to new ways of thinking and doing and lead to unsuspected breakthroughs. Such potential must not be wasted. Unfortunately, this is only too often the case. Senior team partners with an assumedly wider experience often have a tendency to dismiss or ignore contributions from juniors, non-experts, or partners with lesser status or experience. In a *senior-versus-junior* scenario, such intolerance often translates the fact that the junior's opinion is implicitly deemed unimportant or inadequate. In an *expert-versus-non-expert* scenario, it may translate the fact that an expert may consciously or unconsciously consider that he/she has nothing to learn from someone outside his/her field of expertise. This kind of psychological problem reaches well beyond the mere problem of communication grounding. The explicit clauses of the communication contract aim at making sure that the communication process is not abused by privileged stakeholders as a means of dominating others.

The openness clause

The openness clause complements the tolerance clause by stipulating that responsible communication should be as transparent as possible and open to other viewpoints. When differences in opinion exist, they must be acknowledged sincerely. Responsible policy making is not a battlefield where arguments are used like weapons, or where devious persuasion strategies destroy constructive exchange. Such scenarios engender a heavy cost on the functioning of a group and the information flow between stakeholders in a decision making process. Most importantly, they totally compromise sound and responsible decision making in situations of crisis or threat.

The promptness clause

The function of the promptness clause is to increase the awareness of stakeholders that it is in their own best interest to deal with an incurring problem as promptly as possible. The clause helps getting potential conflict scenarios under control as soon as the earliest detectable signs begin to show.

The balance clause

Effective and ethical communication between responsible individuals relies on a certain balance of the times taken by the different partners to make their point in the communication process. Situations where some protagonists are given significantly more weight than others, or where a particular stakeholder notoriously monopolizes the lion share of time available in the process, are costly. Non-respect of the balanced contributions clause may have the effect that important issues are not addressed for lack of time remaining and thereby affect responsible policy making. Violations of the balanced contributions clause are quantifiable indicators of communicational dominance patterns (Itakura, 2001; Edelsky, 1981), where some stakeholders do not have a voice, but are being dominated by others. This very subtle kind of communication bullying is common, in the board room as well as in families, and it often engenders a heavy cost. The causal relation between communicational dominance, power discrepancies (victimization) and domestic violence, highlighted in psychological studies (e.g. Babcock *et al*, 1993), draw attention to the importance of getting rid of such behavior in sincere and responsible communication.

The optimal timing clause

Time is precious. Wasting it carelessly when stakes are high and important decisions need to be made is irresponsible and counterproductive. Some individuals waste time deliberately, or make others waste theirs strategically to gain some kind of advantage. Letting things ride may be a means to an end, but is not an option for sincere and responsible individuals. A communication contract adapted to modern society must include a clause which increases and fosters individual awareness that time must be made for communicating beings to interact, to keep their projects going, and to allow for responsible decision making when something is at stake. A general thumb rule here would be: the higher the stakes, the greater the importance of making as much time as possible available for exchange. The optimal timing clause thus encourages sincere and responsible individuals to combine their efforts in respecting time. This clause can be readily implemented in "watchdog" procedures to avoid the particularly detrimental effects of delayed action in risk management.

The negative effects of communicational dominance: results from a pilot study

Assigned roles and tasks often produce asymmetries in participatory weights and the distribution of decisional power (e.g. Ten Have, 1991). Such communicational dominance is reflected by repeated violations of specific ground clauses of the communication contract. A pilot study by Dresp-Langley (2009) has shown that these can be quantified in terms of relative and total number of violations signaling unbalanced time management and topic control in team management. The evidence was gathered from analyses of the communication of a small team of senior partners and junior members (design engineers or architects) within a larger organization. The projects of some of the junior members were not progressing, and two junior members had resigned from that team the year before because they had not been able to concretize projects. Team meetings were generally called at very short notice by the team leader, and they were infrequent, with time gaps of up to three months between meetings. At least seven of the thirteen team partners were aware of the problem with the junior projects and had expressed their concern informally at various moments (coffee breaks, corridor talk, etc.). The team leader communicated the time and place of a crisis meeting to all team members by e-mail quite late (after regular work hours)

the evening before. Five senior team members were unable to attend the meeting and sent e-mails to the team leader, stating "too short notice" or "have other important business to see to" as reasons for their absence. The meeting was attended by all the five junior members (three female, two male) and only four of the nine seniors (three male, one female), among whom were the former department director (male) and the team leader himself (male). Hierarchical status and gender of partners were coded, individual identities remained anonymous. The communication process was analyzed using a rigorous method of content analysis (Dresp-Langley, 2009). This permitted identification of clause violations based on explicit quantitative and qualitative criteria and indicators (FIGURE 2).

Analyses of the pre-meeting questionnaire showed that three of the five junior team members expected more from the meeting than a general information update. Six of the nine team members, including all the five juniors, expected the meeting to be specifically concerned with the junior team projects. Interestingly, on the forms given to them, all team members indicated that his/her expectations would most likely not be satisfied by the meeting. In additional comments, four of the five juniors stated that their expectations had not been satisfied in previous meetings. Eight of the nine participating team members stated that the outcomes of previous meetings were "moderately positive", one junior member reported "mostly negative experience from previous meetings", another junior wrote down "previous meetings with poor outcomes". None of the participants of the meeting explicitly identified themselves as the team leader, despite the fact that the team had an officially appointed head, and a clear hierarchical structure. One senior participant stated that he considered all people in the team to have equal status. Two of the four seniors associated themselves with an "important status" in the team and the five juniors considered their status in the team "not very high", or "low".

Sequential analysis of the communication process allowed a reconstruction of the chronological sequences, revealing that 80% of the overall time period available for communication were monopolized by two of the nine team partners: the team leader, and the former department director. The other two senior partners spoke only a few minutes at the meeting. Of the junior partners, the two male juniors spoke, but only a few minutes. Quantitative analyses revealed a marked imbalance in the communication process characteristic of communicational dominance patterns, where the two male seniors with the highest status in the team "took the floor", leaving little or no time at all to other team members to have their say. This scenario was accompanied by multiple violations of other clauses of the communication contract. Sequence-by-sequence analyses of the exchanges revealed multiple violations of the tolerance clause, the openness clause and the clarity and continuity clauses by the male senior partner who was formerly a department director. A large number of these violations was detected in the first eight minutes of the meeting in exchanges between two male senior partners and the sole female senior team partner. These clause violations occurred in a context where the team leader requested to be informed about the status of two specific project submissions. The female senior partner, who was the coordinator of these projects, would have been the one expected to reply to that request, but was prevented from doing so by the former department director, who spoke up for her and later again for other team members, without having been invited to do so. The disruptive effect of clause violations was brought to the fore by analyzing the topical contents of the communication sequences in which they occurred.

Analyses of the post-meeting questionnaire revealed that seven of the nine team partners, including the four seniors, were "reasonably satisfied with the meeting and its outcome". One junior stated to be "not satisfied" and another junior was "not satisfied at all". None of the team partners reported being entirely satisfied with the meeting and its outcome. By applying a 'satisfaction coefficient' to each of the four possible answers, with a coefficient of 1 for "entirely satisfied", coefficients of 0.75 for "reasonably satisfied", 0.25 for "not too satisfied" and 0 for "not satisfied at all", we were able to compute a quantitative indicator of the

condition of closure of the communication contract for that specific meeting. With nine participants as here, the optimal satisfaction rate indicating 'closure under the best possible conditions' of the communication contract would be 9/9. As it was, we obtained an overall satisfaction rate of 3/9, which is only about 33% of the optimal rate. When computing satisfaction rates as a function of the status of the team partners, we obtain a rate of 2/4 (25%) for the seniors, and a rate of 1/5 (20%) for the juniors. This result suggests that the juniors were less happy with the way things went at the meeting than the seniors. It can be expected that clause violators would, indeed, suffer less from the consequences of a deficient communication scenario with multiple clause violations than those who have to suffer the violations. Seven of the nine team partners considered that the effectiveness of team communication "needs to improve", one female junior judged it "ineffective", but stated that she "could not say why" and another junior deemed that "time is wasted on irrelevant matters". None of the nine team partners thought that the team communicates effectively. When asked whether they had and took every opportunity to speak up in the meeting, three seniors of the nine team partners stated that they did, three juniors stated that they did not speak because they considered it "not worth the try", two juniors stated that "others in the team speak more often" and the female senior team partner declared that she "had hardly any chance to speak and that it "bothered" her "a lot". Four of the junior protagonists thought that the "team should meet more often", only the male seniors deemed that the "team meets often enough". One junior team partner stated that there should not be any more meetings because "most of the time is wasted in the meetings". When asked to make suggestions on how the effectiveness of communication within the team could be improved, three of the senior team partners stated to "have no idea", while two juniors suggested to "involve the junior team members more". Two others, one junior and one senior, suggested to "plan and target the meetings better" and to "meet more regularly". Analyses of the second post-meeting questionnaire given three days after the meeting revealed that what the junior partners most remembered from that meeting were irrelevant details such as private jokes. Those who lost out in this deficient and ineffective communication process were the junior members of the team, for whom not a single clause violation could be noted because they were simply not given or did not take the chance to express themselves. This problem was compounded by the communicational abstinence of the sole female senior partner of the group, who did nothing to try and get the communication process on the right track. The results of this pilot study have shown that the communication contract can be exploited as a powerful tool in communication analysis. Quantitative and qualitative indicators have permitted generating data and clear conclusions about what needs to be done to get that team to communicate more effectively.

Communicating under risk in the global society

The design of tools and procedures for the responsible and effective management of risks to humans and their environment places the ethical ground clauses of the communication contract at the heart of the global, multicultural society. The communication contract provides universal rules for responsible data exchange, with general guidelines for sincere, transparent, prompt, and cooperative information sharing in risk engineering and management. Such are essential for mitigating the potentially disastrous consequences of non-action in response to early risk warnings. Too often, relevant scientific data and/or expert knowledge are not adequately taken into account. In numerous post-disaster reports, faulty communication has been identified as the major cause of delayed action in response to risk. Implementing and testing the communication contract as a theoretical framework for the design of tools and procedures in risk engineering, especially in the context of early warning systems, is to promote solutions to problems of uncertainty in the evaluation and management of hazards (biological, ecological, financial or other). Large-scale risks need to be anticipated responsibly to protect humans and their environment. Assessing and

minimizing the vulnerability of individuals or communities to multiple, often interrelated, hazards represents one of the major challenges in this field.

Identification of stakeholders, their roles, and their responsibilities

Any individual, group, or community directly or indirectly, passively or actively, involved in or affected by activities incurring risks (biological, ecological, financial or other) becomes a legitimate stakeholder in the communication process. Yet, identifying and characterizing stakeholder responsibility is not self-evident. There are the potentially exposed and therefore vulnerable stakeholders on the one hand, and the stakeholders who are to be responsible for taking care of this vulnerability on the other. The communication contract is to ensure that who and what matters most in the process is accurately identified as soon as possible. It permits to clarify stakeholder rights and responsibilities at several major levels of analysis. Social and psychological factors act to either dampen or amplify both the collective and individual perception of risk in any given context (Pidgeon & Kasperson, 2003). Cross-cultural differences need to be considered for assessing such perception and its potential, negative or positive, influence on policy making and regulatory action. The communication contract provides the basis for developing a set of universal tools that will help to increase individual and collective responsibility and awareness in any cultural context given because the clauses of the communication contract are based on a limited number of simple, explicit, and universally acknowledged principles of common sense. Risk engineering and management is to optimize hazard preparedness and to help design mitigation strategies. This requires a global systems perspective which recognizes the complex interactions between environments and social systems, at local and global levels of human aggregation.

For a definition of the notion of risk consistent with such a perspective, we propose that a group, community, area, region, or environment is to be considered "at risk" whenever there is a high probability of adverse impact from one or more events. The inherent heterogeneity across multiple hazard scenarios often does not permit suggesting a single measure or even globally consistent multiple measures of hazard severity in complex situations. Meaningful quantitative estimates of random or systemic uncertainties and other quantitative analyses are often compromised by a substantial lack of knowledge about hazard occurrence and loss in specific time frames. Artificial intelligence, machine learning approaches and computational modelling using fuzzy logic and genetic algorithms (e.g. Muttil & Chau, 2007; Zhao *et al.*, 2006) have made it possible to simulate and predict critical changes in specific environments with great precision in space and time. Yet, whether the generated data are effectively taken into account for adequate decision and action depends entirely on social, economical, and psychological, factors.

Hazards may have adverse local impacts on regions and communities and other, essentially positive, effects at a larger scale. This would be the case of thunderstorms, devastating coastal regions and affecting populations locally, but engendering globally beneficial effects on agriculture and water resources, for example. Apart from such particular and exceptional scenarios, the consequences of hazardous events, such as death or injury of people or loss of valuable structures and assets, are generally undesirable, and very often detrimental to many more than those directly affected. This is one of the reasons why the concepts of exposure and vulnerability are core issues in early warning systems for understanding the multiple implications of the notion of "risk", which is associated with a wide range of natural and man-induced hazards. Assessing the degree of exposure of humans and their environments to different potential hazards is anything but straightforward. Decision makers are generally afraid of overreaction to what could be a "false positive". Moreover, accurate and reliable probability estimates for population exposure to specific types of hazard and for a whole range of event magnitudes and characteristics are often impossible to obtain. Population distributions and activities vary across time and are governed by a multitude of socio-economic factors and variables. The differential rates of such change cannot

straightforwardly be projected into the future. Also, the stresses to which any given element at risk is subjected to will depend on hazard magnitude and other characteristics. Such stresses include mechanic solicitation in the case of earthquakes, inundation in the case of floods, and so forth. Any given element at risk may be extremely vulnerable to one hazard and unaffected by another, as some buildings may collapse under seismic stress and incur damage through thunderstorms and floods, but suffer very little or no stress during a drought. For any given hazard, vulnerability will vary from one element to another, as some houses erected on platforms may be less vulnerable to flooding than other houses built within the same area. Individuals and communities with larger resources and economic alternatives often tend to be less vulnerable, or able to recover more quickly, from stresses and damages than populations with fewer resources.

Regulations for action taking are needed just as much as quantitative predictions and statistical data characterizing hazards in terms of consequences on individuals and communities and their social and economic activities. The role of the communication contract in risk analysis is to ensure that information is made available as soon as possible and to as many individuals as possible. Up to now, this has too often happened far too late. International regulations and recommendations for the handling of chemicals, now worldwide recognized as dangerous to human health and the environment, only exist since 2002, such as the GHS recommendations of the United Nations for safe production, transport, and use, or the REACH regulations of the European Commission, with national helpdesks for the different countries, which exist only since 2007. Individual and collective differences in risk perception have been identified to be important social and psychological variables, which need to be taken into account effectively. The communication contract is to ensure that vulnerable stakeholders and those who are responsible to protect them from exposure are identified as soon as possible. All stakeholders are to be made aware of their individual responsibilities in their communication process, regardless of social status, education, or culture. This requires effective systems of information exchange between analysts, policy makers, experts, witnesses and other members of the public. What policy makers need most are sound guidelines and tools which lead to the right decision at the right time. Yet, the vulnerable stakeholders and those who are in charge of taking care of this vulnerability at the governance and policy making levels often have conflicting interests. Implementing and testing the communication contract will show that this conflict can be resolved by watchdog tools which ensure that the protection of the potentially exposed is placed before any other goals. Theoretical models of risk analysis aim at global systems approaches and integrative knowledge generation, but from a purely technical viewpoint such global system approaches have thus far had very little impact on risk management and policy making. Exposure estimates are always based on very limited amounts of data. The social and economic consequences of hazards (mortality, damages, resource losses) are evaluated at best in form of national statistics "after the horse has bolted".

Dilley's multi-hazard model (2005), published by the World Bank Press, defines a minimal number of six universal steps in global risk management (FIGURE 3). The first model stage describes what may be called the "ground truth". This refers to the true state of matters regarding exposures to multiple-hazard risks of regions worldwide. This true state will never fully be known because it cannot be reliably assessed because of technical and practical limitations to generating the necessary data, as explained above. Early warning systems rely on hazard probabilities and estimates of vulnerability and response capacity sampled by experts independently at levels 2 and 3. Individual stakeholder responsibility comes into the game at these and all further levels, although the earliest stages do not involve all of the stakeholders. Simulations of cross-hazard dependencies and their interaction with other vulnerability estimates are provided at level 4. The data patterns are then to be examined in the light of currently existing policies and measures to enable decisions about whether they are adequate or not, and which other measures are likely to be necessary (level 5). Whenever such a critical decision making process is triggered, all stakeholders need to be fully informed, and given specific tasks and responsibilities (levels 5 and 6). The quality and

reliability of information exchange between all levels of the model directly determines "who knows what and when" in risk engineering and management. This clarifies why level 7 of the risk analysis model ultimately controls all prior levels of analysis. Early warning systems are useless, if they do not lead to proper action. However reliable early signs of alert may be, they are consistently more likely to trigger action in terms of appropriate mitigation strategies if they are known by as many stakeholders as possible, whether these are experts or not, and whatever the nature of the risk (floods, storms, forest fires, or other). Whether relevant data regarding risks are communicated in due course to as many stakeholders as possible solely depends on individual awareness and responsibility.

"Watchdog" procedures: where and when are they needed?

Existing tools and procedures for risk analysis, such as the Systems Engineering Competency Model (SECM, 2007) of the MITRE Institute, a non-profit organization that carries out research for the US Federal Government and the United Nations, could be exploited as a working model and revised in the light of findings from step 1. The SECM model consists of several critical stages (FIGURE 4) where "watchdog" procedures are needed to ensure that the communication contract is fully operational. Under the working hypothesis that the sincerity clause is respected by all stakeholders, the nine other clauses need to be monitored through these procedures to regulate information exchanges and ensure effectiveness, which translates into implementing the following criteria:

- ✓   the most relevant information is processed with priority – *relevance clause*
- ✓   uncertain information is handled prudently – *prudence clause*
- ✓   information is communicated to openly and transparently – *openness clause*
- ✓   information generated at <u>any</u> stakeholder level is taken seriously – *tolerance clause*
- ✓   information is given in clear and explicit terms, no jargon – *clarity clause*
- ✓   information sharing is ensured consistently and on a regular basis – *continuity clause*
- ✓   exchanges between stakeholder levels are balanced – *balance clause*
- ✓   information is made available to all as soon as it is available – *promptness clause*
- ✓   when early warnings are detected, action is not to be delayed – *optimal timing clause*

Late action to early warnings: better sorry than safe?

Family doctors give the benefit of doubt to their patient by deeming that it is better to be safe than to be sorry. I argue that the same principle needs to be adhered to in global risk engineering. The heavy consequences of non-communication and late action in cases where early hazard warnings were ignored or dismissed reveal to the full extent the need for a clear and firm communication contract between stakeholders. Failure to communicate, decide, and act whenever early warnings are issued can have disastrous consequences, as illustrated by a series of international case studies published by the European Environment Agency (EEA) in 2001. To give just two examples here: the damages caused by long-term exposures to antimicrobials in food animals (Edqvist & Pedersen, 2001), or to blue asbestos dust in factories (Gee & Greenberg, 1001) extend over scales which nobody seemed to have anticipated when the first hazard warnings were issued. A closer look at the other thirteen case studies shows that in all these cases

- •   early warnings were generally dismissed or ignored
- •   action was triggered only when proof beyond reasonable doubt was available
- •   action was triggered when incommensurable losses had already incurred

"Watchdog" procedures must ensure that what needs to be communicated to whom and when is known and made explicit, in early warning systems and in all further steps of the risk management process. Three different levels of warning and certainty need to be considered

here. The first level describes a situation where early warnings are formulated and where the first preventive actions should be taken. Case histories have revealed that such early warnings are generally ignored or dismissed by policy makers because the short-term financial cost of reacting to what is deemed a potentially false positive is to be avoided. For example, the very first early warnings of asbestos induced health hazards were formulated in 1898 by a woman Medical Inspector of the Crown, who instigated microscopic analyses of the sharp, jagged, glass-like asbestos dust particles and concluded on their damaging effect on bronchial tubes and lungs. Her conclusions were confirmed a few years later by similar reports of two other women inspectors and published in the annual reports of Her Majesty's Chief Inspector of Factories in the UK. Yet, the evidence was not communicated to all the stakeholders. The politicians who were aware of the reports at the time disregarded them completely. By doing so, they were giving priority to short-term economic gains, to the detriment of long-term sustainability and human health. This case scenario is an example of violation of ground clauses 2 (relevance), 4 (openness), 8 (balance), 9 (optimal timing) and 10 (prompt resolution) of the communication contract. Highly relevant data indicating potential risk to public health from several competent reports were ignored or dismissed by a few irresponsible stakeholders when these data should have been given priority (clause 2). The data should have been communicated as soon as possible (clause 9) to as many stakeholders as possible (clause 8), and a balanced panel of several independent experts (clause 8) to ensure that action is taken promptly (clause 10). Clear rules and procedures for decision making and action would have helped to address the problems of risk and uncertainty explicitly in a global and transparent approach.

From precautionary principle to clearly defined procedures

The precautionary principle is a concept invented by policy makers, suggesting some supreme framework of thinking in hazard assessment and management. The concept advocates the use of foresight in situations characterized by uncertainty and ignorance, where regulatory action as well as inaction could engender potentially large costs. A clear definition of this principle, however, does not exist. This lack of clear terminology and rules of due procedure for what needs to be done, when, and by whom as soon as early warning signals are detected compounds problems of complexity, uncertainty, and controversy in risk management. Scientific uncertainty is far too often used as an excuse, to delay regulatory action on the one hand, and to foster public ignorance on the other. Who is to judge what risks can be considered acceptable, and who are the stakeholders that need to be represented in the decision making process? What needs to be done when early warnings are issued, and how early should action be taken to protect vulnerable stakeholders from harm? The potential implications of early warnings may be quite clear to an individual scientist, a victim, a family doctor, a health inspector, or a few members of an already exposed community, yet, how can we ensure that such elements of hazard cognition are communicated to and taken into account by those who have the power to act? There are no general ground rules for applying the precautionary principle. Communication and decision making at managerial levels is a quicksand where priorities shift between the prevention of potentially harmful hazards and the promotion of economic priorities that are potentially harmful in other ways. Society is, more than ever, badly in need of concrete rules, procedures, and user-friendly computer tools accessible to all stakeholders for dealing with crisis and risk in a responsible manner.

Implementing the communication contract in global risk management

The final steps of risk mitigation processes consist of implementing knowledge, procedures and tools into global platforms of risk management. This would consist of developing user-friendly training tools and management programs that can be made accessible to citizen stakeholders, experts and policy makers. However, at the global management level, conflicts of interest that may engender conflict between specific clauses of the communication

contract need to be identified. For example, while the prudence clause commits stakeholders to careful consideration of uncertain information before action is precipitated, it must not ever be used as an excuse for non-action. Whenever early hazard warnings are issued and global and intangible long-term costs in terms of deaths and devastation of resources can be expected, as in the case of earthquakes, tsunamis, floods, and storms, preoccupations about false positives under the premise of a particular interpretation of the prudence clause must be dropped. This is a lesson already learnt from past experience and it should guide all future decision making. It is always better to be safe than sorry. One of the most important problems to be addressed at this ultimate stage is how to deal with the problem of uncertainty at a global level.

The problem of uncertainty in risk engineering involves three functionally distinct levels of hazard cognition (FIGURE 5): ignorance (no data about a hazard and its potential impacts are available, but individual observations and intuitions may be reported), uncertainty (impacts have been observed but predictive statistics are not available), and risk (impacts are known and statistics are available). Early warnings connect with the first or second level of hazard cognition. They may involve stakeholders at the individual level (direct witnesses) or the expert level (medical doctors, scientists, and other experts). In the EEA case study on early warnings of asbestosis, it is reported that the earliest account of the health hazard represented by the blue dust particles were provided by an individual health inspector who was at the time not considered an expert, but who observed carefully, had the right intuitions and took the initiative to instigate further microscopic analyses of the dust, which confirmed her concerns. Despite the fact that the report was published and that experts had access to the knowledge made available, it was ignored. When the first action was triggered several decades later, asbestos induced mesothelomia had already reached epidemic proportions in the UK. Retrospectively, the delayed action has been explained by the fact that policy makers were placing short-term economic profits before the long-term interests of the workers and society. This is a clear example where the stakeholders who had the power to act and to protect the vulnerable ones from exposure did not manage their individual responsibility with the right amount of care by setting the right priorities at the right time. At a level where risks are real and hazard statistics available, it is often too late to implement successful mitigation strategies because the first losses have incurred and have already triggered irreversible consequences which, at that moment in time, cannot be predicted or even understood (FIGURE 6). Ground rules of the communication contract must therefore enter the equation from the first moment when intuitions of a direct witness (an individual, a family doctor, or a victim) are reported. It is therefore important to design and implement readily accessible, but protected and therefore to a given extent privileged, risk communication channels *("all stops pulled out")*. Individuals must be able to use these swiftly and responsibly to inform experts. Connected channels where experts can take immediate action to inform the competent authorities immediately will also be needed here. Those who have the power to decide and act must then dispose of tools which help them control that data are not ignored, but processed promptly and adequately.

The ultimate goal of a communication contract for the global society is to help citizen stakeholders, experts, and governance to communicate about risk in a fully connected process where information exchange is transparent and effective, and where action can be triggered promptly. This refers to theories of high reliability organizations (Weick & Sutcliffe, 2007, Dresp-Langley, 2008). Global systems engineering and management needs to strive for high performance in situations that can be planned for, and for readiness to anticipate and adapt to unexpected events which, by definition, cannot be planned for.
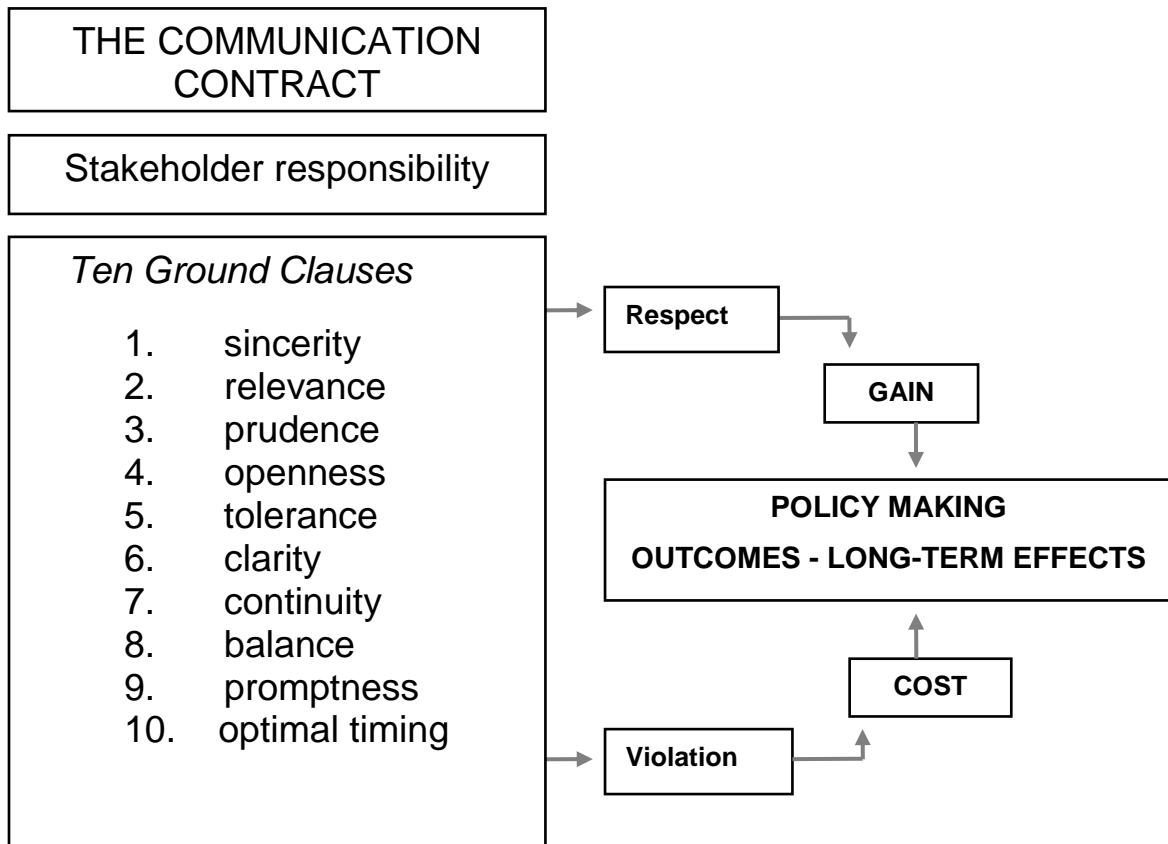
Figure 1: Responsible communication between stakeholders is placed under the premises of a **communication contract** (Dresp-Langley, 2009) with ten binding ground clauses.

Topical efficiency coefficient (between 0 and 1): **0.22**
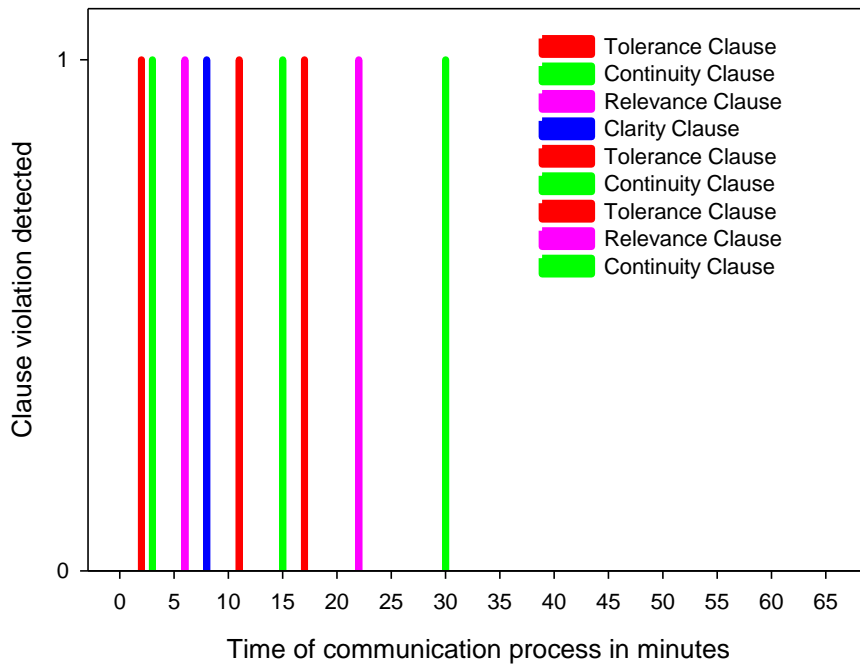Stakeholder satisfaction coefficient (between 0 and 1): **0.33**

<u>Figure 2</u>: Data from the pilot-study showing multiple violations of the communication contract in the first minutes of a team communication process (Dresp-Langley, 2009). Data analysis was achieved through a content analysis scheme described in detail in the publication, combined with pre- and post-analysis questionnaires. **Topical efficiency**, which is the number of topics adequately addressed over the number of topics listed on the agenda, and **stakeholder satisfaction**, which is the number of stakeholders reasonably satisfied over the number of stakeholders participating, were shown to **score below average** in this case study.
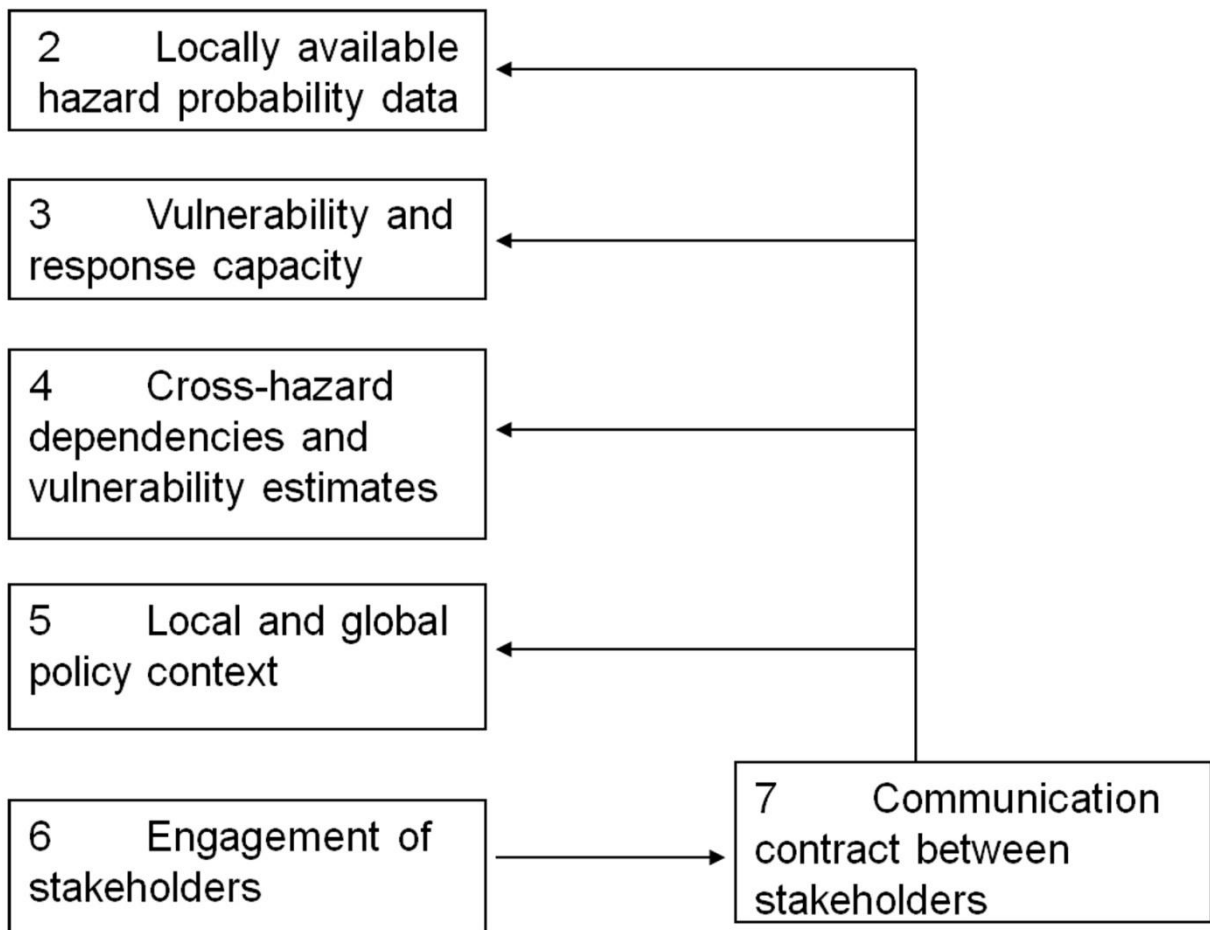
Figure 3: A multi-hazard risk analysis model (inspired from Dilley, 2005). The outcome of the communication process (communication contract) between stakeholders at levels 5 and 6 has repercussions on all levels of data processing and information sharing. Appropriate tools and **procedures for monitoring the communication process at all levels** are therefore required.

Figure 4: Global risk engineering models, such as the Systems Engineering Competency Model of the MITRE Institute (2007), involve multiple steps of decision-making for risk tracking and action planning. This requires generating further knowledge, procedures, and tools which ensure that a communication contract is put in place and fully respected at all critical stages. To this end, "watchdog" procedures need to be designed and implemented from stages 1 to 4, shown here above, in terms of iterative and re-iterative control steps. This could ultimately lead to the development of widely accessible web-based applications and platforms for data exchange and research.
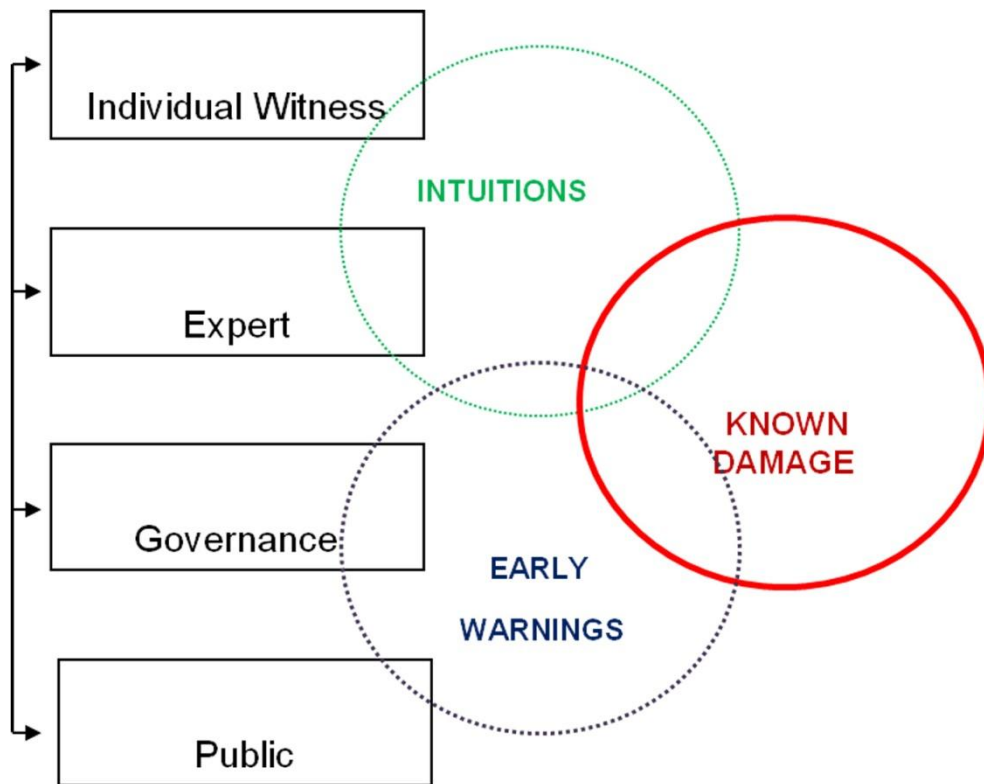
Figure 5: The **concept of uncertainty** in risk analysis confounds three major stages of hazard cognition. Level 1: The first **intuitions** of a direct witness such as a family doctor, victim, expert or small group of experts when nothing is known for sure yet. Level 2: Observations alert experts to give **early warnings.** Level 3: **Damages are known** and there is certainty that losses have already occurred and more will occur. Effective tools for risk engineering must not solely rely on hazard statistics, which become available far too late in the process.

1 - Early Warnings → Take precautions**** / Ignore data *

2 – Inklings of Proof → Minimize losses** / Wait for more data ***

3 - Proof Beyond Doubt → Take late action* / Process data *****
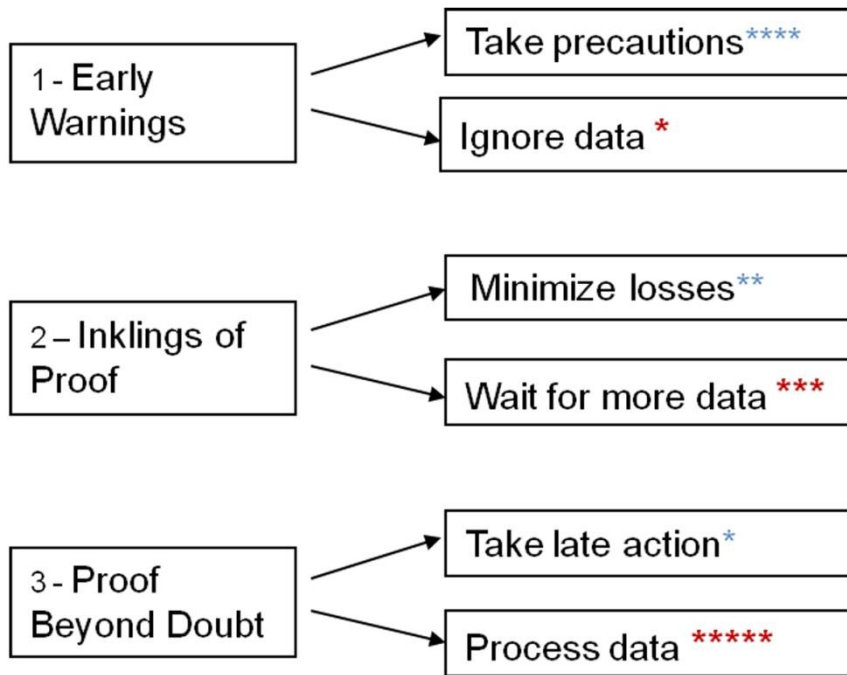
Figure 6: There are three major levels of hazard proof in risk engineering. Ignoring early warnings at first level of alert is likely to induce latent periods of non-action between first exposures (level 2) and late damages (level 3). This may produce cascades of irreversible consequences before any action can be expected to get things under control. **Disaster levels (red asterisks)** induced by communication failure and non-action increase, often incommensurably, with the level of proof. **Levels of control (blue asterisks)** dwindle away as the level of proof increases. Implementing the communication contract with tools and procedures to ensure that it is respected must therefore start at the level **of early warnings.**

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