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CONCLUSIONS

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In their discussion the NeTWork group tried to address the question raised in the introduction. Is it possible to coherently decide on risks? What then does coherence mean? Is it desirable to do so and is it possible and desirable to do so over the full breath of risk bearing activities?

Various domains of decision-making were explored. These ranged from decision making on a national scale to the purchase of commercial products to serve in potentially high risk machinery such as aircraft to safety in the operating theatre of a hospital.

Coherence could be defined by *equal decisions in equal circumstances*. Decisions on risks are often called incoherent when an equal or similar risk, expressed in some consistent metric, is accepted in one case and rejected in another. A typical example of this seemingly inconsistency, which occurs often in the discussion, is the comparison between the risks of having a fatal accident in road traffic and as a result of a mishap in the chemical or nuclear industry. The risks of road traffic that are acceptable numerically are much higher than what is found to be acceptable in the chemical and nuclear industries. Countries dealing with risks are seen to use differing criteria, which is deemed not only to be inconsistent but also a threat to free trade and, from the part of a potentially regulated industry, an undue burden.

In chapter 3 a number of numerical examples are given. There it becomes apparent that circumstances under which a judgment is given are rarely equal. As is explained in that chapter two main factors cause this inequality and thus the seemingly inconsistency in the decisionmaking:

- the specification of attributes that play a role in the decision is incomplete.
- the decision is based – in part – on imponderables that are not expressed in the numerics.

Both occur and they occur simultaneously.

A decision on risk rarely is a decision on risk alone. The decision is on an activity that involves risk, but involves many other things as well. The most obvious “others” are the benefits.

And there is more to risk than consequences and probabilities. There have been several attempts to list other attributes o risk that play a role in the judgement of risks and risk bearing activities. The list of Slovic´s is one of the most comprehensive listings of the important attributes of risk:

Consequences and probabilities

- Disastrousness
- Involuntariness
- Unfairness

- (Assumed) uncontrollability of the occurrence or the extent of the consequences (by self)
- Lack of confidence in or openness of the responsible authorities
- New technology
- Hidden, delayed or irreversible damage
- Unclear advantages (for society or self)
- Identifiable victims (especially children)
- Malicious intent.

The attributes all make risks less acceptable. When determining whether a decision about risk acceptability is incoherent, all these attributes need to be considered.

This list, although constructed as a list of risk attributes, already comprises some attributes that pertain more to the activity than to the risk such as unclear advantages.

Similarly the information sought by the regulator in the UK comprise more than consequences and probabilities.

- -the risk source
- -the risk receptors
- -the exposure pathways
- -the harmful consequences claimed
- -evidence of causation
- -estimates of the incidence and magnitude of current and future harms
- -risk reduction options

In addition the managerial context may differ widely. Specification of technical items may be under the control of the decision maker, but they might not be. The legal context may result in differing controls even if the language used in regulation or specifications reads the same. Therefore it is difficult if at all possible to conclude that decisions are or have been incoherent when looking at the resulting accepted risk in terms of a probability of death alone. Coherence assumes that all other is equal and it almost never really is.

Would that, then, make coherent decisions impossible? As the examples on decision making in the Netherlands on the risks of chemical plants, and the transport industry examples in chapter 5 show, coherent decisions can be made. Even uniform standards can be set. This however can only be done within a certain defined technological context or within a defined policy context.

Politics is the only occupation where comparing apples and oranges is legitimate. In fact, policy makers can decide to ignore certain attributes of problems to make them into a single coherent class. The ultimate unification is money. Politicians or policy makers in private enterprises can assign a value to every asset they want to protect or risk and from there make a value judgement on the desirability of a venture.

Once a set of problems or decisions has been declared to be a uniform set or made into a uniform set by expressing every attribute in a single metric, decisions can be made coherent.

Once it has been decided that all facilities using hazardous chemicals are the same in those aspects that are deemed relevant for the decision on their acceptability, uniform risk criteria can be set. This decision involves that it does not make any difference in how people are killed, that numbers killed are a good proxy for the total picture or the damage, including people wounded, societal disruption and material damage, that the amount of money involved in the execution of the policy is worth it on a national scale and that differences in size and other specifics of companies can be ignored.

Similarly in aviation the decision can be made that the risk is expressed as the probability of a hull-loss incident or a reportable incident. Once that has been done the contribution of every piece of hardware, software

and peopleware can be expressed in a consistent way. By allotting parts of the risk to identified parts of the industry, target levels of safety can be defined and expressed in consistent metrics such as the probability of failure.

It should be borne in mind though that these decisions are valid in the defined frame of reference. They may be challenged when the activity or the decision invades into another realm or is seen to be doing so. An example is given by Heijer & Hale regarding the decisions on the risk of airports. A national airport has a scale of activity and a scale of spatial extent that makes it no longer in the same category of regular industrial facilities and the scale and nature of the activity as a special attribute can no longer be ignored. The policies and risk limits that are in place for industrial facilities in general cannot be applied to an airport and different approaches have to be found. This may look incoherent but in fact it is not. The inequalities have to be taken into account.

In light of the above one should not be surprised to find different levels of risk, when expressed in the same metric, to be acceptable at different times, for different activities. On the contrary, one should take these differences as indications that apparently there is or has been more at stake than risk alone. On the other hand, equal justice avoids envy or unwanted relocation of activities to locations where authorities may be more lenient. In that respect there is a lot in favour of having a consistent risk acceptance policy and the use of fixed criteria in designated areas of industry allowing operational decision-making. It also makes decision-making predictable. Predictability and transparency of the actions of the local public authorities always seems to be an advantage in the eyes of entrepreneurs looking for a place to start new operations.

On the other hand, once a framework for decision-making or the decision space has been set, meaningful comparisons can be made. In a set framework, judgements can be made whether sufficient efforts have been made to reduce the risk and whether measures to improve a situation exist and should be applied. Especially in the case of hospital operating theaters there seems to be room for improvement. The example of railroad safety shows that meaningful targets of safety or levels of acceptable risk can be derived from similar other activities or risks associated with other activities in the same industry.

What holds in the decision-making arena also holds for the discussion between experts and public. As indicated in chapter 1, there is not much difference between public and experts, as most members of the public are expert in some area and most experts are only expert in one area and lay in all others.

In many cases objections against new technological activities or against decisions can be expected when taking into account the “Slovic” list given above. Experts in most cases have become experts in their field of science or technology because they are attracted to it. That makes them inherently biased towards the advantages of their favourite technology. When these experts are given the task to judge the associated risk objectively, it is asking the impossible. There is not much chance that the non-experts will accept such a decision. On the other hand, there are experts that have become experts to be effective in achieving their societal or political aims. In reality it is very difficult for experts to be completely impartial and for decision makers to find impartial scientific advice. Rather then trying to be completely objective, experts would do better to be open about their opinions next to their expertise.

If objective or neutral judgement is required, "impartiality" has to be organised (HSE 2000c) and if the opinions of experts are known just as the opinions of other stakeholders, impartiality **can** be organised. All stakeholders should be heard, their attributes listed and their arguments weighted in a transparent process. That will not lead to a decision that everybody likes. It also will not end the discussion nor will it end parties challenging other parties’ arguments or motives. It will also not prevent decisions to be called incoherent. But it provides the best chance of decisions that all parties can live with.

That is the conclusion of this discussion in the NetWork. Coherent decisions on risk would be desirable, but coherency does not mean that an equal level of risk, when expressed in a certain metric, should always be acceptable or not acceptable. Coherency in that sense implies that all other is equal, and it rarely is. To declare certain problems as belonging to the same class, within which coherent decisions can be possible – is as political a choice as the choice for a particular risk policy or risk standard. Policies should be transparent, public and open for debate.

Ways forward – a preliminary research agenda

In the introductory chapter, barriers to risk coherence were clustered into five categories: individual, organisational, socio-political, cultural and physical/natural. Some suggestions for ways to improve risk coherence and risk transparency are elaborated below as a preliminary research agenda in this area.

Individual

For some years the flow of information on risks has generally been from expert to public. Since early studies of public perception of risk, there has been unfortunately a tendency to use the fact that 'the public' have apparent biases in risk perception, as a 'stopping rule' when trying to consider risks across different domains. This has not advanced our understanding, and has also reinforced risk regulation practices and research remaining partly isolated from their main stakeholder: the public. There seems to be a clear need to better understand why such biases exist, how they are formed, and their stability. The flow of information across the main 'frame' of the risk 'bicycle' model shown earlier needs to be more two-way, and sociological and psychological studies of risk biases and tolerances need to be carried out so these phenomena are better understood. This should then lead to true common ground between experts and public in various risk areas, and act as a basis for more meaningful risk communication and risk 'sense-making', and ultimately better risk-informed decision-making.

Organisational

Despite difficulties, it has been shown in the chapters in this book that risks from different domains can be compared, although this is easier when considering fatality statistics than more complex areas such as occupational diseases and 'indices of harm'. Since the main thread of this book is arguing for better risk communication, common metrics that allow risk comparability seem a useful direction in which to proceed. This would allow better risk presentation and enhanced risk communication.

Socio-political

When viewing risks across different industries, there are clearly uneven playing fields and risk compartmentalisation. There seems particularly room for improvement in the medical domain, and also via various ministries at least considering functional administration of areas, e.g. considering comparability of risks across all transport media or all energy sector industries. This may require a study of regulatory bodies themselves, in an effort to consider how better harmonisation at least between related areas or domains can proceed. The idea of a Risk Relatedness Matrix, enabling meaningful comparison of target levels of safety in different domains, would be one potential technical basis from which to consider and develop such harmonisation.

Cultural

Although the chapters have largely been focused on industrially related risk, cultural differences in risk perception and risk aversion to a range of phenomena, from industrial accidents to natural disasters need to be better understood. The idea of a 'global fault tree' or risk schedule could be a useful avenue of exploration. Currently the concept of 'societal risk' is very much rooted in the context of the so-called 'developed' nations, and might vary considerably for so-called 'developing' countries. There may also be significantly different perceptions and attitudes within these two large groupings.

Physical / Natural

The potential problems of risk migration and risk export have been shown to exist, and are a natural consequence of the proliferation of risk management strategies and methods across different sectors of industry and normal life. This area needs both better understanding and methods to determine how risks can propagate across system boundaries. Such approaches can then help to avoid undesirable side effects of risk management strategies.

There are doubtless other research and development projects that could take place; the above are simply seen as those offering good steps forward at this stage. However, whatever else happens, in this current 'Information Age' the gap between 'expert' and 'public' has never been smaller. Discussions and comparisons of risks are going to intensify. Whether this will lead to coherence is unclear. But it is likely that people will want to understand and manage their own personal risk 'profiles' better. It is hoped that the chapters and insights from this book may help in some way towards this aim, at least by showing the nature and extent of the 'landscape' of risk approaches that exist.