THE COMFORT BLANKET OF RISK ASSESSMENT: AN INVESTIGATION INTO THE SUBJECTIVE ASSESSMENT OF RISK

Adam Greene, David Root and Tony Thorpe

Department of Civil and Building Engineering, University of Loughborough, Loughborough, Leicestershire, LE11 3TU, UK

There is a growing emphasis being placed upon the objective analysis and assessment of risk on construction projects encouraging the utilisation of quantitative methods of risk assessment. This paper argues that risk is fundamentally a subjective view of a hazard, and consequently is dependent upon the knowledge and values of the individual. By treating the perceptions of hazard as an objective phenomenon, quantitative techniques encourage the externalisation of the risk perception process and differentiate between the individual's risk perception and the outcomes of decisions made by those individuals. Consequently the quantitative techniques act as a comfort blanket for the subjective perception of risk and provide a reconstructed logic of the risk perception process.

Keywords: risk, risk assessment, hazard, uncertainty.

INTRODUCTION

Adams argues that risk "is culturally constructed; where scientific fact falls short of certainty we are guided by assumption, inference and belief" (Adams 1995). Yet risk, both in its assessment and management is being presented as a fundamental part of the construction process, however this construction process is largely the product of a socially constructed intersubjective agreement of what the construction process is, similar to the notion of the 'technical system' (Seymour and Rooke 1995) which has evolved over time in response to historical pressures (Root et al 1999). Given that the objective process is a product of 'social action' (Jenks 1993), it is cultural requiring closer attention to be paid to the relationship between the individual (who make the individual assessment on hazards) and the collective (cultural) context of the organisational procedures/structures within which they operate.

DEFINITION OF RISK

In keeping with its subjective element, there is no all-encompassing definition of risk to be had. In acknowledging this Chicken and Posner (1998) recognize that any definition of risk is likely to carry an element of subjectivity depending upon the nature of the risk and to what it applies to, and instead postulate that:

Risk = Hazard x Exposure

Hazard is defined as "the way in which a thing or situation can cause harm," (ibid) and Exposure as " the extent to which the likely recipient of the harm can be influenced by the hazard" (ibid). Harm is taken to imply injury, damage, loss of performance and finances, whilst exposure imbues the notions of frequency and

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probability. It is the position of the authors that hazard is not the "way in which" rather it is the '*thing*' itself i.e. the landslide is the hazard, but it is the result of the landslide and its impact upon the person or their property is the harm associated with the hazard.

However the Royal Society (1983) takes a more statistical view of 'risk' as the probability "that a particular adverse event occurs during a stated period of time, or results from a particular challenge." The Society continues to state that; "As a probability in the sense of statistical theory risk obeys all the formal laws of combining probabilities" (although Feynman's (1989) account of the Challenger Shuttle disaster shows that this too can be a treacherous area which can generate an illusion regarding hazards). However the main problem with statistical theory is that it is only ever a guess, or an approximation of what is to occur. All that can be done is to express risk as a range of possible outcomes with attached probabilities (Smith 1999). When there are ranges of possible outcomes but no assumed probabilities there is only uncertainty (ibid). Thus to the Royal Society, the distinction between risk and uncertainty lies in the ability to ascribe these probabilities.

THE PROBLEM OF THE CONSTRUCTION PROJECT

The problem with risk management in the context of construction is that the construction project is a complex 'open' system (Williams, 1999, Shirazi *et al* 1996) to which predictive models are not suited (Loosemore 1994). The application of risk management in such a setting concerns events that have yet to transpire which are dependent upon events, which may in turn be unknowable at the time of prediction, because they too are dependent on other events. All assessments are therefore made on the basis of finite knowledge within the setting of a complex system or 'wicked' problem (Rittel and Webber 1973) to which there is no correct or incorrect answer, only good or bad in relation to the subjective point of view of the individual(s) concerned.

Within a complex system, the risk assessment process lies at the non-programmed end of Simon's (1965) two polar types of decision making relying heavily on the intuits skills of the construction professional. The primary reason for this is that in the complex system of the construction project, the principle nature of the wicked problems faced arise from social interaction. As Simon (1965) puts it "an important part of man's environment is man. This is, moreover, an exceedingly "rough" part of his environment. Interacting with his fellow man calls on his greatest flexibility both in sensory activity and response. He must read the nuances of expressions, postures, intonations; he must take into account in numerous ways the individuality of the person opposite him" (Simon 1965:42).

To truly predict a hazard an encompassing holistic view is required of the situation, including that of human behaviour, which will never be totally achievable, even under laboratory conditions. Consequently "risk means uncertainty and the results of uncertainty… risk refers to a lack of predictability about problem structure, outcomes or consequences in a decision or planning situation" Hertz and Thomas (1984) limiting the ability to view risk in a narrow probabilistic perspective.

And yet, by viewing the construction project as a 'technical system', the subjective human behavioural elements are hived off from the abstracted 'process' (and often are labeled as a system in its own right in models of the construction project, Newcombe *et al* 1991) in what seems to be an attempt to divorce the technology form its root concept of *tekn,* or skill. In doing so, the 'technical system' encourages the adoption of the narrow definition of risk in terms of probabilistic outcomes capable of statistical assessment.

A NEW DEFINITION OF RISK

In defining 'hazard' as a situation which could lead to harm (Royal Society 1983), it is the realisation that a situation may induce 'harm' that inspires the recognition of risk in association with the hazard. What needs to be embodied in any revised definition of risk is the philosophy concerned with the understanding of the nature of harm associated with the hazard.

This new definition views risk as the philosophy associated with the identification and assessment of the likely impact of a hazard, it becomes a "systematic way of dealing with hazards" Beck (1986). If it is acknowledged that uncertainty is associated with any prediction of a hazard occurring, then logic dictates that there is only uncertainty because there is only ever a *prediction* of the likely occurrence.

For a risk to exist there must be a *hazard* and the perception of hazard is entirely subjective; what is hazardous to one man may not be perceived to be so by his neighbour. It is the way in which individuals and groups feel threatened by circumstance and in turn the opinion developed by association with the threat or hazard. This perception of hazard is centred around previous experience, cultural values and to some extent the aspect of specialist training in an area or field of expertise that allows hazards to be identified and for credence to be placed upon certain categories of hazard.

Uncertainty

Rarely can one ever state with confidence that they have all the information they require when researching or investigating an element of any system. However, in a closed mechanical system, it is at least theoretically possible. The nature of open, complex systems means that the sum of our data/information is insufficient to allow an absolute description of the system. The resulting uncertainty arising from this incomplete definition/description and can take more than one form.

Rowe (1977) recognizes this is identifying two types of uncertainty:

Descriptive uncertainty - uncertainty relating to that information which is lacking which would allow taxonomic definition of all those elements which constitute the system in question

Measurement uncertainty - uncertainty relating directly to the manner and measure of value of those system variables.

To Rowe (ibid) descriptive uncertainty represents the 'degrees of freedom' of knowledge; a degree of freedom being a 'variable' or the ability of any piece of a dynamical system to move independently (Gleick 1987:135). From that knowledge arises the 'information paradox' (Rowe 1977) which requires that for every degree of freedom acknowledged, a measure is required to value it. Therefore the more that is learnt about a system, the more variables are identified requiring more measures resulting in a greater potential for uncertainty.

In an attempt to reduce the descriptive uncertainty, attempts can be made to learn more about the underlying processes that govern that system; i.e. the sources of information which acts as a basis for the decision making, and the mechanism by which decisions are made. By establishing these governing factors, measurement criteria can be established to lessen the impact of the ‘information paradox’.

The measurement criteria are implicit within descriptive uncertainty but may remain difficult to quantify. For example the system may be the information contained within drawing release for a window. From an understanding of the nature of the system, and the number of degrees of freedom, can be derived the criteria for successful drawing dissemination, i.e. values in content required of the drawing. The potential variables in the window design may be legion, ranging from the minimum compressive strength of the timber to the size and number of fixings, but the criteria may be much more limited to satisfy the system i.e. wood or uPVC, sash or casement, and size of opening.

However the criteria themselves may be difficult to define because they are subjective measures of both the builder and architect. This is strictly a subjective measure on behalf of both the originator and the recipient and so to apply requires agreement by both parties as to what is acceptable demanding as a precondition a common language in communication and an agreed rationality.

To understand what is required of measurement criteria in this sense, the originator, who may think that the drawing contains all the information required in an accessible manner, and the recipient, must be considered to be ‘rational.’ Rational is deemed to define a pattern of behaviour that is both predictable and invariable, (a minimal degree of descriptive uncertainty) within predefined parameters (Rowe, 1977). This is to some extent unachievable as some decisions are based on emotional responses and not a rational assessment of the situation.

The classic example is given by Pugsley (1966) who looked at structural failure and noted that human emotions were "exceptionally sensitive to the fear of structural failure” and differentiating between the presence of a finite risk of failure and the perception of the possibility of failure:

> *"During the last war aircraft designers had the choice, to some extent, of trading off structural safety against other qualities in the aircraft. Now the losses from bomber aircraft by enemy action were very high, something like one out of twenty in each sortie. Against this the losses from structural failures were very few, much less than one aircraft in ten thousand. The structure of an aeroplane accounts for practically a third of its total weight, and it would have been rational to have slimmed the structural parts of the bombers in return for other advantages.*
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> *If this had been done there would have been some small increase in the structural accident rate, but the weight that would have been saved could have been invested in more defensive guns or in thicker protective armour. In that case there would no doubt have been a significant reduction in the net, or overall, casualty rate. But the airmen would not hear of anything of the kind. They preferred the big risk of being shot down by the enemy to the smaller risk of the aircraft breaking up in the air for structural reasons (Pugsley, 1966)”*

Any process or system that relies on interaction with an individual, or group of individuals is subject to another source of uncertainty, the route of which is human behaviour and it’s interaction with the system/process. The most that can be expected is a prediction of the most likely pattern of behaviour of an individual, which can be obtained from experimental observation and as such may be classified as objective (or the product of intersubjective agreement by a number of observers). Alternatively historical information of behavioural patterns derived from in the field observations, which can be deemed subjective on the part of the observer, can be utilized. Both of these methods, once correlated, may assist in the prediction of behaviour and help to minimize the associated descriptive uncertainty.

RISK PERCEPTION

Such an anecdote would seem to give support to a quantitative approach to risk assessment.

Yet Adams (1995) contends that *"Everyone is a true risk 'expert'.."* , the expertise being based upon everyday experiences and the ability to learn from them. The difference between the scientific perception and the non-scientific perception is that the scientist will quantify the risk, relying on scientific analytical paradigms to prescribe the method of interpretation (a programmed assessment process), and the layperson will rely on experience and intuition (non-programmed assessemts).

Both the scientific community and the laity will arrive at their own notion of objectivity regarding the risk. There are similarities in how they will do this using dialogue and comparison with peers, agreeing between themselves an intersubjective account or group consensus of what is 'objective' reality. The result on the construction project is that the objective reality becomes a 'conventional wisdom' (Boyd and Wild 1999).

The lay public is uninterested and unable to identify with the probabilistic quantification of risk. Beck (1986) realises that; " what becomes clear in risk discussions are the fissures and gaps between scientific and social rationality in dealing with the hazardous potential" (ibid). The chances of winning the lottery are renowned to be remarkably low, probabilistically speaking; however millions of people each week still gamble on becoming a millionaire when they would not necessarily gamble at roulette which provides far better odds.

In addition to this there is also the aspect of the cultural influence upon decision-making; "when faced with estimating probability and credibility, they [people] come already primed with culturally learned assumptions and weightings." (Douglas, 1992). Depending upon the social setting in which norms and related experiences have been established, the notions of risk will differ widely from those of others; our experiences help to construct 'filters' through which we view the world.

It has not to date been established by the authors, the extent to which risk perception affects construction projects. However, risk perception on its own arguably forms only one half of the risk behavioural cycle. Taken in conjunction with risk propensity, which is a person's willingness to either take or avoid risks, a more detailed potential impact of individual perceptions may become apparent. If a person is risk averse, i.e. they do not like exposure to hazards then they may not be suitable for a project requiring innovative construction or contractual methods. However a project of such a nature overpopulated with risk takers, may not be all that successful having taken one risk too many.

It is possible to assume that the professionals whom we trust with the tasks of risk management are prone to the same influences that shape a persons 'risk philosophy' as the next man, and just as personal perception guides our daily lives so can it guide our actions whilst at work. The risk management software available is still only as effective as the person utilising the data. The perceptions of the individual inputting the information into the computer will naturally bias that information, not only in its raw state, i.e. what is to be included as, but how the manipulated data, i.e. the level of uncertainty, is to be acted upon.

RISK PHILOSOPHIES

The risk philosophies of an individual can be viewed as the manner by which hazards are identified, personally assessed and then managed by that individual. The components of this risk philosophy are detailed as follows;

Hazard perception - relates to the individuals subjective view of a particular hazard. This perception is constructed socially (Douglas and Wildavsky, 1982) and may occur at a local level, i.e. at home amongst family, friends and work colleagues, by experience, language and culture, and globally, i.e. the evolution of environmental awareness.

Risk Preference - The nature of a person to be either risk-averse, risk neutral or risk seeking can be termed their risk preference. This is dependent upon the individual's perception of hazard and their ability to relate directly to that hazard by experience or education.

Uncertainty Propensity - This is the term used to define an individual's desire to either court or avoid uncertainty.

Risk Compensation - The unconscious effects of risk compensation have been shown to modify the behaviour of individuals in instances such as recreational boating (Mcarthy and Talley, 1999) and by Adams (1995) who found that drivers who wear seatbelts are more likely to drive at an increased speed than they would if driving in the same conditions without a seat belt.

Risk compensation in its simplest form is the theory that all individuals are happy living with a certain level of uncertainty. If the life of an individual is regulated in some way to make it 'safer' or more certain, the behaviour of that individual is modified so that the individual acts to create a corresponding increase in the uncertainty associated with another situation.

Mcarthy and Talley (1999) have identified this type of behaviour in recreational 'sailors'. Those sailors who were experienced, those with 100 hours or more at the helm, were more likely to consume alcohol whilst at sea than those sailors who were not so experienced. The assumption here is that the notion of experience brings with it control over future events, i.e. uncertainty. This can be labeled complacency and is also to be found in the recent incident at the Selafield Nuclear fuel reprocessing plant, as reported on 17th February 2000 by the BBC. Workers at the plant had falsified records appertaining to shipments of recycled nuclear fuel, which has in part been attributed to the tedium of the task due to repetition. These circumstances may arguably have induced complacency on the part of management and staff due to the incident free past of this repetitious process.

This risk compensation exhibiting behaviour has implications for the management of hazards in any circumstance, especially where there is repetition of tasks, or an element of familiarity with circumstance.

IMPLICATION ON RISK ASSESSMENT

It may not be feasible to treat an individual as a system, but it is possible to place them in an environment with which they interact and in turn influence and are influenced by that environment. The effects of both the global and local environments on the individual are manyfold and are to some extent reliant upon the individuals subjective perception of how the environment within which they operate affects them. The individuals may find themselves in another paradox; the environments affect them and in turn their actions affect the environment. This nonlinear iteration has no discernible cause and effect relationship, as it quickly becomes impossible to differentiate between the two effects, on the individual and the environment, as soon as one is introduced to the other. This is in direct opposition to the scientific objective measurement of the reality of the environmental effects, (supposing that there was a value by which this particular descriptive uncertainty could be measured).

In 1960, Edward Lorenz, a meteorologist, proved that long range weather forecasting was impossible by accidentally rounding up the result of an iterative calculation to three decimal places rather than six, producing a totally different weather prediction from that which was expected when reiterated into the calculation. Lorenz showed that unpredictability, uncertainty or chaos (call it what you will), lies dormant within every deterministic, causal model. At some point the cause and effect relationship of the rationalistic paradigm no longer functions and the reductionist perspective can no longer cope. Where there are more than two elements under consideration it fails to predict the nature or manner of the interaction between them; it becomes a complex system.

From this point onwards meteorologists have not relied on the precise prediction of long-range weather forecasting, but have acknowledged the uncertainty associated with such predictions and have accustomed themselves to the unpredictable nature of the weather. The question then is why are such long range forecasts still made? Just as a pilot requires an artificial horizon, man requires a point of reference by which he can steady himself within his environment. Without an 'artificial horizon', sense cannot be made of the world. Whilst globally there is an inability to predict events with useful certainty, locally it is possible to improve on the degree of certainty achievable. However if we were to look beyond our artificial horizons and attempt to explain the interaction and potential impact of elements beyond the horizon we would soon realize that control of our environment is illusory.

The impact of the smallest element, and its' ramifications are amongst the reasons why a true, full understanding of a hazard will never be achievable. Not only are these finite elements not apparent to all, they are open to different interpretation. The weatherman cannot take into account the beating of a butterfly's wings in China when predicting weather behaviour. It is simply inconceivable that we even attempt to consider this minutiae information in risk assessment. The level and detail of information utilised should be adequate for the purpose of identifying the nature of the hazard and its potential impact.

We utilise human experience and knowledge to identify hazards and potential threats, but the need for information regarding the ramifications of the realisation of hazards demands qualitative assessment. To accomplish this complex mathematics are employed such as 'Monte Carlo Simulation' and 'fuzzy set logic' which takes place deep within the bowels of risk management software. It is highly unlikely that anybody concerned with the outcome of this process fully understands what actually takes place within the software, however great the import placed upon such predictions happens to be.

The externalisation of the process by the adoption of quantitative measurement of exposure is more akin to mans need for his artificial horizon than any inherent laziness or McGregor-esque notion of theory 'X'. It is not because we do not trust our colleagues to properly asses the level of exposure qualitatively, rather we are saying that we do not trust ourselves, and it is that notion of lack of self belief that drives us ever forward for the holy grail of certainty, that we hope and believe will be made ours by employing the black arts of complex mathematics.

Those fishermen native to certain far flung isles who regularly undergo rituals such as the blessing of the boat etc, as means of protection against the dangers of the sea and to bring in a good haul of fish, do so not because they do not believe in their own ability, rather they are not aware of their own ability. The fact that they return safely after a trip with a good haul has less to do with their fishing gods and more to do with their ability as fishermen. However the effect of the ritual to reassure the fishermen is probably invaluable. Take away the ritual and you are left with the same skills and abilities as before, but without the confidence to act the results will not be the same. Fishermen who are worrying about the nature of the sea swell are less likely to concentrate upon their fishing as they are upon getting back home safely.

The fact that early Christianity adopted the altar and candles etc of earlier pagan rituals was less to do with their need of such artifacts and trinkets, and rather more to do with the priests recognition of the power of ritual and faith in trinkets and artifacts that the laity held to be true. So is the need for faith in the prediction of risk.

But do not let us forget the Heizenberg effect within all of this. The view differs dependent upon the line of sight adopted. Once we become aware of a hazard we will react towards it and so change the nature of the hazard. If we are aware of the danger of possible injury to our children who have to cross a road congested by busy traffic, we may choose to take an alternative route rather than cross that road. The road will still be congested by busy traffic, but the hazard has been eliminated because there is no longer a threat to our children's safety.

Similarly as we become aware of other hazards and plan to eliminate or mitigate them, so the nature of the hazard changes. But we place more value upon our own qualitative measurement of exposure than the quantitative measurement. The qualitative estimation feels right because it has been generated internally. The quantitative estimation is arrived at by complex means, offering complex solutions to complex problems.

When asked about the nature of exposure/consequence calculation employed in his organisation one senior planner responded with, risk calculation by Monte Carlo Simulation etc, is utilized only to satisfy his bosses that he was doing all he possibly could to mange risk. He himself placed no credence on the results gained from such quantitative analysis, and instead preferred to go with his own 'gut feelings'.

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