

Differentiating between Risk and Uncertainty in the Project Management Literature

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6th July 2016

The purpose of this paper is to review the literature on risk and uncertainty in the management of projects. It considers the variety of definitions of the terms risk and uncertainty and compares and contrasts their characteristics in the context of project management.

Defining Risk

The Oxford English Dictionary defines risk as “*the probability of a negative occurrence*”.

Unsurprisingly, most project management textbooks also contain definitions of project risk. Here is just a small selection taken fairly randomly from the bookcase in my office at The University of Manchester:

"Risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on project objectives. A risk has a cause, and if it occurs, a consequence" (Larson & Gray, 2011, p.211).

"Risk means possible unfavourable outcomes" (Chapman & Ward, 2011,p.3)

"A risk is concerned with unpredictable events that might occur in the future whose exact likelihood and outcome is uncertain but could potentially affect their interests/objectives in some way."(Loosemore, Raftery, Reilly, & Higgon, 2006, p.8)

"Project risk is often defined as the product of the probability of an event's occurrence and the extent of its impact" (Loch, DeMeyer, & Pich, 2006, p.2)

"A risk source is, therefore, an underlying state of affairs; a risk event is an event that can happen given that underlying state of affairs. Conceptually the relationship between the risk source and the risk event is expressed in terms of the probability of its occurrence given the risk source; probability is, therefore, a property of the event and not the source." (Winch, 2010, p.347)

Both main project management professional institutions, the PMI and APM, have also marshalled their experts to draw up definitive statements of project risk. The Guide to the Project Management Body of Knowledge (PMBOK) defines risk as “*an uncertain event or condition that, if it occurs, has a positive or negative effect on a project objective*” (PMI, 2008, p.127). The APM's Project Risk Analysis and Management Guide states that a risk is “*an uncertain event or set of circumstances which, should it occur, will have an effect on achievement of the project's objectives.*” (Association for Project Management, 1997).

Characterising Risk

There are five key characteristics of project risks that consistently appear in both the above listed and many other definitions of risk in the literature:

1. Risks are occurrence or event based

The terms “event” or “occurrence” are central to many of the above definitions of risk (see also Head, 1967 and Perminova, Gustafsson, & Wikström, 2008). Risks are potential events that may unfold or emerge during the course of the project lifecycle. For example, a key supplier may be unable to supply the required quantities of raw materials in a timely manner, or a critical resource on the project team may fall ill. Project risks may be financial, technical, political or organisational; they may be internal or external to the project and they may be expected and anticipated or come out of left field. One typical risk categorisation is shown in Figure 1 but there are many others. However, all risks have a source (an underlying state of affairs) and a subsequent event that may occur as a result of that underlying state of affairs (Winch, 2010).

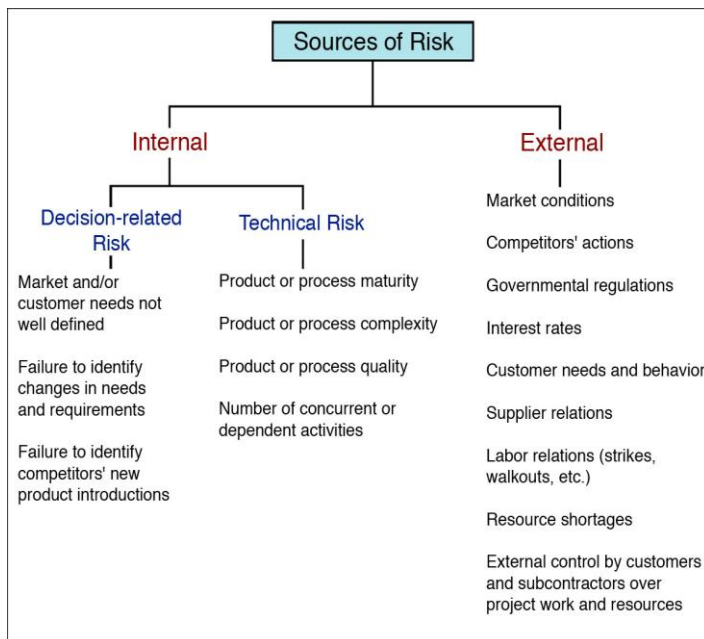


Figure 1: Sources of Risk (Larson and Gray, 2011)

2. Risks are quantifiable; often with estimable probabilities of occurrence

Cleden (2009) states that a risk is an “*expression of a conceivable or quantifiable threat, which endangers the accomplishment of one or more of the project goals*” (Cleden, 2009, p.12). Risks are perceived as being based on hard data, or on experience and analysis from similar past projects (Loosemore et al., 2006). In many, but not all cases, risks can be quantified in terms of their potential impact on a project and the likelihood of their occurrence (Krebs, 2011). Sanderson (2012) is more specific still. He draws on Knight (1921) and Keynes (1937) to argue that risks have either a priori probabilities (objective probabilities akin to the throwing of a dice) or statistical probabilities (based

on empirical information about these events in the past, acknowledging that there is an element of subjective probability in this).

Risks can be mitigated against, in theory at least, acknowledging that it may not always be cost or resource efficient to do so (Cleden, 2009). For example, a project manager may identify that there are a number of possible technical solutions available to resolve an aircraft engine design issue, however sufficient resources are not available to pursue each of these designs in parallel, selecting the optimal design ex-post. Instead, he must proceed with one selected design, after the briefest of feasibility studies, mindful that that the risk remains that his design will require significant rework further along the project timeline.

3. Risks are the consequences of uncertainty

The third characteristic of risk identified in the literature is its relationship with uncertainty. Both Perminova et al. (2008) and Olsson (2007) argue that risks arise as a consequence of uncertainty in projects. Cleden agrees, stating that "*uncertainty is the intangible measure of what we don't know, risk is the statement of what may arise from that lack of knowledge*" (Cleden, 2009, p5), a view shared in turn by Ward & Chapman (2003) and Loch et al. (2006) who contend that underlying uncertainties are the source of all risk. For example, an uncertainty in major infrastructure projects is the financial environment over the lifetime of the project, such as the extent to which interest rates or exchange rates will fluctuate over a possible 25 year concession agreement to operate a specific piece of infrastructure. The risk to the project that flows from this uncertainty is that the project may cost more than intended to build and operate.

4. Risks are socially constructed

Gaba argues that risks are always socially constructed and negotiated and are therefore subjective. He quotes Diane Vaughan writing about the Challenger Shuttle Disaster:

"Risk is not a fixed attribute of some object, but constructed by individuals from past experience and present circumstance and conferred upon the object or situation. Individuals assess risk as they assess everything else—through the filtering lens of individual worldview." (Vaughan cited in Gaba, 2000, p.88).

Chapman & Ward (2011); Morris (2013) and Winch (2010) all support the notion that risk is often subjective. Winch (2010) in particular discusses how different project managers will have different propensities for risk taking, which will influence both the identification and documenting of risks and how they are analysed and mitigated. This underlines the importance of risk identification being a collective, rather than individual process, using techniques such as brainstorming or the Delphi technique to drive out as many risks as possible at the earliest possible stage in the project lifecycle.

5. Risks have an impact on the project if they occur

The final characteristic of risk in the project management literature is that risks, by definition, must have an impact on the project. Hillson articulates this characteristic succinctly here

"Risk can be defined as any uncertainty that, if it occurs, would affect one or more [project] objectives" (Hillson, 2004, p.12). So, new Federal Aviation Authority (FAA) regulatory requirements might slow progress on a civil aerospace development project and thereby be a risk to the project, whereas those same regulatory changes would be irrelevant to a small internal project to redesign the

workplace canteen, and would therefore not constitute a risk to the project. A trivial example maybe, but you get the point.

There are notable differences of opinion in the literature as to whether the impact of a project risk must always be negative, or whether there is such a thing as positive risk. For example Chapman & Ward (2011); Cleden (2009) and Morris (2013) argue that the term risk covers only those potential events with a negative impact on the project. Project risks are therefore threats to the success of the project. In contrast, both the PMI and APM, and a number of scholars (c.f Larson & Gray, 2011; Lehtiranta, 2014; Perminova et al., 2008) take a more expansive view of risks, arguing that the impact of risks can be both positive and negative: positive in the sense of providing new opportunities for the project, and negative in the traditional sense of threatening the delivery of one or more project objectives. Hillson (2002) was one of the earliest proponents of this view, calling for existing risk management processes to be extended to incorporate both downsides risks and upside opportunities that a project may be able to exploit. Hillson makes the further proposal that this new broader risk management process could be renamed ‘uncertainty management’ (Hillson, 2002, 2004), a proposal that has, as yet, gained limited traction amongst practitioners. One explanation for this may be that project managers intuitively understand project risks as negative threats to the project, whereas uncertainty is a more multi-faceted (Saunders, Gale, & Sherry, 2016), and possibly ambiguous concept to grasp. For this reason, we now turn our attention to defining uncertainty and synthesising its key characteristics from the project management literature.

Defining Uncertainty

Definitions of uncertainty are less ubiquitous in the core project management texts. However, one of the founding fathers of modern project management, Professor Peter Morris does discuss the emerging field of ‘uncertainty management’ in his recent text *Reconstructing Project Management*. He states that “*uncertainty really reflects unknowns*” (Morris, 2013, p.192). This view of uncertainty as a state of unknowing, is consistent with the dictionary definition of uncertainty as “*not able to be relied on; not known or definite*” (Oxford English Dictionary). Both Chapman & Ward (2011) and Cleden (2009) echo this conceptualisation of uncertainty in their respective definitions of uncertainty as shown here:

“*Uncertainty is a simple lack of certainty*” (Chapman & Ward, 2011)

Uncertainty is “*the sum of the unknown and unknowable aspects of the project, the consequences of which may threaten the achievement of one or more project goals. It is the intangible measure of what is not known about the project*” (Cleden, 2009, p.121)

Surveying the literature, there are several other important definitions of uncertainty. Some emphasise uncertainty in terms of an absence of information and others deconstruct it into associated terms of variability, ambiguity and lack of clarity. A selection of these definitions is reproduced here:

Uncertainty is “*an individual's perceived inability to predict something accurately*” (Milliken, 1987, p.136)

“*uncertainty is understood in its most basic form as not knowing for sure, due to lack of information or ambiguous information*” (Grote, 2015, p.272)

"the absence of information required for the decision that needs to be taken at a point in time" (Winch, 2010, p. 347)

"Theoretically uncertainty can be defined as a lack of certainty involving variability and/or ambiguity" (Brauers, 1986)

"Uncertainty in the plain English sense of 'lack of certainty' is in part about 'variability' in relation to performance measures like cost, duration, or 'quality'. It is also about 'ambiguity' associated with lack of clarity because of the behaviour of relevant project players, lack of data, lack of detail, lack of structure to consider issues, working and framing assumptions being used to consider the issues, known and unknown sources of bias, and ignorance about how much effort it is worth expending to clarify the situation." (Ward & Chapman, 2003, p.99)

Characterising Uncertainty

There are six characteristics of uncertainty that can be identified from the literature on the management of projects. These are each described in turn.

1. Uncertainty is a state of unknowing

At the core of the concept of uncertainty is a state of unknowing; a lack of certainty over the parameters, the context or the possible outcomes of a particular set of circumstances (Howell, Windahl, & Seidel, 2010). Indeed, Boeschen & Wehling (2004) use the term "nichtwissen" (non-knowledge in English) as an overarching description of uncertainty, standing in contrast to knowledge – that which we know. As argued by Cleden (2009), uncertainty is the intangible measure of what is not known about the project, whether in terms of project scope and content, organisational and technical capabilities to deliver it, the project context or its complexity. Uncertainty encompasses everything that is unknown or uncertain about a project, acknowledging that there is a distinction between those *known unknowns* – areas of known uncertainty, and the more unnerving *unknown unknowns* - areas of uncertainty that we do not know that we do not know – epitomised by Donald Rumsfeld in 2003 but more eloquently explored by Nicholas Nassim Taleb in his book *The Black Swan: The Impact of the Highly Improbably* (Taleb, 2007).

2. Uncertainty is a lack of information

Several authors refer to a lack of or missing information in their definitions of uncertainty – see for instance (Grote, 2015; Meredith & Mantel, 2010; Thiry, 2002). Meredith & Mantel (2010) define uncertainty as "*having only partial information about the situation or outcomes*" (Meredith & Mantel, 2010, p.13). Thiry (2002) also describes uncertainty in the language of data and information, stating that "*uncertainty is defined by the difference between the data required and the data already possessed: it is a lack of information*". This is a very helpful definition as it provides conceptual hooks that the project manager can grasp hold of and manage. Information and data are in some sense tangible. Information can be requested, collated and analysed enabling decisions to be taken and progress towards project objectives to be made. Gaps in information define the project uncertainties in a manner that may be recorded and monitored. Actions may be put in place to seek out the required information, or flexibility and adaptability may be required from the project team to work with remaining uncertainties (Olsson, 2006). This may involve the use of contingencies, additional project

resources or parallel development of a number of solutions before a final decision is made. Many of these information gaps do reduce as the project proceeds; indeed it would be a challenging project where the gaps in information increased as the project progressed.

3. Uncertainty is less susceptible to analysis, involving variability and ambiguity

Whereas risks are quantifiable and probabilities occurrence known or estimable, the same cannot be said for uncertainty. The classic Knightian distinction between risk and uncertainty is that risks have quantifiable probabilities whilst uncertainties do not (Knight, 1921). For Keynes (1937) uncertainties have no scientific basis on which to form any calculable probability. The probability of occurrence is simply not known. Sanderson (2012) preserves this distinction between risk and uncertainty, defining two types of uncertainty. Uncertainty type 1 is equivalent to known unknowns discussed earlier. Here there are a known range of possible future events but no data to assign objective probabilities to each. Type 2 uncertainties are unknown unknowns – situations where the nature and range of future events is unknown, not simply hard to understand because of a lack of relevant data. Cleden argues that *"Uncertainty is much less susceptible to analysis: it is what is left behind when all the risks have been identified. Uncertainty represents a threat, but we cannot be sure what form it takes otherwise we would identify it as a risk"* (Cleden, 2009, p.4). Loosemore et al. (2006) echo his view stating that uncertainty is non-quantifiable and based on subjective probability and informed opinion. Ward & Chapman (2003) further deconstruct uncertainty in projects into its associated variability and ambiguity reflecting the difficulty of quantifying uncertainty within a mass of variables such as project structures, project players, changing customer requirements and unwritten assumptions to name but a few.

4. The consequences of uncertainty are project risks

The fourth characteristic of uncertainty is that of its relationship with risks; a characteristic mirrored in our earlier characterisation of risks. A number of authors articulate a clear relationship between risk and uncertainty; that uncertainty is the source of all risk and that risk is a consequence of uncertainty (Cleden, 2009; Olsson, 2007; Perminova et al., 2008). The following table provides a number of concrete examples of this relationship in the context of project management. The left-hand column of the table lists a series of uncertainties in our project. The right-hand column of the table lists the implications or the consequences of these uncertainties on the project delivery – the risks. These are expressed in terms of impact on the project delivery timescales, scope or budget.

Uncertainty	Risk
We do not know how many engineering resources will be made available to the project?	We may not have sufficient resources to deliver the project to plan
We do not know what changes the industry regulator may require to our proposed product design?	We may need to do significant product redesign, delaying the project delivery
We do not know what the impact of an external industry report into a previous industrial accident on our project may be?	We may need to incorporate new safety features into our project, again delaying the project delivery and increasing project cost
We do not know what the end point of our project is?	We may not be able to deliver on time and to budget if the scope is not clearly defined

Table 1-1: Examples of relationship between uncertainty and risk

5. Uncertainty is a subjective phenomenon

As was the case for risk, uncertainty is a subjective phenomenon. Head asserts that a key meaning of uncertainty comes from the discipline of psychology, where uncertainty is a state of mind; “*a psychological phenomenon existing only within the mind of the person who doubts*” (Head, 1967, p.206). More recent work by Madsen & Pries-Heje (2009); Perminova et al. (2008) and Winch (2010) maintains that uncertainty is a perceptive phenomenon; with different individuals perceiving and attending to uncertainty differently as a result of their personality profile, individual and collective cognitive biases, the specific circumstances of the project and the requirements of different stakeholder groups that have influence over the project.

6. Uncertainty can be positive and negative

Morris argues that the term uncertainty is increasingly used to cover the management of both upside opportunities and downside threats to the projects (Morris, 2013). Several authors (notably Chapman & Ward, 2002, 2011; Cleden, 2009; Hillson, 2004) argue that uncertainty can be both positive in the sense of providing new opportunities that can be exploited and negative in the sense of threats to the organisation. Whilst this is in theory true, anecdotal evidence gleaned from recent discussions with both practitioners and other academics points to a continuing focus on the downsides of uncertainty, with few practitioners and organisations explicitly identifying and following up unexploited opportunities as a result of uncertainty. Rather, practitioners remain overwhelmingly focused on the well-established risk management processes. Proposals for how this might be changed in the specific context of safety-critical projects can be found in a blog post I wrote in 2016 (www.fionasaunders.co.uk/approaches-to-managing-project-uncertainty-in-safety-critical-environments/), and in (Saunders, Gale, & Sherry, 2015; Saunders, Sherry, & Gale, 2016)

A working definition of uncertainty

The number and variety of definitions of both risk and uncertainty in the project management in part reflects the difficulty scholars have in adequately defining these multi-faceted and widely used concepts. Uncertainty encompasses the unknown, the intangible and the immeasurable and can be viewed as the source of all risk. Risks, in contrast, are easier to conceptualise, being measurable, event based and typically underpinned by hard data. I define project uncertainty as being about areas of unknown –related to the content of the project, its industry context and the capability we have to deliver it. Risks are the potential implications and consequences of those areas of unknown on the predictability of project delivery. This is a working definition grounded in practical example that enables us to move forward into investigating how project managers manage uncertainty on in their day-to-day project reality – topics covered in other blog posts at www.fionasaunders.co.uk

Summary and further reading

The aim of this paper was to discuss definitions of two key concepts in the management of projects: that of risk and uncertainty. It has drawn on the extant literature to synthesise a set of characteristics of both risk and uncertainty that should enrich your understanding and reduce your confusion about the similarities and differences between the two terms. For further reading the following books are a good place to start:

1. Chapman, C., & Ward, S. (2011). *How to Manage Project Opportunity and Risk*. Chichester:

John Wiley and Sons Ltd.

2. Cleden, D. (2009). *Managing Project Uncertainty*. Farnham, UK: Gower Publishing Limited.
3. Loosemore, M., Raftery, J., Reilly, C., & Higgon, D. (2006). *Risk Management in Projects* (2nd ed.). Abingdon: Taylor & Francis.

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