MANG6143 Project Risk Management

Performance Uncertainty Management Processes - PUMPs

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1 The PUMP Approach to Uncertainty and Underlying Complexity Management

The phrasing "uncertainty and underlying complexity management" has been specifically selected as the title of this section to contrast with the risk management title of the course as a whole. Traditional views of risk management offer a limited scope and an incomplete picture. Often the focus is event uncertainty reflecting the standard dictionary definition of risk: *a hazard, chance of bad consequences, exposure to mischance* (Stevenson and Waite, 2011). This approach does not address the whole of the uncertainty affecting the project, and in the worst case can lead to failed delivery of project objectives. The Performance Uncertainty Management Process (PUMP) framework encourages departure from the event-centric approach advocated by best practice, to consider all corporate, operational and planning sources of uncertainty. This expanded perspective allows the capture of ambiguity uncertainty, inherent variability, systematic uncertainty, as well as event uncertainty. Utilising the PUMP framework shifts the focus of risk management towards the achievement of opportunity efficiency and risk efficiency, through the vehicle of uncertainty management.

Procedures ensure consistency and quality is maintained throughout repeated applications. A good procedure is designed to be simple, repeatable and transparent. However, this cannot be a uniform approach. Some high complexity, high uncertainty projects require sophisticated, tailored procedures. The PUMP framework supports this concept through PUMP packs; a set of PUMPs tailored to specific projects and project lifecycle stages.

1.1 The Project Lifecycle Context

A traditional four stage view of the asset/change lifecycle is a useful starting point to consider the scope of a project. The four stages are conceptualize, planning, execution and delivery (E&D) and Utilization. As explained, effective uncertainty management requires a macro-view of the entire project to capture the different aspects of uncertainty. This leads to an elaboration of the lifecycle to incorporate 12 stages, each emphasizing a different management purpose. There is discussion as to the usefulness of such high clarity in the lifecycle, however it provokes in-depth consideration of all types of uncertainty (Ward and Chapman, 1995). Both views are shown in figure 1.

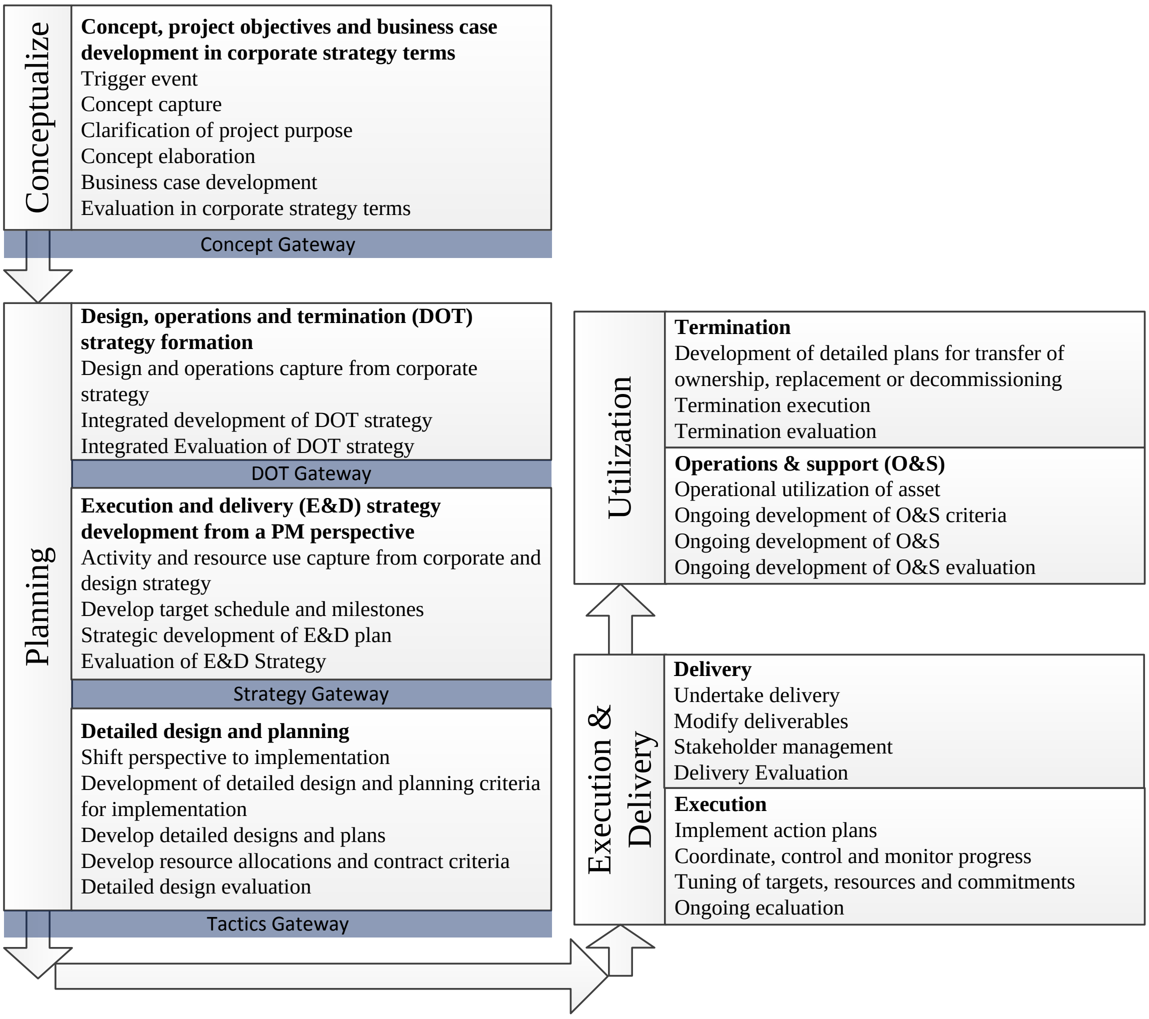


Figure 1: Twelve-stage asset/change lifecycle - adapted from Chapman and Ward (2011)

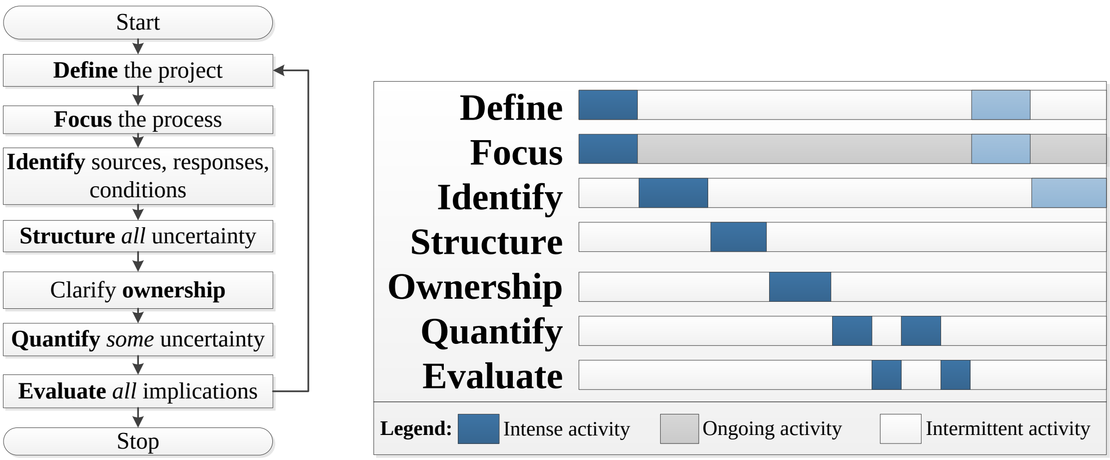
The planning stage of the traditional lifecycle is expanded to three shaping stages and three governance stages. The E&D strategy shaping stage takes a form more familiar in traditional project management. The activity and resource requirements are derived from the corporate strategy and the design, operations and termination (DOT) strategy. This stage considers aspects of the project execution and asks how the asset/change will be delivered? Schedule derivation takes place in the

E&D stage, including the reconciliation of corporate expectation and real-world plausibility. Integrated evaluation is vital to ensuring only viable projects proceed to later more expensive stages of the lifecycle. This paper is concerned with PUMPs tailored to this lifecycle stage.

1.2 PUMP Overview

The PUMP approach was developed through the assimilation of other industrial risk processes, building upon the best practice approaches from project management bodies. The process was developed by Acres International Management Services for BP and first implemented on the Magnus offshore North Sea project in 1976. Chapman (1979) published the process as SCERT (Synergistic Contingency Evaluation and Review Technique) and the technique has since been used in a variety of high profile projects for BP, National Power and the Highways Agency. The process has been refined and assimilated into a complete framework suitable for a variety of clarity requirements.

The PUMP process is a seven stage iterative cycle as shown in figure 1. A linear 'right first time' approach is not a clarity efficient methodology. A version of Pareto's principle, sometimes called the 80:20 rule (Sanders, 1992), empirically states that 20% of the issues causes 80% of the problems. The first iteration of the PUMP is a high level sweep to identify the key areas of concern. Subsequent iterations focus on these issues until a sufficient level of clarity is achieved. This allows the achievement of clarity efficiency, by minimising time spent on unnecessary detail while achieving the required level of understanding.

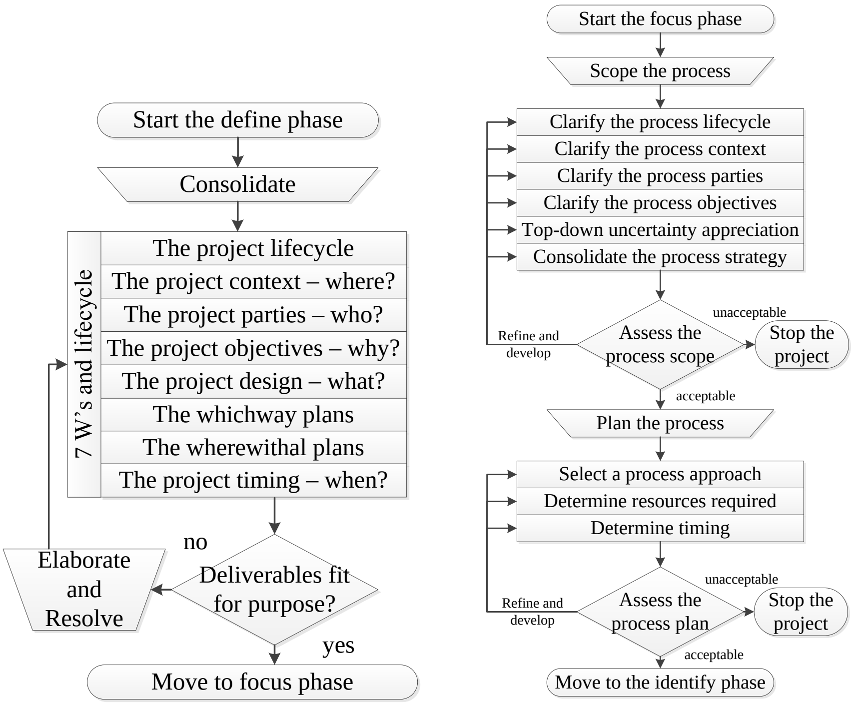


(a) Flowchart Visualisation (b) Gantt Chart Visualisation

Figure 2: The generic PUMP process - adapted from Chapman and Ward (2011)

The initiating phase of the generic PUMP is the **define** phase. This phase defines and develops an understanding of the project as a basis to ask the right questions in subsequent phases. It features high level context capture and approach development at a strategic level. There are two key activities in this phase; consolidate and elaborate as shown in figure 3(a). A useful framework for adequately addressing these issues is the 7W's: where, who, why, what, whichway, wherewithal, when? Using the 7W's to consolidate the existing information, then sub-iterating in order to sufficiently define the project is a useful method to complete this phase. The phase is complete when the project deliverables are fit for purpose.

The **focus** phase involves scoping the level of analysis required during the E&D shaping lifecycle stage. During this phase, the generic PUMP is tailored to the specific requirements of the project at hand as captured from the corporate context. This phase is closely coupled with the define phase. The aim is to achieve clarity efficiency by stating all working assumptions at an early stage. The phase ends when the scope, strategy and plan for the tailored PUMP process is fit for purpose.



(a) Define Phase Process (b) Focus Phase Process

Figure 3: Phase process flowcharts - adapted from Chapman and Ward (2011)

The identification of all sources of uncertainty, relevant response options and conditions is undertaken in the **identify** phase. This phase has key distinguishing features that are vital to achieve clarity efficiency and to understand all relevant uncertainty and underlying complexity. This is considered in detail in section 2.

Following the identification of sources of uncertainty, responses and conditions, an understanding of their relative importance is qualitatively established in the **structure** phase. This phase contributes to the clarity efficient nature of PUMPs, by maximising the effort expended on issues of perceived importance. Responses should also be considered, as early identification of powerful general responses means less effort is required to deal with specific responses. Source-response diagrams, decision tress and influence diagrams are useful tools for this phase. Failure to deal with underlying complexity, assumptions, interdependencies and detail could endanger the success of the project. Seemingly small details missed in the structure phase represent systematic uncertainty that could lead to later threats or missed opportunities. Other key activities are shown in figure 5.

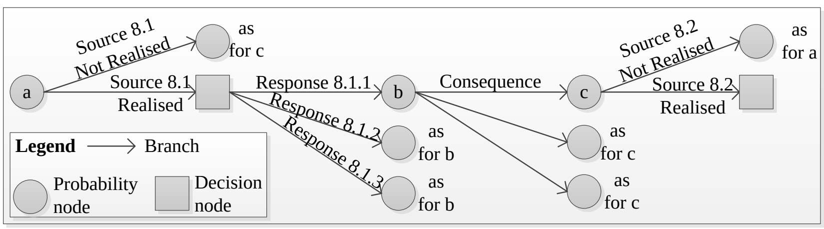


Figure 4: Partial example probability/decision tree - adapted from Chapman (1979)

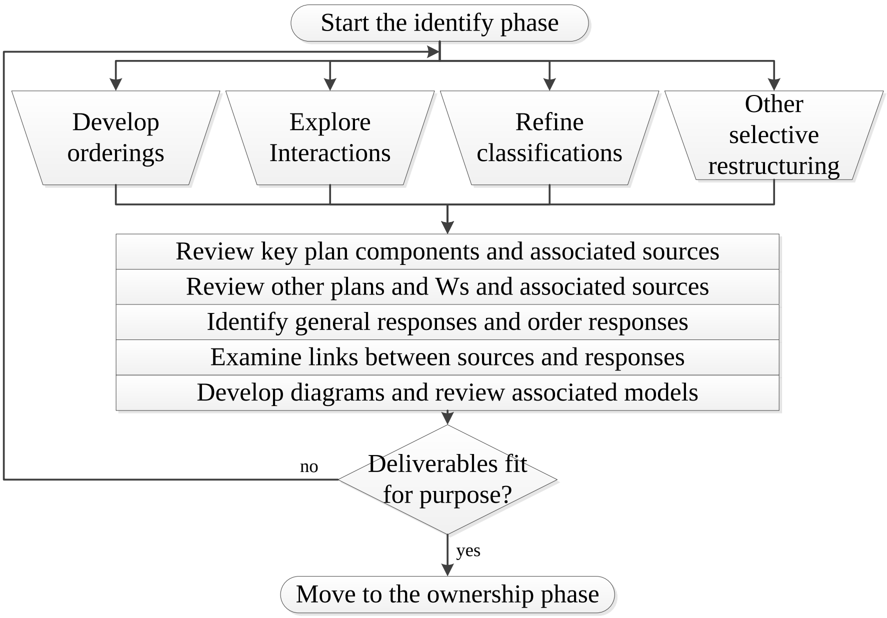


Figure 5: Structure phase process - adapted from Chapman and Ward (2011)

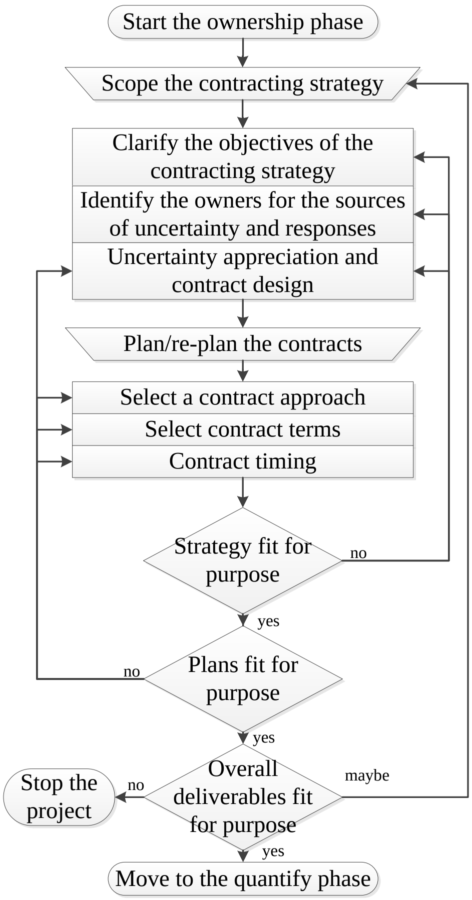
The clarify **ownership** phase allocates financial and managerial responsibility for relevant sources of uncertainty. In reality, all sources are allocated to a party whether explicitly or by default. The key activities of this stage include developing a contracting strategy, distinguishing ownership and allocating responsibility. The aim of the phase is a win-win outcome for all contractual parties, so that client and contractor objectives are aligned.

The key deliverable of the **Quantify** phase is an informed basis for making critical project decisions in the pursuit of opportunity efficiency. Clarity efficiency is achieved by sizing the data on the first iteration and decomposing to subsequent levels of detail where necessary in further iterations. Probability impact grid (PIG) approaches are widespread in industry. PIGs suffer from subjective interpretation of measuring terms (Merkhofer, 1987), a failure to address uncertainty of other than event uncertainty and granular quantisation of sources (Cox, 2008). Where objective data is available, probabilistic density functions should be utilised. It would be foolish to disregard the expertise of experienced personnel; subjective probabilities provide a method of using this information in the absence of objective data. The SRI technique published by Spetzler and Stal Von Holstein (1975) provides a framework for probability elicitation. There are some complexities discussed by Merkhofer (1987), including strategic misrepresentation (Flyvbjerg et al., 2003) and it remains an inexact science.

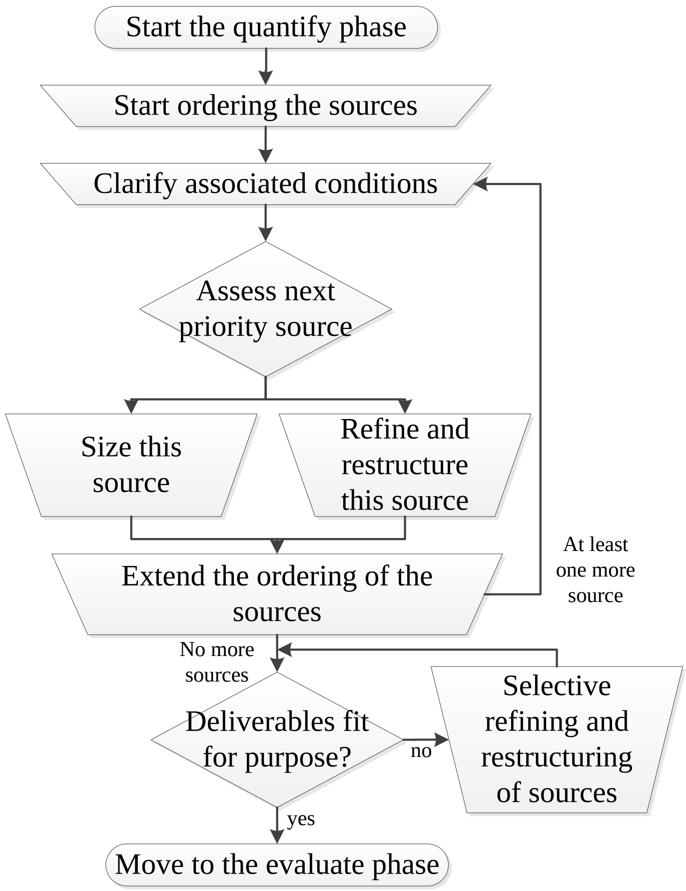
The **evaluate** phase involves synthesizing the results of the quantify phase and assessing the statistical significance of results. This phase is critical to the successful application of the PUMP process, and consolidates much of the understanding of uncertainty. This phase is considered in detail in section 3.

1.3 The Clarity Efficient Approach to Opportunity Efficiency

This section has given a brief overview of a high clarity PUMP for the E&D strategy shaping phase, except for the identify and evaluate phases considered later. Several recurring themes throughout all PUMP phases have been illustrated including the pursuit of clarity efficiency, flexibility and a holistic approach to uncertainty management to achieve opportunity efficiency. The following sections will consider the Identify and Evaluate phases in detail.

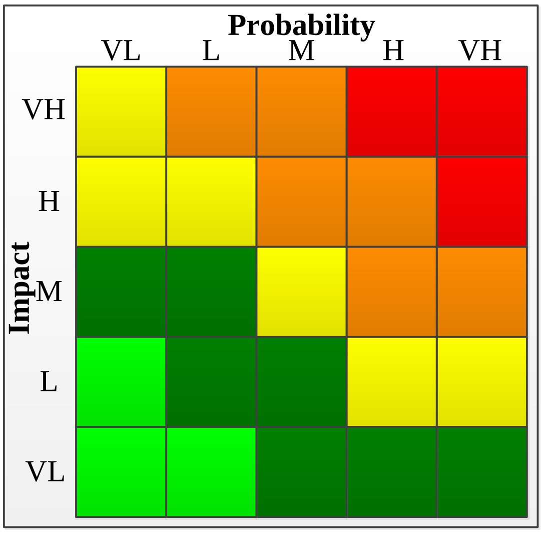


(a) Ownership Phase Process

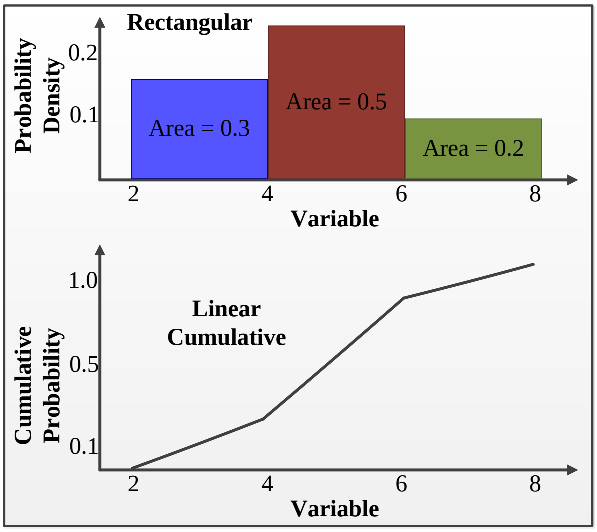


(b) Quantify Phase Process

Figure 6: Phase process flowcharts - adapted from Chapman and Ward (2011)



(a) Example 5x5 Pig Approach - adapted from Cox (2008)



(b) Example Methods of Developing Probability Density Functions - adapted from Chapman and Ward (2011)

Figure 7: Potential approaches to the quantification of data

2 Identify *All* the Relevant Sources of Uncertainty

The identify phase is common through several risk management methodologies, including PUMPs. However, there is a marked removal from common practice in the PUMP approach resulting in an iterative, holistic, inherently creative methodology to identify all relevant sources of uncertainty, possible response options, assumptions, conditions and second-order sources. This encourages the consideration of all types of uncertainty to a relevant degree of detail thus achieving clarity efficiency.

Common practice approaches such as the Project Risk Management (PRM) framework prescribed by the Project Management Institute (PMI, 2013) are linear processes whereby all relevant risk events must be identified at an early stage. The identification of response options is left until later in the linear process and decoupled from the identification of the sources themselves. Assumptions and conditions are also decoupled, since unbiased estimation is not a formal goal of the process. This approach does not optimise clarity efficiency and powerful general responses are often not realised until a much later stage. The complexity relating to secondary sources of uncertainty due to the consequences of response options is not considered. Moreover, a dangerous false sense of security can be created through such approaches where linearity obscures the underlying complexity which may ultimately endanger the achievement of project objectives.

Within the PUMP framework, the identification of sources of uncertainty and possible response options are closely coupled. Considering possible response options as new sources are identified increases the chances of developing powerful general responses that are critical to the delivery of clarity efficiency. Moreover, unidentified responses contribute to ambiguity uncertainty. On some occasions the consequences of the response can lead to secondary sources which may also require consideration. The identify phase allows an enlightened reshaping of relevant base plans and contingency plans as required.

The process has two main features. The **search** task involves finding all relevant sources responses and conditions. The **classify** task provides a suitable structure where sources have been aggregated or decomposed as necessary upon which further analysis can proceed. The process is shown in figure 8. The keyword in the process is ‘relevant’. The skill of the risk practitioner is in seeing where maintaining strategic level composite sources or decomposing to further levels of detail is useful.

The search for relevant response options is addressed in step 2 of figure 8. An informal assessment of each response option is required which is usually easiest when the uncertainty types are viewed as a general composite. The search for possible responses is simple at face value. Following the identification of a source of uncertainty, it is frequently obvious how one would immediately respond. However, a more considered systematic approach may uncover opportunities that are not immediately apparent, particularly for sources that are particularly significant or complex.

The PMI (2013) advocates four generic response types; avoid, transfer, mitigate and accept. Figure 9 shows eleven generic response options that Chapman and Ward (2011) assimilate from literature. The mind-map format indicates that this is by no means a complete list of responses, but a trigger for the consideration of diverse response options. In reality, many responses fall into several categories. The aim of using such tools in this step is to maximise opportunity efficiency through robust early response development and a qualitative understanding of the consequences. This enables important sources of risk inefficiency to be designed out and provides a clarity efficient methodology for capturing opportunities.

For the identify phase to be effective, creativity must be embraced and encouraged. Identification can be undertaken by an individual or by a team of practitioners. The most straightforward approaches are ’pondering’ techniques using a simple blank sheet of paper. While this could prove too simple

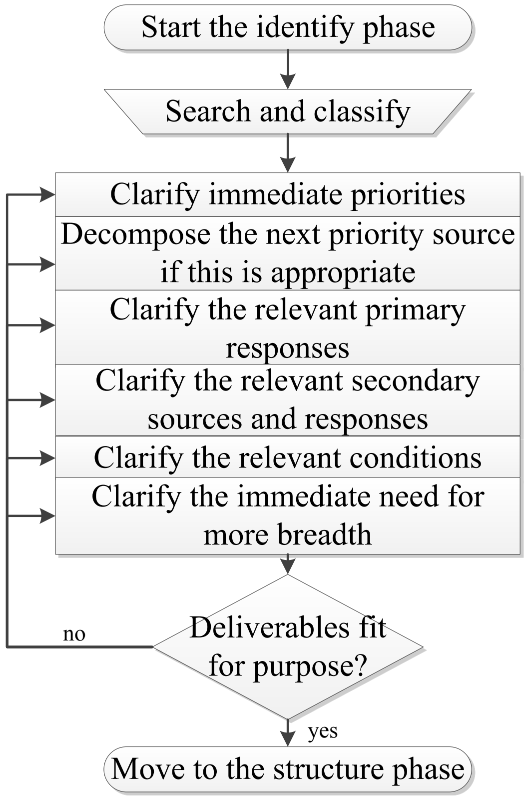


Figure 8: Identify Phase Process - adapted from Chapman and Ward (2011)

and limited for some projects, it should not be dismissed as a starting point. Brainstorming is another familiar technique used to harness creativity. When used with groups with particularly keen understanding of the project at hand, or those with applicable prior experience, brainstorming can provide important responses. Synectics (?) and decision-conferencing techniques (?) are alternative techniques for problem-solving with groups of people. List based approaches could also prove useful as checklists to ensure the creative process has considered viable alternatives before moving on. Encouraging creative solutions and harnessing the relevant experience and expertise in a clarity efficient manor is key to realising powerful general response options and uncovering key opportunities.

Special consideration of the identify phase has been given in this report, since when operating in a high clarity context, identification can require significant effort. However, given an understanding of the process and of the project at hand, it is arguably one of the simplest phases in the PUMP framework. Simplification for lower levels of clarity is possible, providing the balance between clarity efficiency and holistic consideration is maintained. Clarity efficiency remains the key principle. The identify phase must ensure an adequate level of decomposition is performed for important sources, while higher level aggregates are utilised for those less important. The common practice approach offers only a glimpse of the total uncertainty, often missing key opportunities and the underlying complexities of sources identified. The PUMP approach to identification gives the widest possible appreciation of uncertainty as early as practicable in the process, which allows risk efficiency and most importantly opportunity efficiency to be achieved.

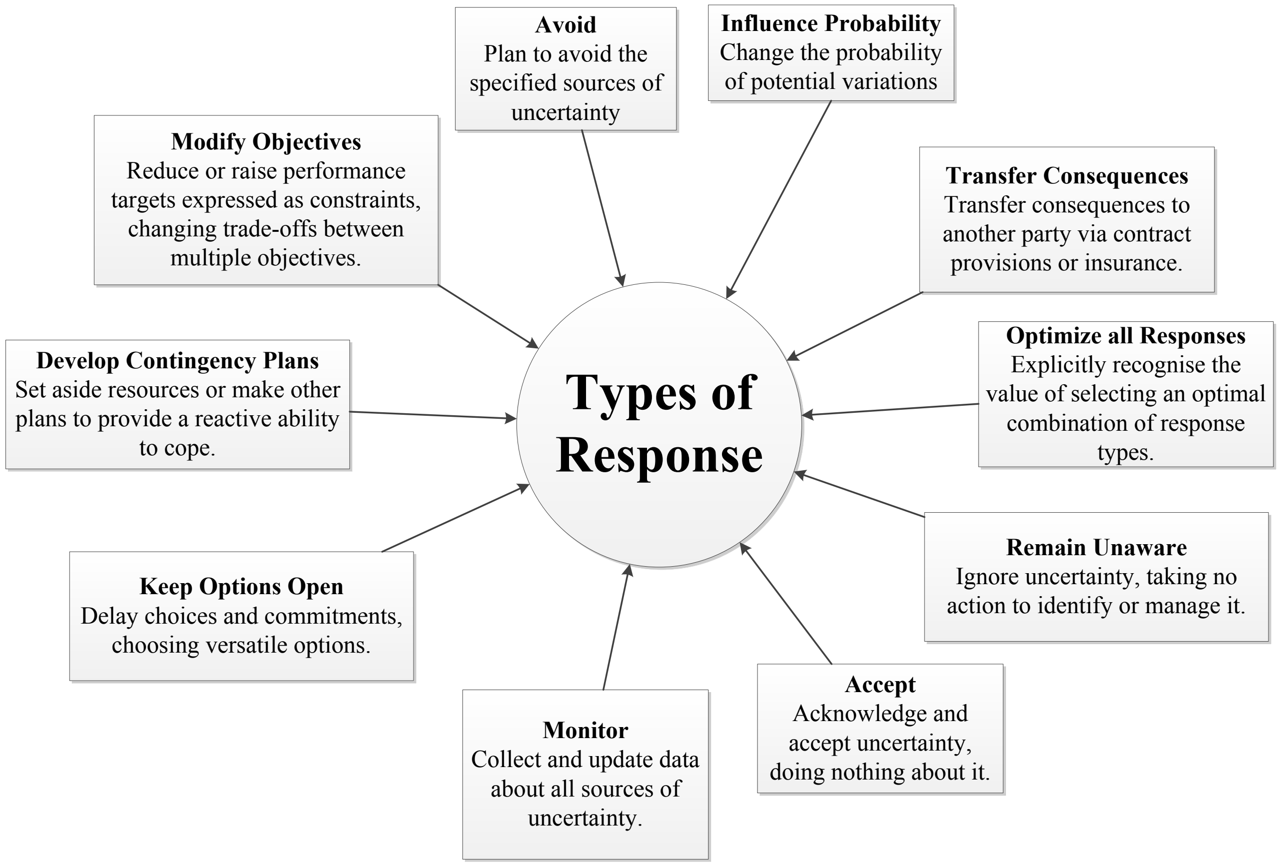


Figure 9: Generic response types - adapted from Chapman and Ward (2011)

3 Evaluate *All* the Relevant Implications

The evaluate phase is the pivotal phase of the PUMP process and plays a critical role in consolidating understanding and controlling PUMP iterations. The phase involves collating all of the insight and results gained during previous phases into a coherent and comprehensive narrative understanding of the uncertainty involved and the response options available in a clarity efficient manner. An intuitive understanding of statistical and causal dependence is required to adequately understand the implications of underlying, often-complex relationships. Following result synthesis, the results must be presented in the most clarity efficient method, usually diagrammatic, to allow interpretation of their practical meaning to ensue.

The phase deliverables may be a simple list of priority sources and responses at early project stages. This may be developed further to diagnose specific issues and suggested revisions to base plans so that specific sources of risk inefficiency are avoided, and to ensure opportunities are captured. There are five 'modes' of operation of the phase, shown in figure 10.

Specifying dependence is an important mode of the phase. To simplify the approach, many practioners following common practice may assume independence between sources. This is an extremely dangerous tendency, and any formal analysis based on this assumption on a non-evidential basis should be immediately discounted. Falsely assuming independence paints an optimistic picture by ignoring the knock-on effects of ignored underlying complexity. This can be compounded by computational tools aiming to make calculations easier, and by a managerial preference for limited variability. Positive dependence is a more reasonable assumption, making a more conservative robust assessment of the

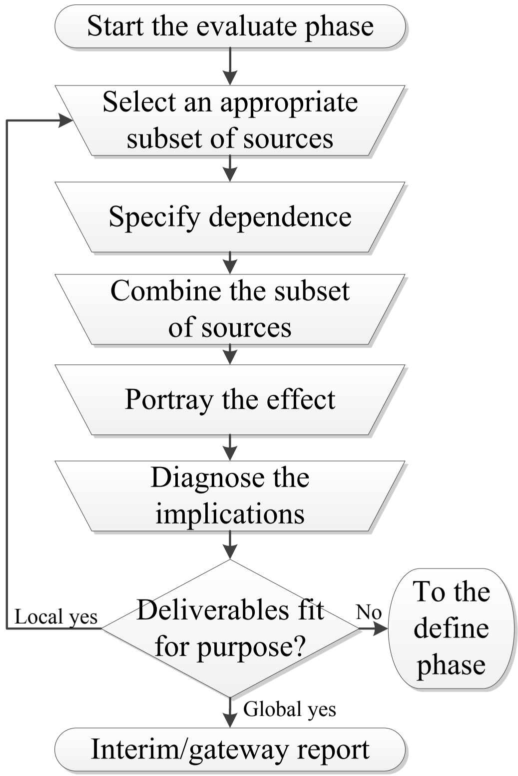


Figure 10: Evaluate Phase Process - adapted from Chapman and Ward (2011)

impacts. In high-clarity contexts, complex statistical and causal dependencies may require more sophisticated modelling approaches to adequately understand the full implications. The dangers of false underestimation of the impacts is shown in the contrast between independent and positive correlation in figure **??**.

Positive Dependence Figure Here

Another key mode of the phase is the presentation of results. The story that has been developed throughout the analysis must be conveyed in the most clarity efficient manner to be of any practical value to the project organisation. Sensitivity diagrams are an important tool for conveying and explaining uncertainty. The common phrase “a picture is worth a thousand words” is relevant here. A sensitivity diagram gives the audience the required information in a non-threatening easy-to-grasp format so that intepretation can take place and issues raised can be resolved.

The sensitivity diagram shown in figure **??** shows the collation of NUMBER sources associated with Geotechnical Investigations in preparation for the construction of a power station. The gap between each curve portrays the effect of the labelled source, so that NUMBER is clearly the most important in this case. The ordering of the sources are important, so that causal and statistical dependence is portrayed.

Sensitivity diagram 11.5 shown Chapman & APM

It may be useful to expand a sensitivity diagram where schedules are concerned. Uncertainty can be decomposed through a number of project milestones and contracting activities. This can be displayed alongside a Gantt chart to portray the schedule implications to the reader.

Diagram and explanation about gantt sensitivity

There are also other types of sensitivity diagram which may be useful for presenting uncertainty when there are several different parameters involved. One of these is the tornado diagram

Tornado!!!

sensitivity in diagnosis?

conclusions!

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