# A Risk Breakdown Structure for Public Sector Construction Projects

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## Abstract

This research is part of a wider project (ProRIde) focusing on the risk identification stage of the risk management process. The specific remit of the study is to analyse the text of National Audit Office (NAO) reports to identify recurring risk sources on public sector construction projects. A textual analysis software, QSR N6, is used to code the data. The risk source information in organised and presented in a Risk Breakdown Structure (RBS), a hierarchical presentation of risk sources.

The output of this study represents a contribution to knowledge in that it is empirically derived – many risk identification support tools are compiled on an ad-hoc basis through brainstorming or personal experience. This research takes advantage of a rich existing database and employs a systematic methodology to develop an RBS that is specific to the context of public sector construction projects.

**Keywords:** Public sector procurement, construction, risk identification, risk breakdown structures, QSR N6

# 1. Introduction

## 1.1 Overview of the ProRIde project

ProRIde (**Pro**ject **R**isk **Ide**ntification) is an EPSRC-funded project (GR/R51452) concerned specifically with the risk identification phase of the risk management process (see Figure 1). Concurrent studies within the ProRIde project examine risk identification by individual project managers [1] and work is starting on group dynamics.

Comprehensive risk identification is central to the relevance and effectiveness of the subsequent risk management process [2] - unidentified risk sources remain as unknown and unmanaged threats to the project objectives.

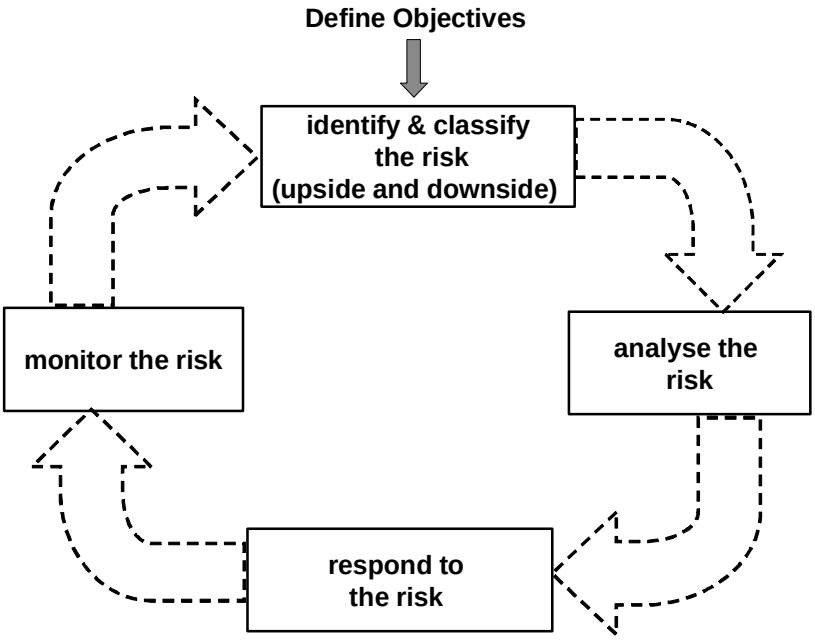


*Figure 1: The ProRIde risk management process. After Winch 2002, p.322*

Yet the identification stage is relatively neglected in risk management research [3]. There is much emphasis on the risk response stage of the process, with less attention paid to the initial identification and assessment sub-stages. Tah [4] observes that the risk identification stage is omitted from most risk management tools e.g. Monte Carlo simulation and sensitivity analysis, which only operationalise the assessment and analysis phases of the risk management model. Risk identification is assumed to be performed external to, and prior to, the implementation of most risk management techniques.

In the terms of the basic risk management model above, the aim of this study is to produce guidance for the identification phase based on a review of previous projects (the input arrow), leading to improved risk identification performance (the output arrow). High quality risk identification output provides a more accurate basis for subsequent stages of the risk management process.

The ProRIde scoping study [5] identified 'important common causes of concern' in the NAO reports on construction projects. The authors proposed the generation of:

'A feedback loop which offers all parties involved in the management of large, expensive, and complex projects the opportunity to improve efficiency and effectiveness'.

To create this feedback loop, this study takes the individual VFM reports to the next level of analysis. The text of the reports is combined in a knowledge base and reviewed for recurring themes. High-level lessons for risk identification specific to public sector construction projects can be drawn on the basis of multiple projects.

It is important to feed individual project learning in a wider framework so that we develop a systemic approach to risk identification. Ayas and Zenuik [6] note that despite the widespread and successful adaption of project-working, success is usually assessed in terms of a single project or organisation.

Using the past as a guide to future action has obvious limitations. No matter how many project reports are included in review, the final risk breakdown structure can never be considered comprehensive – unpredictable risks will always occur. But while we remain cognisant of this inherent uncertainty, it is important that we take advantage of the information that is available to us. This study takes a pragmatic perspective - reviews allow us to capture a certain amount of useful information and use it as a reference point to improve risk identification on future projects.

## 2. Risk Identification in the Public Sector

The high rate of failure on public sector projects in terms of time, cost and performance criteria suggests that a review of the Government's current risk management practice is due [7].

Risk identification for large-scale public sector projects is exceptional in terms of its scope and complexity. For example, in a multi-organisational context, as is the case for most government construction projects, it is important to identify systemic risks i.e. 'risk affecting a whole industry or service, as distinct from risks to the position of any individual organisation' [8]. The Office of Government Commerce (OGC) advise organisations to be aware of the risk management approaches adopted by their partners [9]. But NAO findings reveal that only 13% of departmental staff are aware of the risk management systems of other departments or their partner organisations in the private sector [10].

Government priorities also extend the range of risks to be identified. An obligation to secure public value and guarantee service provision means that risks posed by a wide range of external stakeholders and environmental conditions must be considered.

The potential for improving risk identification through project-based learning is limited by the movement of personnel on most public sector projects. Ideally staff would review project performance and record lessons learned centrally. But project personnel are often inaccessible after the event. Baldry [11] acknowledges that the usual method of accumulating past project experience and extrapolating to identify likely risks on future projects is not so straightforward on government projects. Concerted efforts are required to collate historical data due to 'the erosion of large directly employed, professional employee groupings within the public sector organisations' so that experience becomes 'distributed, transferred out or fragmented' (p.38).

## 2.1 Risk Identification Performance

A survey of risk management performance by the NAO [12] gives some indication of the Government's current proficiency in risk identification. The report highlighted the following areas of concern:

1. Responsibility for risk identification is generally allocated to board level – senior management are responsible for risk identification in three quarters of departments. Only 42% of departments report that other staff are responsible for identifying risks. A dedicated risk manager operates in only 13% of departments (p.57).

2. Departments report using a range of risk identification and risk assessment techniques, including a formal register for recording identified risks and self-assessment questionnaires for staff to record relevant risks. However, only 19% of departments are convinced of the effectiveness of these methods (p.62).

3. Fifty-six per cent of departments report that they identify the main risks relating to their key objectives. Focus group participants reported that 'objective setting and risk identification are treated as two separate processes and these are not routinely linked' (p.55). The NAO recommends that clarifying key objectives in terms of outputs and services facilitates the process of risk identification - departments can 'work back', identifying the risks that pertain to the achievement of these objectives.

4. The NAO warn against 'risk identification overload' – whereby every conceivable risk is recorded regardless of its potential probability or impact. NAO consultation with the private sector indicates that departments should focus on the top 10-15 key risks and opportunities – 'any more than this and management effort can become too diffuse across a large number of less strategically important risks' (p. 87).

5. The internal focus of most risk identification is evidenced by the three most frequently identified risks - financial risk (91%), project risk in terms of time, cost and specification (89%), and compliance risk in terms of failure to comply with regulations (85%). The NAO note the emphasis on departmental inputs and activity - there is less recognition of risk as a threat to outputs and services. The list also illustrates a relative neglect of the importance of external factors e.g. risks relating to external stakeholders.

This corresponds with the assessment of the Strategy Unit [13]. They note that the identification of financial and operational risk sources is relatively advanced on public sector projects. By comparison, the 'systematic assessment of policy risks is much less apparent' (p.46). This pattern of development is reflected in risk management generally – the area of audit / finance risk is most mature, followed by health and safety risk, operational and project risks and finally strategic risk. In relation to strategic level risk, the Strategy Unit states that 'systems still need to be developed that replicate the accountability and responsibility frameworks that exist for financial management' (p.46).

Despite the deficiencies in performance, a review of the available public sector guidance would suggest that Government is at the forefront of risk management – in theory. For example, the Strategy Unit describes the use of progressive risk identification techniques such as futures workshops and horizon scanning by government departments. Another example is the introduction of Risk Maturity Models to measure developments in risk management performance [14]. Also, considerable resources are allocated by Government to research and guidance documents for risk management. But the NAO results suggest that the practice of risk management lags behind the theory. The guidance is in place but it is not consistently implemented.

One reason for this may be a perceived gap between the available models and the conditions of the project in hand. Considerable work may be required to translate the generic guidance so that it is appropriate for individual projects. As such, an objective of this study is to produce a risk breakdown structure that is directly relevant and applicable to the circumstances and events of public sector construction projects.

# 3. The Current Study

## 3.1 Data – National Audit Office Value for Money Reports

The NAO is the external auditor for central government departments and all government agencies in the United Kingdom. The Comptroller and Auditor General has the power to report to Parliament at his / her own discretion on how government bodies have used public funds. The NAO presents approximately fifty Value For Money (VFM) reports on government procurement projects to Parliament each year.

The purpose of an NAO investigation and report is two-fold. Firstly, there is the traditional audit function - monitoring departmental spending. Secondly, the NAO has developed a more proactive function - that of adding value to government projects and thereby improving the quality of public service provision. The VFM reports combine both objectives – scrutinising performance against targets while also making recommendations for beneficial change on future projects.

The reports vary in scope, from examination of specific projects to comprehensive surveys of issues and practices across the whole of government procurement. They are primarily concerned with the performance of projects in relation to the time, cost and quality criteria. Reports generally conclude with recommendations for improved practice.

The series of VFM reports constitutes a valuable dataset that has been relatively unexploited to date. This research aims to take advantage of the detailed analysis and unique insights into the operation of complex projects that are available in the reports.

Reports that chart the entire project life cycle of a construction project are included in this study, a total of twenty-five project case histories. To assist the research effort, the NAO supplied

electronic versions of all the earlier VFM reports that are not available online. A study of construction projects was perceived to be particularly worthwhile because although the NAO produce an annual report on the performance of major defence projects, there is no equivalent collation of information for construction projects. This is because no single Government department has responsibility for the construction procurement. As such there is no central structure or process for accumulating lessons learned and producing guidance for future construction projects.

Both conventionally procured projects and PFI projects have been included in the dataset. They have been treated similarly in the analysis on the basis that many of the risks to successful project management are generic, regardless of how the project is procured. However, it is anticipated that there will be some variety in the types of risk sources that pertain in each case. When the analysis is complete it will be possible to split the dataset according to procurements strategy to identify idiosyncratic risk sources.

## 3.2 Methodology – Textual Analysis

This is exploratory research. The aim is to produce a full account of the range and type of risk sources that occur on construction projects, rather than their frequency or impact. A qualitative research method is most appropriate to this objective.

QSR N6 is a textual analysis software, based on a code and retrieve facility. Units of text that are perceived to be connected are coded together into two different types of nodes (see the coding framework in Figure 2 below). **Free** nodes contain text units relating to independent, stand-alone issues. **Tree** nodes contain categories that are related in hierarchies. These nodes make up the coding framework for the project. The option to recode and rearrange hierarchies allows the researcher to change the coding framework as new risk sources emerge and merge. The retrieval function has several aspects. A text search retrieves text from the original document or from selected nodes based on keywords. Various 'Boolean', 'proximity' and other searches permit more complicated retrievals.

For the current research, the value of the software lies in the discipline that it affords the analytic activity of the researcher. In line with Lewins' [15] recommendation - 'it is important to know and to understand your methodological standpoint first, and then to bring a methodology to the software, rather than see the software as being the architect of your method' (p.303). In this study, the software is used as a tool to support a qualitative analysis, guided by an *a priori* organising framework – the risk breakdown structure.

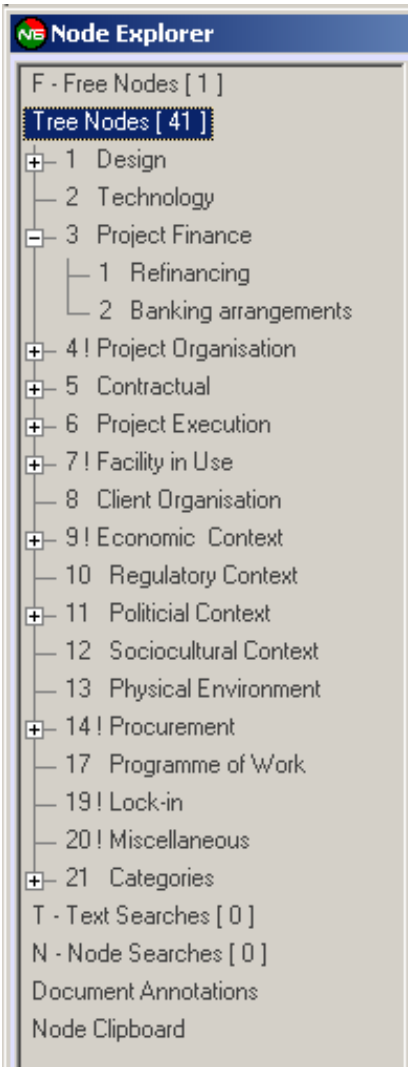


*Figure 2: Coding framework in QSR N6*

## 3.3 Organising Framework - Risk Breakdown Structures

An RBS is a framework for organising risk source data. Hillson [16] proposes the following definition:

'*A source-oriented grouping of risks that organises and defines the total risk exposure of the project or business. Each descending level represents an increasingly detailed definition of sources of risk*' (p.2).

Hillson offers a compelling account of the RBS as a means of presenting risk information to aid comprehension and guide the risk management process. It offers a more sophisticated presentation of risk information than the long lists that characterise checklists and risk registers. Checklists are one-dimensional – they do not offer insight into the structure of risk for the overall project. Neither does a list does not represent patterns of risk exposure or highlight areas that require special risk management attention.

An RBS was selected as a suitable organising framework for the current analysis. It provides a structure for the process of extracting and coding risk source information from the reports. An RBS also offers a practical solution for the management and presentation of the numerous risk source categories. An unwieldy list of risk sources can be re-organised and presented more efficiently within a hierarchical framework. There is the further advantage that the RBS and the QSR N6 coding framework share a hierarchical structure. This correspondence facilitates continuity between the data as it appears in the QSR N6 knowledge base and its summary presentation in the RBS format.

Having reviewed the literature, this researcher concluded that no existing RBS was directly relevant to the selected project reports. Therefore, it was decided to take advantage of all the risk breakdown structures generated to date by developing an synthetic RBS based on the range and frequency of existing RBS categories. The method allows the researcher to review, use and synthesise existing results in the research area. Thomas, Kalidindi et al. [17] used a similar technique, to develop an initial list of the primary risk sources on large infrastructure projects in India.

The risk source categories at the various levels of the available risk breakdown structures were collected in an Excel spreadsheet. Similar risk sources were grouped in the same column – this allocation was made when items were considered to describe similar risk areas even if they used different terminology. Some items were re-arranged and column titles were developed during a brainstorm session involving the researcher and supervisor. The resulting synthesis RBS was used as the basis of the coding framework in QSR N6.

## 3.4 Research Process – Iterative Cycles

A fundamental objective of this study is that the output should be empirically derived, in this case based on a rigorous analysis of the data in NAO reports. Many of the existing tools to support risk identification (checklists, registers and risk breakdown structures) do not have an empirical research basis, but tend to be the product of brainstorming or personal experience.

The research process proceeds in iterative cycles. Five reports are coded and reviewed in each cycle (see Figure 3).

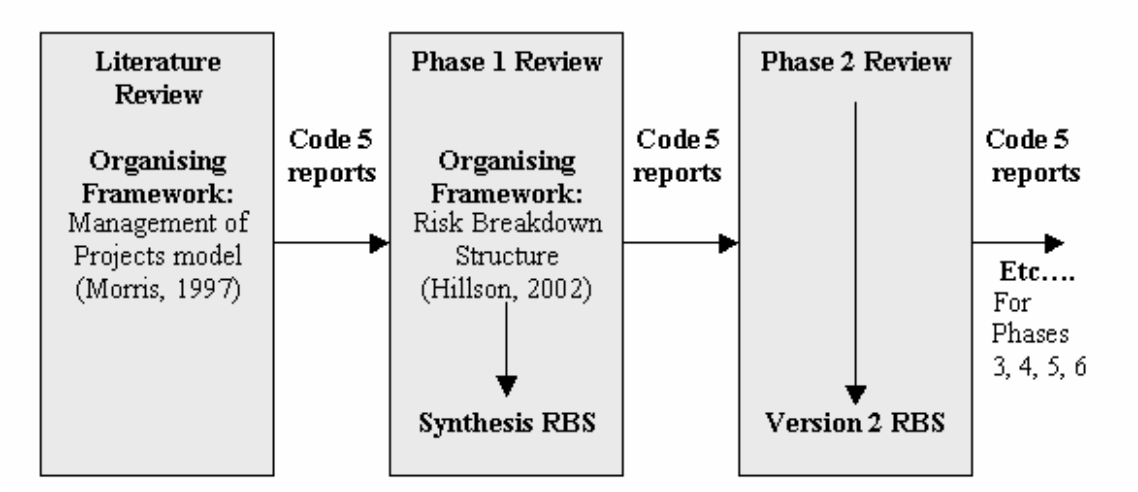


*Figure 3. Model of cyclical research process*

During the coding stage, the researcher goes through each report, text unit by text unit i.e. sentence by sentence. Text units that are considered to fit with existing nodes in the coding framework are coded into those nodes. Text units that do not fit into any of the existing node categories are temporarily stored in a 'miscellaneous' node.

During the review stage, emerging themes are identified, leading to either the sub-division of the existing node or the creation of new nodes. By this process the coding framework is amended and extended to accommodate those risk sources that are particular to public-sector construction projects. The developing RBS has been presented to NAO staff for feedback at regular intervals.

The cyclical review system also functions as an audit trail – developments in the risk breakdown structure and its underlying knowledge base in QSR N6 are recorded at each review stage.

The final version of the coding framework in QSR N6 equates to the output RBS.

# 4. Results to Date

## 4.1 Commentary on Version 5 RBS

To date, twenty NAO reports have been coded and reviewed. One more coding cycle (i.e. five more reports) is planned before the final version of the RBS is complete. This should be available for presentation at the conference in June. In the absence of final results, this section offers a commentary on the progress of the analysis to date.

The latest version of the RBS, Version 5, has developed significantly from the initial synthesis RBS. It contains 231 nodes compared to the fifteen nodes in the original RBS. The hierarchical structure now extends to six levels. In some cases, the nodes contain very few text units. These may be amalgamated with other nodes or removed altogether in the final analysis.

Alternatively, the new nodes may be supported by the next phase of coding, or through the further re-arrangement of text units in the final review phase.

It was anticipated at the outset that the developing RBS would become increasingly sector specific, that is, that the lower levels would refer to the construction context in detail. So far, this is not the case. In a feedback meeting [18], NAO employees agreed that the risk source categories of the Version 4 RBS were sufficiently generic to be applied to projects in most sectors. However, some of the novel risk source categories are specific to the public sector context, such as 'responsibility to the taxpayer' and 'civil estate'.

A cursory examination of the size of the hierarchies attached to the risk sources provides an early indication of risk-critical areas – the 'design', 'procurement', 'project organisation' and 'project finance' nodes are characterised by extensive hierarchies. By contrast, the 'external' risk sources are relatively clear-cut – the hierarchies for 'economic context', 'political context', 'regulatory context', 'socio-cultural context', 'physical environment' and 'programme context' do not extend beyond Level 3 of the RBS. This suggests that factors within the control of the project organisation pose the greatest risk to the completion of construction projects, although this pattern may also be a function of the focus of the NAO investigation. However, the result does correspond with research on the determinants of project success at NASA [19] in which the authors found that external factors, such as legal-political difficulties, are not necessarily 'fatal' obstacles to project success if they are mitigated through effective management of more controllable factors. But the internal factors are more significant - a poorly managed project is most unlikely to be successful. To a large extent the project's capability to deal with the external forces is determined by the quality and effectiveness of the organisational structure, the contract strategy and the financing arrangements, suggesting that it is not the external event that is decisive, but rather how it is managed.

## 4.2 Evaluation against Research Objectives

The research is on target to meet its objectives:

The analysis is providing a detailed breakdown of the risk sources that occur on large-scale infrastructure projects. Several of the risk sources represent a contribution to knowledge in that they are specific to a public sector context, and have not appeared in previous risk source taxonomies.

The RBS is empirically derived. A sound methodology of iterative cycles has been utilised so that coding is checked and re-checked in the light of emerging themes in the RBS. The method also creates an auditable trail of the evolving versions of the RBS.

The research has harnessed the rigour and discipline afforded by the data management functions of the textual analysis software.

The analysis is retaining the rich qualitative data. Data is stored at several levels of detail - the RBS is a summary of the text units stored in each node (the knowledge base). The original NAO data in each node is available by accessing the relevant node.

Feedback from staff at the NAO indicates that the final version RBS should have potential for further development as a practical risk identification tool. Indeed, it may be useful within the NAO as there is currently no generic risk register available to guide VFM investigations - the issues to be investigated by the NAO are chosen on a project-by-project basis. A comprehensive account of the risk sources encountered on previous projects would facilitate issue identification and provide a context for analysis.

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