RISK MANAGEMENT TOOLS AND TECHNIQUES USED WHEN ESTIMATING INITIAL BUDGETS FOR BUILDING PROJECTS

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This paper presents the results of a survey of 125 professional quantity surveying practices in the UK. The survey focuses on the use of risk management tools and techniques used when estimating initial budgets for building construction projects. Risk management is introduced and the research methodology is discussed, including reference to key publications. The results of the survey show that the awareness and use of most "academic" tools and techniques is low, and the performance of most methods used is perceived as mainly "fair" to "good" - with the exception of only a small proportion of responses. It is recommended that further research is needed to evaluate the potential use of the relatively unknown risk management tools and techniques, and it is argued that excellence should be achieved in performance of client budget risk management methods used by quantity surveyors.

Keywords: Budgets, buildings, quantity surveyors, risk.

INTRODUCTION

All too frequently professional journals report on building projects which finish late, are over budget, or which do not meet specification. Three years ago Flanagan & Norman (1993) and Raftery (1994) published leading books on "risk management". This inspired the School of Construction at Sheffield Hallam University to investigate the field of risk management further and to survey the impact of these publications on the building industry.

In essence, risk management is concerned with three stages - identifying risk, analysing risk, and responding to risk. Identification comes first and may be achieved by, for example, "brainstorming" and using checklists. This can then enable the main risks to be ranked, with the source, event, and effect of the risks being considered. Next the analysis stage defines if the identified risks are controllable or uncontrollable - but the key task here is quantification. By its very nature risk is concerned with uncertainties so it is not always easy to be objective with this quantification task, so techniques such a "subjective probability" may have to be used to produce numerical measures of risk. Here it may also be appropriate to ask "what-if" questions and then, rather than just producing a single point estimates of the outcome, produce a range of figures, e.g. worst case, best case and most likely case. The final stage of the risk management process is the response to the risks analysed, this may take the form of retaining the risk, transfering it to someone else, investigating further to reduce it, or attempting to remove it completely. The outcome of this total process may be a database of project specific risks, which may then be used as a management action

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plan to monitor and control the uncertainty inherent, and minimise the exposure to risk.

This is just an initial introduction to risk management, it is beyond the scope of this paper to explain the different views and systems available.

RESEARCH METHODOLOGY

Initially a review of literature was carried out in the domain, together with attendance at relevant conferences. The conclusions from these were that risk in building is a very broad field, relevant to every person and each process of building construction, and also that the published literature at the time, although a useful starting point, was rather general and non- specific.

In an attempt to narrow the focus of the research a range of key industry personnel were identified for initial discussion, interview, and questionnaires. A sample size of around fifty building professionals included clients, developers, project managers, engineers, contractors, quantity surveyors and architects. Each was questioned on risk in building construction, covering subjects such as procurement, types of construction work, types of building, building elements, and also there about awareness and use of risk management tools and techniques.

The results of this initial survey were considered together with the literature review and brain-storming sessions were used to decide on a narrow focus for further investigation. What was clear at this stage was that risk management was still a "grey" subject to most, and thus the research could have taken one of many possible directions. After much deliberation it was decided to focus on the risk in budget estimates for building projects, and hence the work of the professional quantity surveyors. This topic was considered to be a problem area in industry, proven by some major project cost overruns, a few prominent examples being the British Library, Guys Hospital Extension, and Trident Works.

It is in the early stages of a building project that critical decisions are made. Brandon (1990) said that the new orthodoxy is to accept risk and uncertainty and to use and develop techniques which take it into account. Raftery (1991) stated:

"Given a set of drawings, a cost consultant or quantity surveyor is able to predict tender price with an acceptable degree of uncertainty. The most difficult areas of modelling are, from the point of view of the design team, the forecasting of building price before drawings are produced, and from the point of view of building contractors, the evaluation, in today's turbulent building environment, of financial and construction risks on projects".

Crosher & James (1994), a large sized London firm of quantity surveyors, surveyed clients and found that clients believe they would get a more effective service with risk analysis than with traditional cost control methods. Several respondents said that quantity surveyors should be more pro-active and requested that "the consultant draws his attention to areas of doubt, risk, at the earliest possible date". Another survey by academics, Fortune & Lees (1994), confirmed that only a minority of professional quantity surveyors use risk management techniques. The results also revealed there were some "unidentified" risk analysis methods, which indicated the need for further investigations.

The trend appeared to be continuing, and in a poll by Barrick (1995) it was found that nearly a third of construction clients said their projects finished late or over budget,

with one in six saying costs often exceed the budget by 20%. A Treasury Report (1995) also revealed that on 803 construction schemes in 1993-94 more than a quarter finished over budget. One of the key recommendations of this report was that future "business cases, risks and contract be carefully drawn, assessed and managed" ... "and the production of a business case is a crucial stage in the early part of the procurement process". In response to these reports it was decided to carry out a national survey of risk management tools and techniques used by professional quantity surveyors when determining initial budgets for building projects. The survey was undertaken between May and June 1996, and the results from this survey forms the main theme of this paper.

AIMS AND OBJECTIVES

The survey aims to:

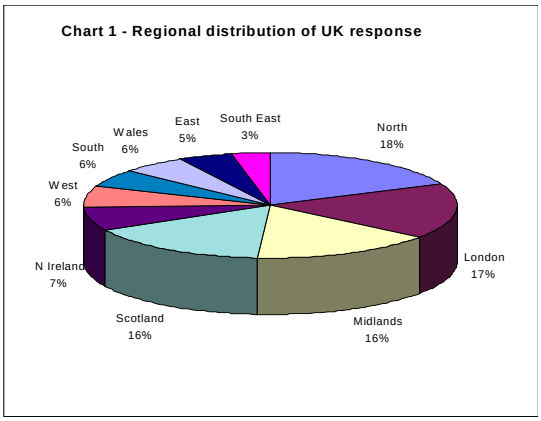
- establish what base methods are used to calculate initial budgets for buildings; and
- determine the awareness, use, and performance of risk management tools and techniques for estimating initial budgets.
- The object is to:
- ascertain the need for further research into risk management tools and techniques for use when estimating the initial budgets for building projects.

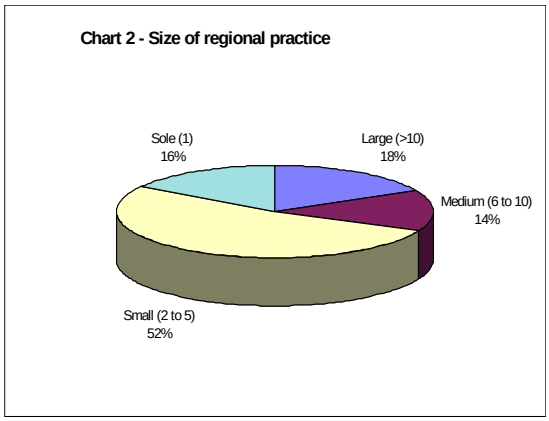
Ultimately it is intended that the results will help the research to focus on tools and techniques in which to carry out industry case studies.

RESPONSE TO SURVEY

Following a successful pilot survey in Sheffield, the method used was to mail questionnaires to professional quantity surveying practices accompanied by cover letter and pre-paid envelope. A "cold" approach was used, and delegates were asked to reply within three weeks of receipt. References to the method described are discussed in more detail by Descome (1993), Heather and Stone (1991), and Wilson and McClean (1994).

Practices were selected from the "Geographical Directory" published by the RICS (1995), which is divided into ten UK regions. The largest town in each region was selected, and the questionnaire was sent to a total of 500 quantity surveying practices. 125 questionnaires were returned completed within the stipulated 3 weeks time limit, giving a response rate of 25%. Chart 1 shows the percentage of responses in each region, making up the total UK response. This excludes 2% of responses which failed due to retirement, duplication, insolvency, etc.

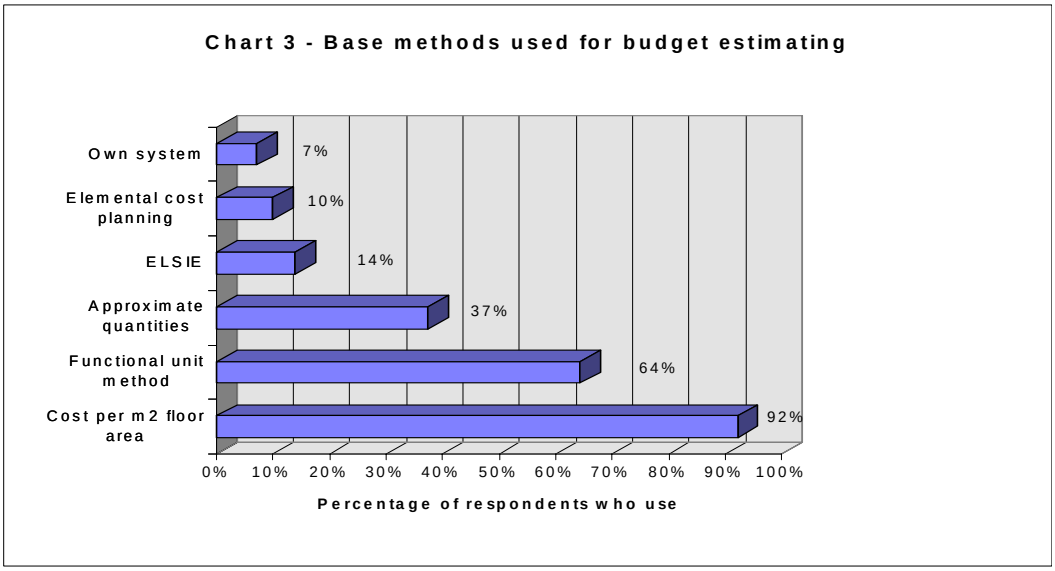




For observation reasons the practices who responded have also been categorised into large (over 10 Chartered Quantity Surveyors), medium (6 to 10), small (2 to 5), or sole (1), as shown in Chart 2. The purpose of these two charts is to prove that a reasonably representative sample of responses was obtained, and it is not the intention of this paper to draw comparisons between differing practice sizes or regions.

Base methods used when estimating initial budgets

The first results from the survey refer to the "base" method used when estimating initial budgets. The most used method is "cost per m^2 floor area", which, as shown in Chart 3, is used by 92%, nearly all respondents. Also highly used, by about two thirds, is the "functional unit method", and over a third use "approximate quantities".



From the questionnaire answers it was also possible to calculate that 68% use the "cost per m^2 floor area" method most often, with 17% using "approximate quantities" most often, and only 1% use "functional unit method" most often. Together with the other three methods shown in the chart, a few respondents also use others such as "BCIS", "cost per cube", "previous similar internal projects", and "inspiration".

AWARENESS OF RISK MANAGEMENT TOOLS AND TECHNIQUES

Of the twenty-one tools and techniques (t&t)[1] that were identified in the background research, Table 1 shows that "contingency % allowance" is the only one to have been heard of by all respondents, although 99% have heard of "professional judgement and intuition". T&t that are also well known include "prompts/checklists", heard of by 89% (possibly high because of ISO 9000 Quality Systems), "brainstorming", heard of by 82% (possibly high because it can form part of "value engineering"), and "ELSIE", which is an expert system made specifically for the quantity surveyor, heard of by 73%.

Tool / technique	Awareness		Use			
	rank	% who have heard of	rank	% who use	rank	expressed as a % of those that are aware
Contingency % allowance	1	100	2	98	2	98
Professional judgement / intuition	2	99	1	99	1	100
Prompts / checklists	3	89	3	79	3	89
Brainstorming	4	82	4	59	=4	72
ELSIE	5	73	=10	14	14	19
Sensitivity analysis	6	61	6	34	7	56
Subjective probability	7	54	5	37	6	69
Monte Carlo simulation	8	52	=8	18	10	35
Risk-adjusted discount rate	9	46	7	22	8	48
Decision tree	=10	42	=12	13	12	31
Decision matrix	=10	42	=10	14	11	34
Expected monetary value	12	33	=12	13	9	39
Algorithms	13	26	14	6	13	23
MERA	14	25	=8	18	=4	72
Stochastic decision tree	15	18	15	3	15	17
Means-end chain	16	17	=16	2	18	12
Utility theory	17	15	=16	2	17	13
Bayesian theory	18	13	=16	2	16	15
Portfolio theory	19	11	=19	0	=19	0
Stochastic dominance	=20	9	=19	0	=19	0
Delphi peer group	=20	9	=19	0	=19	0

Table 1 - Use and awareness of tools and techniques

USE OF RISK MANAGEMENT TOOLS AND TECHNIQUES

Table 1 also shows that generally the risk management t&t which most respondents use are "professional judgement and intuition" and "contingency % allowance", used by nearly all respondents. Of the remaining t&t that were previously categorised as well known, "prompt/checklists" and "brainstorming" are both well used and remain third and fourth in the ranking, whereas "ELSIE" fell sharply from 5th to 10th, with only 14% of respondents using it. Over a third of those surveyed use "subjective probability" and "sensitivity analysis", and, whilst "MERA" was low at 14th in the awareness ranking, it jumped to 6th place in the use ranking, however this is still low

[1] Abbreviation used throughout the text: T&t or t&t = tools and techniques.

with only 18% of respondents who use it. Never used are “portfolio theory”, “stochastic dominance”, and “Delphi peer group”.

Use, expressed as a percentage of those that are aware of
The table also shows that “professional judgement & intuition” is the only t&t to be used by every respondent who has heard of it, although “contingency % allowance” and “prompts/checklists” both came near. Most respondents who have heard of “brainstorming”, “MERA”, and “subjective probability” also use them, and around a half of those that have heard of “sensitivity analysis” and “risk adjusted discount rate” use them as well. Around a third use “expected monetary value”, “Monte Carlo simulation”, “decision matrix”, and “decision trees”, whilst “ELSIE’s” decline in the use ranking continued down to 13th, being used by only 19% of those that have heard of it.

Always used
The questionnaire also asked if t&t are always used, or just sometimes. “Professional judgement and intuition”, “contingency % allowance”, and “prompts/checklists” are used by most respondents all of the time, i.e. 94%, 83%, and 83% respectively. Besides these three t&t there are only two others which are used always by over a third of respondents, these being “brainstorming” by 45% and “subjective probability” by 35%, although 31% do use “expected monetary value”. Also about a quarter of respondents always use “risk adjusted discount rate” and “decision trees” and, in addition to the three t&t never used, four others are only used sometimes - these being “stochastic decision tree”, “means-end chain”, “utility theory”, and “Bayesian theory”.

SOFTWARE USED TO SUPPORT RISK MANAGEMENT TOOLS AND TECHNIQUES

This part of the survey was poorly answered, possibly because of the layout of the questionnaire or because respondents are simply not using computers to support t&t? However, “spreadsheets” and “in-house” software are the most commonly used, others included “@Risk”, “Crystall Ball”, and “ProAct”, but really the sample size is insufficient to draw any other worthwhile observations.

PERFORMANCE OF RISK MANAGEMENT TOOLS AND TECHNIQUES

In this section those surveyed were asked about how they perceived the tools and techniques performed, and whether they performed “excellent”, “good”, “fair”, or “poor”. The results are shown in Chart 4 over leaf, and are discussed below.

Excellent performers
Only two t&t are thought to perform excellent by a quarter or more of respondents who knew how they performed, “professional judgement and intuition” by 29% and “prompts / checklists” by 25%. Only three others are thought to perform “excellent” by more than 5% of respondents, these being “brainstorming” by 18%, “contingency % allowance” by 14%, and “MERA” by 9%.

Good performers
Four t&t are thought to perform good by over half of those who know, these being “professional judgement and intuition” by 63%, “prompts / checklists” by 53%,

"contingency % allowance" by 55% and "brainstorming" by 51%. Over a quarter also thought seven other t&t performed good: "MERA" by 46%, "sensitivity analysis" by 42%, "subjective probability" by 41%, "expected monetary value" by 35%, "risk adjusted discount rate" by 33%, "ELSIE" by 31%, and "decision trees" by 29%.

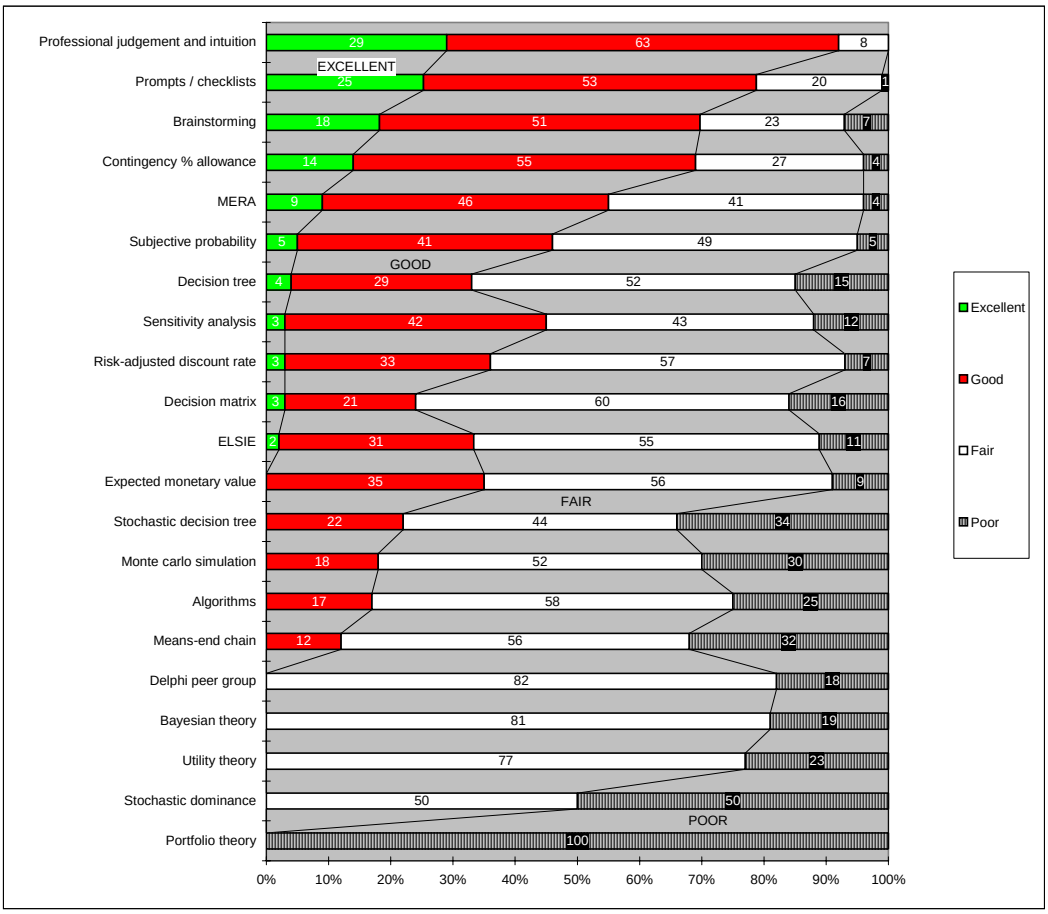


Chart 4 – Performance of risk management tools and techniques

Fair performers

Most t&t fell into this performance category but three are thought to perform fair by more than three-quarters of those that know how they perform, these being "Delphi peer group" by 82%, "Bayesian theory" by 81%, and "utility theory" by 77%. It should also be noted that each of these had relatively low sample sizes of 28, 31, and 48 respectively. Between 50% and 60% of those that had heard of t&t thought nine t&t perform fair, and 40 and 50% thought four others perform fair.

Poor performers

"Portfolio theory" is thought to perform poor by all those that know how it performs, however this has the lowest sample size of only 7. Another t&t thought to be significantly a poor performer is "stochastic dominance", thought so by half of those that know how it performs - this also carries the second lowest sample size of 18. Around a third think "means-end chain", "stochastic decision tree", and "Monte Carlo simulation" perform poor, and about a quarter think "algorithms" and "utility theory" do too.

Performance not known or not stated
Of those that have heard of t&t some respondents said they "don't know" how they performed. Some also left this section of the questionnaire blank, the reason for this is possibly because they didn't know, or maybe because questionnaire wasn't clear? Most (92%) either don't know or didn't state how "portfolio theory" performs, this was followed closely by "stochastic dominance" with 82%. Also about two thirds of respondents didn't know how four other t&t performed, "Delphi peer group", "Bayesian theory", "algorithms", "stochastic decision trees", around a half of those surveyed don't know about six others: "means - end chain", "ELSIE", and "utility theory", "Monte Carlo simulation", "decision trees", and "expected monetary value", and around a third don't know about "Decision matrix", "risk-adjusted discount rate", "sensitivity analysis", "MERA" , and "subjective probability".

REASONS FOR NON USE OF RISK MANAGEMENT TOOLS AND TECHNIQUES

The main reason for not using t&t is due to lack of understanding, also "lack of clear benefit" and "reliability/accuracy" are two other main reasons for non use. In summary the reasons for non use are as follows:

Lack of understanding
Reason by two thirds or more for "risk-adjusted discount rate", "MERA", "subjective probability", "stochastic decision tree", and "Bayesian theory'.

Reliability / accuracy
Reason by 25% for "brainstorming" and "prompts and checklists", 22% "means-end chain", and 18% "stochastic dominance".

Lack of clear benefit
Reason by 32% for "decision matrix", 31% "utility theory", 23% "algorithms", 22% "stochastic decision tree", 21% "Bayesian theory" and "portfolio theory" and "decision tree" and "means-end chain".

Cost
Reason by 19% for "ELSIE", 14% "Delphi peer group", and 11% "MERA".

Lack of IT facilities
Reason by 14% for "ELSIE", 9% "sensitivity analysis", and 8% "Monte Carlo simulation".

AWARENESS AND USE OF OTHER RISK MANAGEMENT TOOLS AND TECHNIQUES / OWN SYSTEM

Only nine respondents listed other t&t they have heard of. The t&t listed included: "pricing books", "BCIS", "cost analysis", "value engineering", "HAZOP"; and "HAZAN". Twenty four (19%) respondents have their own system, which included "consultation", "certainty analysis", "quantities check", "training", "measured estimate", "+/- from mean (ranged estimate)", with "experience" and "in-house database / historical records" proving to be the most common of these. One firm has an in-house dedicated risk management section

CONCLUSIONS

Following a good response rate to the questionnaire, it may be concluded that the survey has fulfilled its' aims in the following way:

- "cost per m^2 floor area" has been established as the most commonly used base method for estimating initial budgets for building projects;
- the awareness of most tools and techniques identified is low, with only four of the twenty-one identified being well known;
- the four most well known tools and techniques are also the most used but few others are used much at all, with three never being used;
- the main reason for non use of tools and techniques is due to lack of understanding; and
- most tools and techniques perform "fair" to "good", and only a small proportion of respondents thought excellence is achieved through their methods.

It is recommended that further research is needed in this topic, and following work should include an evaluation of the relatively unknown risk management tools and techniques to allow a perceived optimum risk management model to be constructed, and subsequently tested with case studies. Finally, it is argued that professional quantity surveyors should strive for excellence in the performance of the methods they use for risk management of their clients budgets.

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