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Building project price forecasting - modelling technique selection criteria

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Abstract

Clients of the construction industry need reliable early stage project price forecasts in order for them to make the best use of their scarce resources. One of the factors thought to influence the quality of the early cost advice provided by construction professionals is the price forecasting model(s) selected for use. Enhancing the quality of building project price forecasts will increase the level of clients' satisfaction with the services provided by design team professionals. This paper addresses issues related to an on-going investigation which has been supported by the RICS Education Trust. The study is investigating the technique selection criteria used by construction professionals when they formulate early stage building project price advice for clients.

This paper sets the context for the work by reporting the main findings of a literature review that was undertaken to identify the potential criteria thought to influence technique selection. The potential selection criteria are then modelled rudimentally in order to allow a follow-up exploratory study to be conducted which has established the actual criteria used to select appropriate models for use. The data gathered has been analysed qualitatively and has allowed a further more conceptual framework to be developed that seeks to model the most significant of the actual technique selection criteria used by practitioners'.

Keywords Building Price Forecasting, Technique Selection Criteria, Modelling

Introduction

Clients of the construction industry need reliable early stage project price forecasts in order for them to make the best use of their scarce resources. One of the factors thought to influence the quality of the early cost advice provided by construction professionals is the actual price forecasting model(s) selected for use. Research aimed at the enhancement of the quality of building project price forecasts will lead to an increase in the level of client satisfaction with the services provided by the building project's design team professionals. Such a research agenda has been promoted by the RICS and others who have identified the need to develop more robust early stage forecasts of construction costs as a means of providing an added value service for clients.

The research agenda on building price forecasting has in the past been driven by, (i) the need to identify and assess the accuracy of all the existing models suspected as being in use and (ii) the need to develop newer computer based non-deterministic models and knowledge based systems that could take more account of risk and uncertainty. More recently the agenda has shifted to consider quality issues. Work in this field has become more people orientated rather than being entirely model-centred as research on matters connected with the personal attributes of forecasters themselves, their levels of expertise, methods of price message communication, types of bias and judgmental skills have been reported.

Quality of building price forecasts is affected by both the technical formulation of the price forecast itself and the human processes involved with the interpretation and transmission or communication of the price forecast to clients. Bowen and Edwards (1994) established that the human processes involved in the transmission of price advice to clients is affected by the interpersonal communication process itself and issues connected with judgment, (intrapersonal communication) such as bias, errors and heuristics. Work on interpersonal communication processes and issues connected with judgment have been the subject of separate studies by Bowen (1995) and Fortune and Lees (1996).

Fig 1 has been developed by Fortune and Lees (1996) to illustrate their definition of the complete advice function and it illustrates the separate research themes indicated above. It can be seen that this particular study addresses the human issues connected with the formulation of strategic building project price advice for clients. In particular the study focuses on the selection criteria used by construction professionals to choose particular building project price forecasting techniques. It aims to develop a model that will aid the price forecasting technique selection process of practitioners in the field.

The paper firstly identifies the potential technique selection criteria that have been established within relevant subject specific literature as well as material addressing the theory of forecasting model selection within general business. In the absence of any accepted building project price forecasting technique selection theory the paper attempts a preliminary classification of the selection criteria in order to establish an initial proposition and framework that could be used in a first exploration of the issue with practitioners. The paper describes a preliminary study that collected qualitatively based data and concludes by establishing a conceptual model that will bound the collection of more data grounded in practitioners experience.

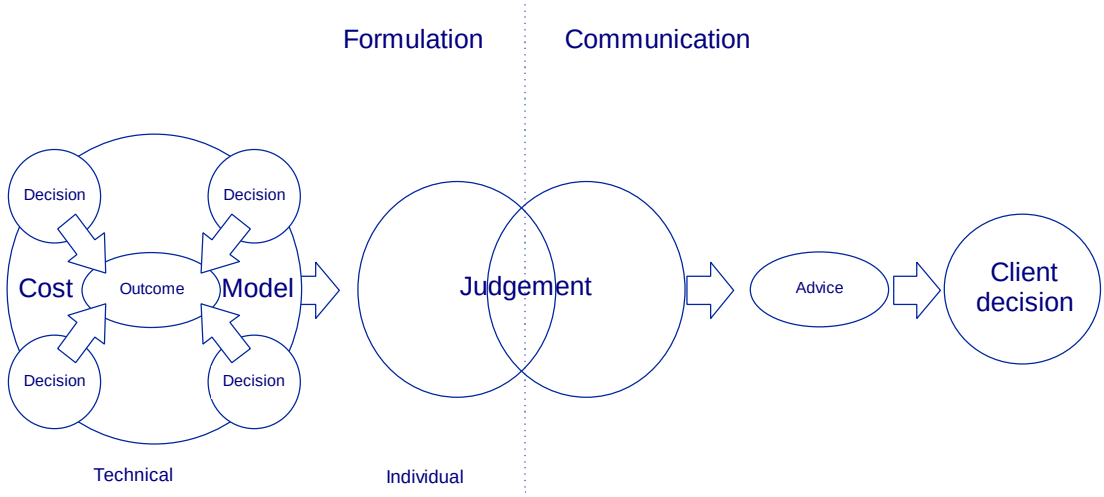

Figure 1 - Advice function the completed picture

Selection criteria for building project price forecasting models

Makiridakis *et al* (1983) commented that it was commonly held that practitioners evaluated differing forecasting models on a single criterion, namely, "the perceived level of model output accuracy". However, they also pointed out that accuracy cannot be considered as the sole criterion of forecasting model selection process as it was not necessarily only the product of the model that needed to be evaluated. This theme was taken up and addressed by Raftery in his Phd study on building cost modelling performance. Raftery (1984) identified different criteria that could be used when assessing the performance of certain cost models, namely, (1) the data, (2) the data / model interface, (3) model attributes or ease of application, (4) interpretation of output and (5) the nature of the decision making process. The criteria advanced by Raftery for model performance evaluation, although limited in scope, provide a basis for an initial rudimentary technique selection framework which has been illustrated in Fig. 2. This diagram provides an indication of the main themes of this study, namely, issues related to the differing models currently in use and issues related to the application and interpretation of the forecasting model(s) and their output. The nature, comprehensiveness and inter-relationships between the sub-issues within each of the "text bins" that make up the rudimentary framework, shown below, now need to be explored within the available literature.

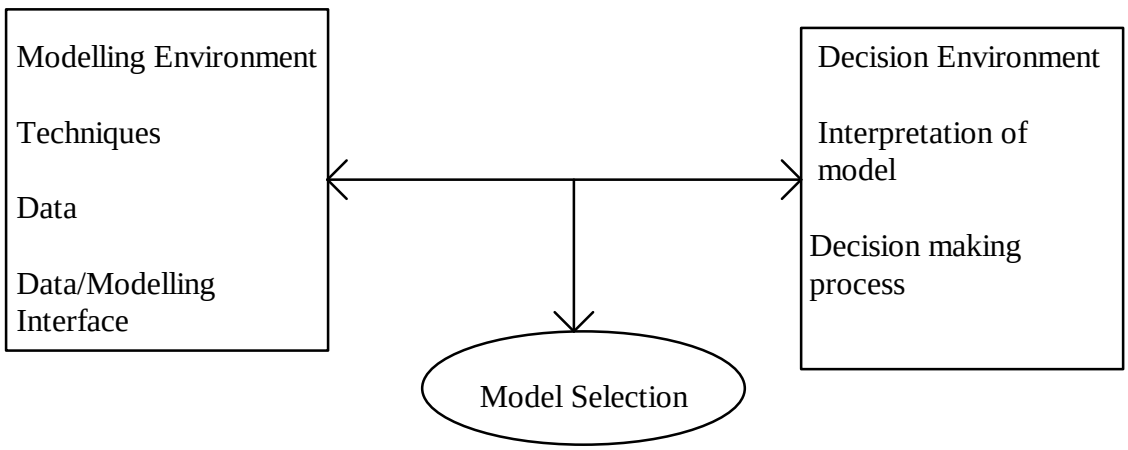

Fig 2 Rudimentary framework of building project price forecasting model selection

Fortune and Hinks (1997) provided a detailed review of material related to modelling building project price forecasts. Amongst the subject specific literature reviewed was material by Raftery (1984), Taylor and Bowen (1987), Skitmore (1990), Ashworth (1994) and Bowen (1995). Amongst the literature on general business price forecasting that was also reviewed were works published by Makindrakis *et. al.* (1983), Mentzer and Khan (1995) and Pedlar *et. al.* (1995). The literature identified a number of potential criteria (1) to (20) [See Table 1] that were thought to be influential in the choice of which building project price forecasting model to use in practice. Although the material reviewed indicated some consensus on the identification of some of the model selection criteria it was evident that there was a general lack of consensus on the identity of which technique selection criteria were thought to be the more influential. The literature reviewed established that as yet there had been no empirically based work reported that had attempted to confirm the above findings or rank the criteria identified in Table 1 for importance.

Miles and Hubermann (1994) indicated that the boundaries of a qualitative investigation should be established before an initial exploration of a phenomenon is commenced. Therefore it was necessary to expand and give more shape and form to the rudimentary text based framework illustrated in Fig. 2. Accordingly, a preliminary subjective classification of the identified criteria was attempted. It sought to place each of the model selection criteria (1) - (20) within an influence "field" or "environment". The influence "fields" or "environments" that have been advanced are related to the technique selection model advanced by Wheelwright and Clarke (1976) in relation to general business forecasting. The existing text based "bins" in Fig. 2 have been expanded and the potential selection criteria have been classified within "bins" now labelled (**A**) the forecast users environment, **(B)** the forecast preparer's environment, (**C**) the forecaster's organisational environment, and **(D**) the forecast model(s) environment.

Category **(A**) the forecast users environment - includes criteria related to the client, the data available, the time available for the forecast production, the type of project, the provision of feedback from past schemes and the client's understanding of the model's usage. Table 1 indicates that the following model selection criteria have been provisionally allocated to this influence environment namely, (1), (5), (6), (10), (11), (13) and (19).

Category **(B)** the forecast preparer's environment - includes criteria related to the use of the data available, the forecaster's understanding, experience and ease of use in terms of available models, the forecaster's assessment of accuracy of the model's output, the forecaster's assessment of the project type that the forecast is required for, the forecaster's use of judgment and the nature of the relationship between the forecaster and the forecaster's manager. Table 1 indicates that the following model selection criteria have been provisionally allocated to this environment, namely,(1),(2),(3),(4),(7),(10),(11),(12), (13),(14) and (18).

Category **(C)** the forecaster's organisational environment - includes criteria related to the resources available, the availability of cost data, the feedback system used, the availability of computers, the nature of the relationship between the forecaster and the manager and the organisation's own assessment of its stage of learning or development. Table 1 indicates that the following selection criteria have been provisionally allocated to this environment, namely, (1),(8),(11),(15),(18) and (20).

Table 1 - Model Selection Criteria Identified from Literature Review

Criteria	Description	Environment
1	Data availability *	A,B,C
2	Data / model interface *	B,D
3	Ease of application *	B,D
4	Interpretation of output	B
5	Nature of decision making process *	B
6	Time horizons *	A,D
7	Model accuracy *	B,D
8	Resources available	C
9	Models responsiveness to change *	D
10	Type of project *	A,B
11	Feedback system used	A,B,C
12	Use of judgment *	B
13	Forecaster's understanding of model *	A,B
14	Experience of forecaster	B
15	Availability of computers *	C
16	Speed of model in use *	D
17	Costs of using model *	D
18	Manager / forecaster relationship *	B,C
19	Nature of client *	A
20	Stage of organisational development	C

Category **(D**) the model's environment - includes criteria related to the data/model interface, the time available for the production of the forecast, the speed and costs of the model in action, the accuracy of the model's output and the model's responsiveness to change. Table 1 indicates that the following selection criteria have been provisionally allocated to this environment, namely, (2),(3),(6),(7),(9),(16) and (17).

It can be seen from Table 1 that some of the individual criteria identified from the literature reviewed above have been allocated to more than one of the influence environments advanced. Fig 3 illustrates a view of the conflicting influence environments [(A),(B),(C), (D) above] that has been developed as an initial framework following the subjective classification of the individual selection criteria revealed in the literature considered above. The classification of the technique selection criteria has indicated that the influence environments cannot be considered to be independent of each other. There is a blurring of the boundaries between one influence environment and another. The overlapping of the influence environments and their respective criteria indicates a "dynamic" interaction between the criteria that may change due to differing circumstances. Fortune and Hinks (1997) identified that the difficulty facing the forecast preparer was that there was no theoretical basis on which an appropriate forecasting model could be chosen. Therefore, the way in which the forecast preparer is influenced by the potential selection criteria needed to be expressed as an initial proposition or "root definition", as defined by Checkland (1981), that would focus and bound the collection of data grounded in actual practitioner experience. Such an investigation would confirm or otherwise the selection criteria identified in Table 1, and their classification, shape and interrelationships within each

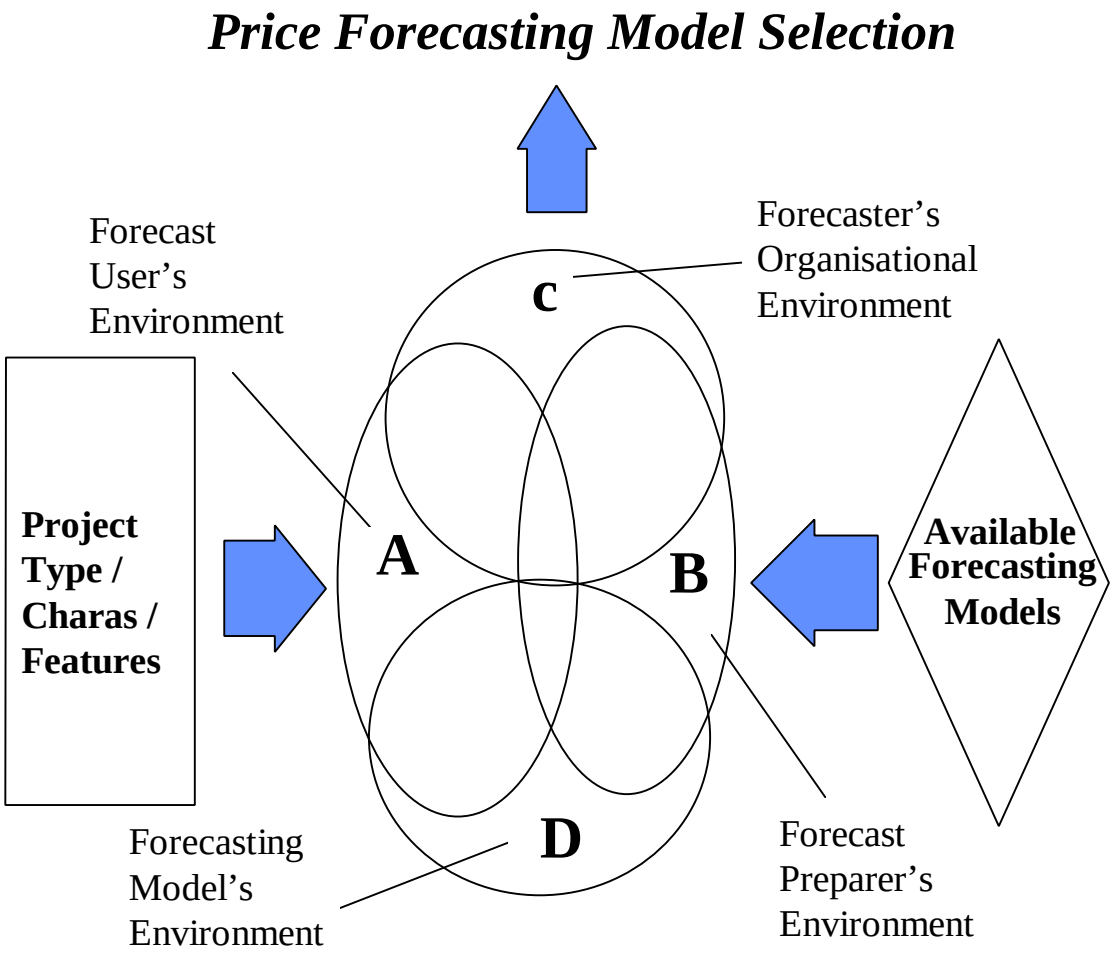

Fig 3 An expanded framework of building project price forecasting technique selection

of the influence environments indicated in Fig. 3. Such an initial mapping of real world experiences would facilitate the development of an initial conceptual model of the technique selection criteria used to formulate building project price advice.

Preliminary Study

Fortune and Lees (1996) reported a large scale survey of quantity surveying organisations based in the north of England. The survey established the early stage building project price forecasting techniques in use in 1993. Statistical analysis of the data collected in the study allowed the identification of factors that affected the use of particular types of techniques. Theses factors were found to relate to organisational size, type, location, status (head / branch office) and approach to information technology. This survey work and the literature reviewed and classified above has allowed an initial proposition, as defined by Strauss and Corbin (1990), to be formed that was capable of further investigation with practitioners in the field. The initial proposition for the preliminary study was framed as follows,

> *"The selection of particular building project price foreccasting techniques depends upon the interrelationship of organisational factors (related to location, size, type, status, and availability of computers) and factors related to the forecast model, the forecast preparer and the forecast user".*

The qualitative nature of the research design for this study has at its core the need to generate a technique selection model that is grounded in practitioners' everyday experiences. Strauss and Corbin (1990) indicated that the data collected within such a grounded theory approach need to be analysed so that what is relevant to the area of study is allowed to emerge from the data. The data need to have codes, or conceptual labels assigned to them and then contextual statements of relationship abstracted.

Accordingly, the data collected for this preliminary study was obtained via a small number of interviews (4) with practitioners in the field. The small sample of practitioners' was selected on the basis of convenience from organisations which offered a building project price forecasting service to clients. The initial proposition suspected that the organisational setting of the practitioner may have an influence on the price forecasting technique used and so interviews were arranged with practitioners who were located in organisations of differing size, nature, type and location. The interviewees selected were all experienced practitioners who both formulated and transmitted price forecasts to clients using more than one type of project price forecasting technique. The interviews were conducted in the subjects place of work and adopted a semi-structured, in-depth, non-directive approach. The conversations were tape recorded in order to achieve the collection of objective data. The transcript of each interview was then returned to the interviewees for approval or alteration prior to analysis.

The analysis of the data was conducted manually and followed the principles set down by Miles and Hubermann (1994). The text within each transcript was broken down into discrete sections and each element within it was assigned a code or label that could then be used to link it to other codes or labels and so develop common themes which could be used as the basis of a conceptual model. The labels that emerged from across the four interviews conducted within this preliminary study have been indicated by an asterisk in Table 1. It can be seen that not all the potential criteria that were identified from the literature were confirmed as being relevant by the practitioners. Other factors that emerged from the analysis of the collected data and allocated to a separate "label" included the following: project height, project size, project shape, project location, site characteristics for the project, the designers of the project, the prevailing market conditions and the perceived quality levels required in the project. These additional factors have been illustrated within Fig. 3 as a text bin labelled "project type/charas/features".

The analysis of the data collected also provided some support for the factors identified as being influential on technique selection within Fortune and Lees (1996) earlier survey work. In particular it was noticed that interviewees within different types and sizes of organisation identified differing clusters of technique selection criteria. This and the collection of codes or labels that represented the data that was grounded in practitioners experience allowed the development of the outline conceptual model shown in Fig. 4. Rivett (1972) indicated that a model was a convenient way of representing a total experience from which a pattern may be deduced which can be used to predict future similar activities. According to Miles and Hubermann (1994) a model is also a set of relationships between controllable and uncontrollable factors that are expressed in a symbolic form to represent an activity and its relevant features. Fig. 4 indicates that the controllable factors in the selection of a building project price forecasting technique are related to the forecasting model and the forecasting preparer's environment. Sub-issues within this environment have been indicated as involving, the forecasters understanding of the

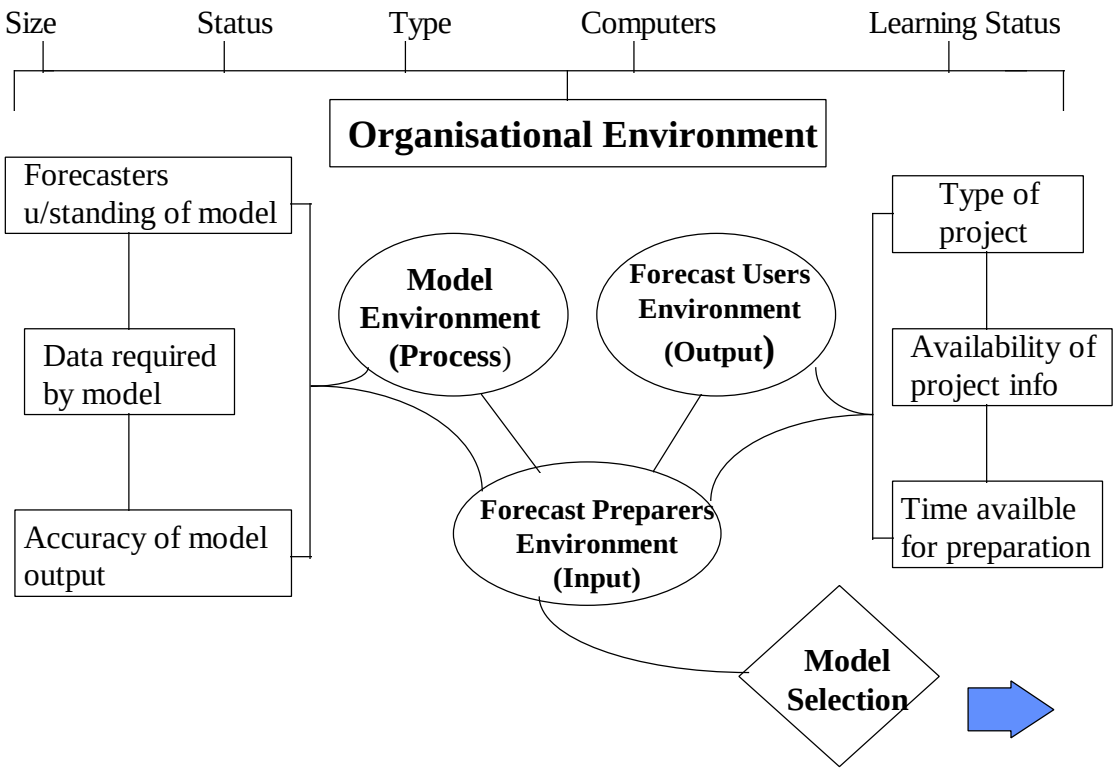

Fig 4 An initial conceptual model of building project price forecasting technique selection criteria

model, the data required by the model and the accuracy of the model's output. The uncontrollable factors in the same selection process are related to the forecast users environment. Sub-issues within this environment have been indicated as involving the type of project, the availability of project information and the time available for preparation. The initial conceptual model shown in fig. 4 has removed one of the text "bins", i.e. the forecasters organisational environment **(C),** that was first developed in the expanded framework illustrated in Fig. 3. This was as a result of the analysis of the data collected via the conversations held with the practitioners in the field. It was noted that issues related to organisational size, status, type, availability of computers and corporate approach to new technology seemed to influence the actual forecasting techniques used. In terms of organisational status (i.e. head office or branch office) and its size there was some evidence that the office status and number of staff actually involved in the formulation of early stage building project price advice to clients had an influence on forecasting technique selected. Similarly there was some evidence to suggest that the type of organisation, in terms of it being either a quantity surveying, multi-disciplinary or project management consultancy and its approach to and use of new technologies had an influence on forecasting technique selected. The interviews were conducted in different geographic regions of England and from the data collected it was not apparent that organisational location had an influence on the forecasting techniques selected.

Given these findings it was decided to use the organisational environment of the forecaster as a potential axis that would help shape and form the initial conceptual model illustrated in Fig. 4. Some of the sub-issues within each of the previously identified "controllable" and "uncontrollable" environments have also been included

within Fig. 4 although the data so far collected precludes any attempt at indicating interrelationships or weightings between the sub-issues identified.

Future Activities

The conceptual model illustrated in Fig. 4 needs to be confirmed as being appropriate and further refined in order to identify and weight sub-issues and their interrelationship This would then allow a more meaningful selection model to be developed that will be of use to practitioners seeking to improve the quality of their early stage building project price advice for clients. This will necessitate the collection of more data. The collection of quantitative data from a nation-wide survey of practitioners will confirm the appropriateness or otherwise of the axis of "organisational environment" suggested in the mmodel illustrated in Fig. 4. The execution of further interviews with typical and non-typical practitioners in the field will produce saturated data that may cause the conceptual model's parameters themselves to be refined or altered. The collection of data from a limited number of typical case studies will allow the assessment of the "dynamics" or interrelationships between the sub-issues making up the model to be determined. The collection of different types of data within the study will improve the reliability and validity of its results. Such a triangulation of data has been identified by Mason (1996) as a means of ensuring that findings of a study are capable of being accepted on a wider scale.

Conclusions

This paper has reported on-going work that seeks to investigate and model best practice in the selection of building project price forecasting techniques. The paper reports on a review of available subject specific and non subject specific literature. It has developed frameworks that effectively bound the study. The paper has advanced an outline conceptual model of technique selection criteria that has been developed following the execution of a small scale preliminary study with practitioners in the field. The appropriateness and detailed refinement of the conceptual model illustrated in Fig. 4 can only be established following the collection of further data.

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