

CHAPTER 7 - RESEARCH METHODOLOGY

7.1 Introduction

In previous chapters it was established that managers have to know the external environment in which their organisations operate and understand the implications of changes in this environment as a prerequisite for successful strategic management. Senior managers in South African consulting engineering firms are no exception and therefore need systems that can provide them with accurate information on their external environment, so that they can make appropriate and effective strategic decisions for their firms.

The previous chapter motivated the need for an industry-specific strategic management information system (SMIS) that could provide the type of information required by the South African consulting engineering industry. A range of potential users and the required characteristics of such a SMIS were furthermore presented.

The methodology for developing the required SMIS should make provision for:

- the variation in the information requirements of the individual potential user-types
and
- the requirement for the proposed SMIS to have certain specific characteristics such as:
 - up to date or current reporting,
 - confidential handling of source data,

- o statistically representative data and
- o affordability.

The problem statement was complex, many important variables were undefined and the reactions of firms to the surveys were unknown. The exploratory study technique [29] was therefore used in order to iteratively:

- develop concepts more clearly,
- establish priorities,
- develop survey methodologies and
- improve the final research design.

This iterative process was ideally suited to coping with previously undefined problems as they arose during the study process.

7.2 Review of secondary data and information

The first step in an exploratory study such as this is a search of secondary literature [109]. For the purposes of this study *secondary data* was regarded as data collected by others for their own purposes [29] and recorded in secondary literature. A desk study was conducted of available historical data relating to the South African consulting engineering, building and construction industries in order to determine the relevance and usefulness of such information for the purpose of developing the proposed SMIS. The objective of this desk study was to extract relevant information on the South African consulting engineering industry from such useful sources. It was foreseen that the major sources of useful information would be the South African Consulting Engineering censuses and possibly also published building and construction industry statistics. Other

potential sources of information, such as the records of professional indemnity insurers and of the SAACE itself, were however also investigated.

The secondary quantitative data was used as a benchmark or reference databank to calibrate and/ or evaluate the accuracy of the information collected through regular industry surveys that were later conducted to collect primary research data. *Primary data*, for the purposes of this study, was regarded as data collected as part of this study with the particular purpose of developing a SMIS for the South African consulting engineering industry.

A large number of industry surveys would normally have to be conducted over a long period in order to collect sufficient information to establish useful databases and meaningful time series. The available (secondary) industry data was therefore used as a mechanism to establish time series for a number of relevant variables within a relatively short period. This was done by linking the historical or reference data with the primary data collected through industry surveys in order to make the survey data live, and therefore useful to the industry, at the earliest possible date.

7.3 Primary data collection

Primary data formed the backbone of this study and was collected by conducting regular industry surveys. The survey methodology is described in the following subsections of the study.

7.3.1 Population to be surveyed

The target population for the surveys consisted of the South African independent professional consulting engineering industry. It has been estimated that the approximately 380 firms [51] who are members of the South African Association of Consulting Engineers (SAACE) represent more than 90% of the independent professional consulting engineering industry (by fee income or turnover) of South Africa [54]. This figure was verified by comparing the official census data on the industry [198, 199] with the SAACE statistics in terms of the total number of offices and the total fee income in Chapters 9 and 10.

The remaining estimated 10% of South African consulting engineers do not belong to a voluntary organisation such as the SAACE and are therefore not easily traceable or contactable. For practical purposes the primary sample of the target population [29] to be surveyed was therefore the approximately 380 member firms of the SAACE.

UNIVERSITY
OF
JOHANNESBURG

7.3.2 Types of data required

The industry surveys that were conducted involved both quantitative and qualitative techniques. Three main groups of data were collected through surveys of the selected target population. The groups, which each in turn covered detailed data on a number of aspects and variables, were:

- Quantitative data on employment and cost of employment.
- Quantitative data on work flow and resultant income.
- Qualitative (opinion) data on future perceptions.

In the light of the exploratory nature of the study certain detailed aspects of the data collected were modified as the study proceeded in order to optimise the study design. It was however foreseen from the outset that both quantitative and qualitative data should differentiate between:

- Geographic areas (e.g. Individual RSA provinces, other African countries, countries outside Africa).
- Client types (e.g. Central, provincial and local government; parastatals; private sector).
- Engineering disciplines and service types or sub-markets (e.g. Civil engineering, mechanical engineering, project management and facilities management).
- Employment categories (e.g. professional engineer, technologist and administrative support staff).

7.3.3 Design of survey forms/ questionnaires

The self-administered computer-delivered mail survey method [29] was used. This distribution method was chosen due to the access to the system used for regular electronic communication, by e-mail, between the SAACE and all its member firms. This system included a live and up to date electronic address database, with the resultant benefits of low distribution (mail) cost, immediate receipt of forms by the surveyed firms and automatic routing to the correct person or respondent in each firm. The selected survey method was therefore extremely efficient, in spite of the geographically dispersed nature of the statistical target population surveyed.

In the light of the exploratory nature of the study it was decided to launch a pilot survey on the entire target population of approximately 380 firms. The intention with the pilot survey was to test the quality and statistical representivity of returns and to provide guidance for the finalisation and iterative refinement of future survey instruments. The pilot survey was designed to be brief and to test the reaction of respondents to both quantitative and qualitative questions.

Survey forms were designed with the seniority and the level of understanding of respondents, who were the mandated principals of SAACE member firms, in mind. These mandated principals are senior directors, Partners, Sole proprietors or Members of consulting engineering firms who have been designated as such by their firms in order to serve as the single representative of their firm regarding SAACE matters or the single point of contact for correspondence and other contact with the SAACE. The very specific respondent type dictates that questionnaire design has to take the following into account [41]:

- 
- The respondents will have a good understanding of the consulting engineering industry.
 - Respondents should have access to and should supply accurate information on their respective firms.
 - Questionnaires will have to be brief and user-friendly to allow respondents to complete a survey form in a reasonable time.
 - The format of questionnaires should be planned to achieve maximum standardisation, both in terms of presentation and type of information required.
 - Survey periods and the resultant frequency of surveys should be planned and, where necessary, reviewed and amended for optimal response/ participation.

Survey questionnaire design and the iterative refinement thereof throughout the duration of the study focused on getting quality data while at the same time improving or maximising response rates. Examples of the survey forms used during the study period are included in Annexure 2.

7.3.4 Distribution and collection of survey forms

The SAACE maintains an accurate database with detailed information on all their member firms and sends regular electronic newsletters (by e-mail) targeted at either the office managers, mandated principals or all Principals (Partners, Directors, Members or Sole proprietors) of firms as appropriate. The SAACE term of mandated principal refers to a person designated as such by their firms in order to serve as the single representative of their firm on official SAACE matters or the single point of contact for correspondence from the SAACE.

The electronic distribution method made it possible to distribute questionnaires directly to the correct person without the normal delays associated with conventionally mailed surveys.

During the study phase completed questionnaires were returned to the SAACE offices by normal mail or fax. It can however be foreseen that future surveys will involve the electronic return of completed survey questionnaires or on-line internet responses to questionnaires and the automated electronic incorporation or merging of data from the respondents into databases.

Response rates were to be monitored on an ongoing basis and appropriate actions taken to ensure that the number and nature of responses provide sufficiently high levels of statistical representivity to achieve the goals of this study. The following practical measures were incorporated in the survey procedure from the outset [86]:

- Advance notification of each survey was given to firms by way of the regular SAACE newsletters. This communication was specifically tailored to illustrate the potential benefits of (continued) participation by individual firms.
- The statistical sufficiency of returned questionnaires was monitored closely. Individual firms who did not respond were however not identified and contacted in order to avoid jeopardising the confidentiality of the survey procedure. General requests, reminders and motivational appeals for co-operation were however sent by e-mail to all the surveyed firms in order to increase the number of returns to an acceptable minimum level.

7.3.5 Processing survey information and presenting data

In order to increase the probability of meaningful responses to surveys, respondents had to be given an undertaking that confidential business information supplied in the surveys were not to be made available to their competitors. It was possible to treat the data of each enterprise as confidential by incorporating the following procedure into the survey process:

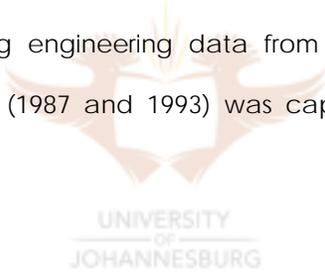
- All SAACE member firms were given unique numerical identification codes by the SAACE's member services manager. These identification codes were captured as a "hidden" column in the member firm database operated by the SAACE. The codes were known only to this SAACE manager and individually by each mandated principal, i.e. for his own firm only.
- The database was used for the electronic mailing of the questionnaires, during which process survey forms were individually coded with the unique numerical identification codes.
- The completed survey forms were returned, either by mail or by fax, to the SAACE's member services manager who monitored the number of returns and reported back to the author on a periodic basis in order to:
 - Obtain a directive on whether to commence with the data capturing process or
 - receive instructions on the actions to follow in order elicit an improved response and achieve an appropriate level of statistical representivity.
- A suitably qualified and experienced independent economist was contracted to capture and process the raw data received from the surveys. The outsourcing contract between the SAACE and the economist included a confidentiality clause, which prohibits the economist from making raw or processed information available to any party in such a form that it could possibly jeopardise the confidentiality of returns submitted by individual member firms.

- With each set of completed survey forms the manager: member services at the SAACE provided the economist with an updated sanitised version of the member database, i.e. a database that showed the identification code and those topical details of a firm which will be relevant for the purposes of data capture, processing and analysis by the economist (e.g. firm size). The database therefore did not include information which could reveal the identity of individual firms, such as addresses, company names and the names of contact persons.
- The manager: member services at the SAACE delivered all completed and identification-coded survey forms directly to the independent economist. The economist then used the sanitised current SAACE member database provided to capture, process and analyse information supplied on survey returns in order to provide the SAACE and the author with processed statistical data as directed.
- The processed data never included any individual firm data.

The results of the pilot survey were used to plan, in consultation with the economist, the preferred format in which processed data should be presented for the purposes of this study. After the pilot survey, the data requirements and required data formats were refined with each subsequent survey in order to ensure that study objectives were met.

7.4 Utilising secondary data to develop time series and regional ratios

The historic secondary data from the sources described in section 7.2 of this chapter was used to develop a national time series for each of a number of key variables that reflect the health of and activity levels in the South African consulting engineering industry. Regional ratios were determined for the South African consulting engineering industry by using secondary data. These ratios were then used to interpret published national construction-related secondary data so that it becomes useful for the purpose of interpreting and extending primary survey data. The following process was followed:

- 
- Consulting engineering data from the two most recent industry censuses (1987 and 1993) was captured on a magisterial district basis.
 - The data was then reformatted to comply with the boundaries of the current nine South African provinces as used in the surveys.
 - Ratios were determined on a national basis for relationships between key variables such as employment, salaries, fee income, and profits.
 - These national ratios (e.g. total employment/fee income, profits/fee income, salaries/fee income etc.) were compared to similar ratios available for another profession, i.e. quantity surveyors.

- The benchmark national ratios established in the censuses were interpolated between benchmark years and extrapolated on either side of the period between the two census years.
- The resultant group of national ratios was then applied to published national construction data from the Central Statistical Services.
- In order to understand provincial trends, published national construction data from the Central Statistical Services was captured on a magisterial district basis. This was done for data back to 1980.
- The captured construction data was reformatted to comply with the current nine provincial boundaries. The resultant provincial ratios for construction were used to develop regional data series to which the limited available consulting engineering data could be related.
- From the above, relevant regional trends were established.

In order to verify the accuracy and relevance of the secondary data obtained through the process described above, the results were tested against available historic SAACE data.

7.5 Combining secondary data in time series with primary (survey) data

The historic national and provincial time series resulting from the process described in section 7.4 were used to test the statistical representivity and to extend the usefulness of primary data obtained through surveys, as follows:

- The historic time series were used to determine the levels to which sample data had to be inflated as well as the relative weighting of extended sample data so that primary data will accurately resemble the total surveyed target population.
- Linking the historic (secondary) data to the (primary) data obtained through surveys made the primary data set live or useful at a much earlier date than would have been possible without secondary data. This meant that meaningful deductions could be made from primary data after completing as little as one or two surveys, i.e. without first having to conduct a large number of surveys in order to obtain a sufficiently large number of data points.

7.6 Establishing regular feedback mechanisms

It was essential to establish a rapport with respondents during the execution of the pilot survey. Feedback mechanisms were aimed at illustrating the benefits of participation to the individual firm. Communication with the sample population was furthermore aimed at building interest in the study on an ongoing basis.

A simple communication (Annexure 3.1) was used to convey the results of the pilot survey to the membership of the SAACE. Thereafter a regular six-monthly report was produced on the State of the South African Consulting Engineering Industry. The format of the report was developed iteratively, but it mainly reported on aspects such as the general economic conditions as well as detailed features of economic activity within the consulting engineering industry. Detailed aspects reported on included:

- Rate (tempo) of activity
- Level of competition
- Profitability
- Capacity utilisation
- Market features (e.g. changes with regard to services, client type or geographic spread)
- Market prospects including confidence levels in the industry
- Phases of the product cycle
- Human resource and employment trends
- Education and training
- Cost escalation trends
- Debtor trends

The iterative or exploratory nature of the study determined that new and topical issues were identified and included in survey forms at various times throughout the study period. The report format was similarly amended to highlight specific new topical issues or not to report on issues that become irrelevant or insignificant.

7.7 Conclusion and recommendations

The methodology for developing the required SMIS made provision for

- the variation in the information requirements of the individual potential user-types
- and
- the requirement for the proposed SMIS to have certain specific characteristics.

The problem statement was complex, many important variables were undefined and the reactions of firms to the surveys were unknown. The exploratory study technique [29] was therefore used in order to iteratively develop concepts, methodologies and the final research design.

The first step in an exploratory study such as this is a search of secondary data [109]. For the purposes of this study *secondary data* was regarded as data collected by others for their own purposes [29]. A desk study was conducted of available historical data relating to the South African consulting engineering, building and construction industries in order to determine the relevance and usefulness of such data. The secondary data was used as a benchmark or reference databank to *calibrate* and/ or *evaluate* the accuracy of the information collected through regular industry surveys conducted to collect primary research data.

Primary data, for the purposes of this study, was regarded as data collected as part of this study with the particular purpose of developing a SMIS for the South African consulting engineering industry. The target population surveyed was the

membership of the SAACE, which represents approximately 90% of the South African independent professional consulting engineering industry.

The study involved both quantitative and qualitative techniques and surveys collected detailed data on a number of aspects and variables, including:

- Quantitative data on employment and cost of employment.
- Quantitative data on work flow and resultant income.
- Qualitative (opinion) data on future perceptions.

The survey method used was the self-administered computer-delivered mail survey [29]. This distribution method was chosen due to the availability of access to an existing system used for regular electronic communication, by e-mail, to SAACE member firms.

Completed questionnaires were returned to the SAACE offices by normal mail or fax while future surveys may involve electronic return and automated processing methods. Response rates were monitored on an ongoing basis and appropriate actions were taken to ensure sufficiently high levels of statistical representivity of data.

Confidentiality of sensitive firm data was maintained throughout the study period.

Historic secondary data was combined with primary data gathered through surveys. National and regional time series were established for key variables such as employment, salaries, fee income, and profits for the South African consulting engineering industry. Historic national and provincial time series were

used to interpret whether primary data obtained through surveys was statistically representative and to extend the usefulness of the primary data.

The results of the initial pilot survey were used to plan the standardised format for subsequent survey and reporting forms. Both questionnaires and reports were however improved iteratively throughout the study period. A simple communication (Annexure 3.1) was used to convey the results of the pilot survey to the membership of the SAACE. Thereafter six-monthly reports were published on the “State of the South African Consulting Engineering Industry”. The contents of these reports always included aspects such as the general economic conditions as well as detailed features of economic activity within the consulting engineering industry.

The iterative or exploratory nature of the study determined that new and topical issues were included in surveys and the report format amended accordingly as such issues arose or became irrelevant or insignificant.

The next chapter describes the secondary data search as the first stage of the research methodology described in this chapter.