CHAPTER 10 - THE DEVELOPMENT OF A NUMBER OF HISTORIC TIME SERIES

10.1 Introduction

A literature survey was conducted and certain of the information contained in the first seven chapters originated from such secondary data sources as indicated in the text and the List of References appended to this document. The secondary data collection discussed in Chapter 8 refers specifically to the data that was considered as potentially useful in the development of a SMIS for the South African consulting engineering industry. Chapter 9 described the first stage of primary data collection, which involved a pilot survey and the first full-scale survey of the consulting engineering industry.

The quantitative secondary data referred to in Chapter 8 was used as benchmark or reference data to calibrate and/ or evaluate the accuracy of the primary research data collected through regular industry surveys. This use of the secondary data was instrumental in limiting the extent, duration and cost of primary data collection by ensuring that data from survey samples can be adjusted to be statistically representative of the consulting engineering industry. The second use of the quantitative secondary data was that of rendering primary data useful during the early stages of the study. Both of these uses of the secondary data were achieved by developing a number of historic time series as described in this chapter.

A large number of industry surveys will normally have to be conducted over a long period to collect sufficient information to establish useful databases and meaningful time series. The limited (secondary) industry data available was therefore used as a mechanism to construct time series for a number of relevant

variables within a relatively short period. These series were used to link the historical or reference data to the primary data collected through industry surveys, thereby making the survey data live and useful to the industry as early as possible.

The use of constructed secondary data time series to establish primary data time series within a short period did not only save costs, but also assisted in securing the continued participation in and support of further surveys by the industry. This was due to the fact that it enabled the author to start illustrating the benefits of the SMIS to both the industry and individual firms during the early stages of the study.

10.2 Choice of key business areas and quantitative indicators

The two main competitive business areas of consulting engineering enterprises can be defined as the workflow (output) side and the employment (input) side [105]. Key business areas were identified within each of these two and representative quantitative indicators of the key business areas had to be selected. The quantitative indicators chosen had to be such that numerical values for the indicators could be calculated from data contained in the available two Censuses on the South African consulting engineering industry.

Indicators selected on the **input side** are:

- Number of people employed
- Number of employers (number of offices and number of owners)
- Cost of employment (salaries and wages)

Indicators selected on the **output side** are:

- Workflow (value of construction work)
- Fee income
- Profit margins

Quantitative data for these indicators should, from the outset, be presented in such a way as to differentiate between geographic areas, and in particular between the South African provinces.

10.3 Establishing benchmarks

The two censuses of the South African consulting engineering profession, which were conducted in 1987 and 1993 by the South African central statistical service (was CSS, now STATSSA) [198, 199], provided the only relevant official statistical information. These censuses recorded national consulting engineering industry statistics, but also showed these statistics per individual magisterial district.

Henk Langenhoven, then SAFCEC's economist, captured the census data by individual magisterial district [95] and reformatted it to provincial data for the current nine South African provinces. This was done by simply adding all the corresponding individual magisterial district data for districts falling within the boundaries of each of the nine provinces. These data points for the years 1987 and 1993 were then established as the benchmarks for developing time series, both nationally and for each of the nine provinces, and are shown in Table 10.1.

TABLE 10.1

National census data on consulting engineering, reformatted per province for use as benchmarks [95]

	RSA	WC	EC	NC	FS	NW	NP	GP	Mpu	KZN
1987										
Owners (no.)	554	94	29	10	34	4	20	248	10	105
Employment (no.)	10 014	1 720	537	57	519	30	166	5 380	78	1 527
Salaries (R1 000)	250 219	45 473	12 685	1 488	10 916	578	3 996	140 267	1 373	33 443
Fee income (R1 000)	497 421	78 261	24 143	2 957	22 797	1 402	8 771	284 565	3 366	71 159
Net profit (R1 000)	53 976	8 823	1 746	615	6 387	297	687	26 723	377	8 321
1993										
Owners (no.)	549	102	24	9	36	13	11	224	9	121
Employment (no.)	11 558	1 606	515	78	588	122	139	6 525	148	1 837
Salaries (R1 000)	720 770	82 348	27 275	3 131	32 610	4 200	8 792	446 281	6 932	109 201
Fee income (R1 000)	1 649 024	180 009	48 676	9 303	69 824	12 357	28 294	1 035 091	40 144	225 326
Net profit (R1 000)	162 912	23 270	2 998	2 198	9 257	2 588	4 681	85 675	5 810	26 435
	RSA	**WC**	**EC**	**NC**	**FS**	**NW**	**NP**	**GP**	**Mpu**	**KZN**

Note: abbreviations used are explained in List of Abbreviations appended to this document.

10.4 Method of interpolation

Having established limited benchmarks for the development of a number of national and provincial time series, a method had to be devised to interpolate between the benchmarks established for 1987 and 1993. The resultant series will then be used to extrapolate values outside the range between the two censuses, i.e. from 1980 to 1987 and from 1993 to 1997.

The SAFCEC economist, Henk Langenhoven, captured the official data published by the central statistical service (STATSSA) on "Actual and expected capital expenditure by the public sector" [200] for the period 1980 to 1997 by

statistical region. He then reformatted the captured data to provincial data by matching statistical regions with new provincial boundaries [95]. The resultant data provided provincial construction industry and consulting engineering industry trends for the period 1980 to 1997 that could be used in the interpolation and extrapolation process to develop historic time series.

This information on capital expenditure by the public sector was used to provide trends for activity in the consulting engineering industry from the basis of the census benchmarks. The public sector capital expenditure data was selected because a high proportion (refer to 9.2.3.2) of the total turnover of the South African consulting engineering industry originates from public sector capital expenditure. Apart from this aspect of a good correlation between the capital expenditure by the public sector and the economic activity in the consulting engineering industry, no other relevant annual data that provide a suitable regional breakdown could be found.

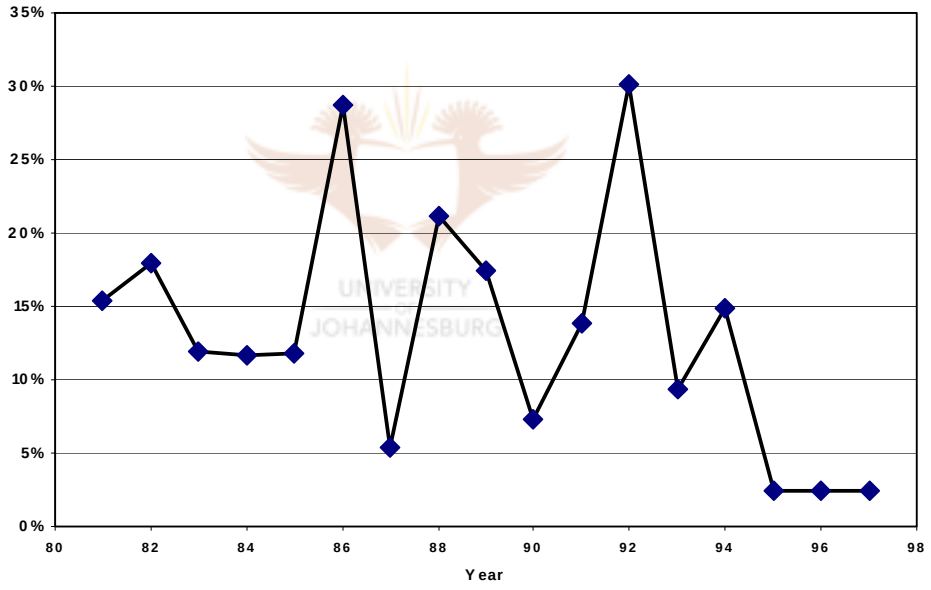
10.5 Consulting engineering price escalation

An index had to be determined for cost escalation in the South African consulting engineering industry for use in constructing the time series. It was found that the indices published by Statistics South Africa (STATSSA) [196] for the group "Finance, insurance, real estate and business services", under which consulting engineering is included, did not provide a reasonable reflection of cost escalation in the consulting engineering industry. The hourly fee rates as published from time to time in the Government Gazette [44] were therefore used as being more appropriate to the consulting engineering industry. These fee rates were negotiated annually at a fees forum where consulting engineers

have to substantiate requests for adjustments in their official hourly fee rates with proof of actual cost increases in the industry. The indices were estimated for those years when updated hourly fees were not published. The resultant values used for year-on-year consulting engineering price escalation in constructing the historic time series are shown in Figure 10.1. The unrealistically low escalation figures shown for the period after 1994 can be ascribed to administrative inefficiencies in government and/ or interventionist policies as discussed in 4.2.2.

FIGURE 10.1

Consulting engineering year-on-year price escalation



10.6 Developing the national series

National series were developed for the period 1980 to 1997 by following the crude procedure as described in the following sections.

10.6.1 Fee income

The ratios of fee income to construction value were calculated for the two census years (8,8% in 1987 and 15,0% in 1993) and are shown in bold in Table 10.2. Ratios for the years between the censuses were interpolated using standard compound interest calculation methods [30] as described in Annexure 4. The ratio for 1980 was assumed to be the same as that for 1991 on the basis of the public sector capital expenditure trends from the reformatted (section 10.4) "Actual and expected capital expenditure by the public sector" data [200] for the period 1980 to 1997 and the average gazetted percentage fee scales at the time. The ratios for the intermediate period (1980 to 1987) were again interpolated using the same compound interest method as before. The ratios for the period 1993 to 1997 were estimated by assuming that the ratio declined linearly towards 1997 to the average ratio reached between 1987 and 1993, the value of which is in keeping with the public sector capital expenditure trends as well as the average gazetted fee scales and market-related fee scales in the private sector in 1997. The resultant ratios are shown in Table 10.2.

TABLE 10.2

Estimated historic ratios of fees as a percentage of construction value

Year	80	81	82	83	84	85	86	**87**	88
Ratio: fees/construction	0.126	0.120	0.114	0.108	0.103	0.098	0.093	**0.088**	0.096

Year	89	90	91	92	**93**	94	95	96	97
Ratio: fees/construction	0.105	0.115	0.126	0.137	**0.150**	0.142	0.135	0.127	0.120

These estimated ratios were applied to the public sector capital expenditure values for the corresponding years to determine estimated nominal total fee income for each year. The nominal figures were adjusted for inflation using the

estimated index of cost escalation for the South African consulting engineering industry shown in Figure 10.1. The resultant historic time series for estimated consulting engineering fee income from 1980 to 1997 is shown in Table 10.3.

TABLE 10.3

Historic time series for estimated fee income

[Fees in R 1 000's]

Year	80	81	82	83	84	85	86	**87**	88
Nominal fee income	549120	579855	519686	522486	498658	505589	479396	**497421**	674193
Fee income ('96=100)	4211106	3859353	2943279	2645183	2256707	2045313	1508383	**1482725**	1660148

Year	89	90	91	92	**93**	94	95	96	97
Nominal fee income	1012543	1460667	1610310	1491840	**1649024**	1498700	1541410	1705680	2033880
Fee income ('96=100)	2123929	2852617	2763667	1964916	**1987098**	1571850	1578579	1705680	1985990

10.6.2 Salaries

The ratios of salaries to fee income were calculated for the two census years (1987 and 1993) and are shown in bold in Table 10.4. It is of interest that the ratio of salaries to fee income has been declining from 1987 (50,3%) to 1993 (43,7%). This can probably be ascribed to increasing computerisation and automation of design office functions during this period. Ratios for the years between the censuses were interpolated and then extrapolated over the entire period (1980 to 1997), using the same methods as described in 10.6.1.

These estimated ratios were applied to the fee income values for the corresponding years to determine estimated expenditure on salaries for each year. The ratios and the resultant historic time series for estimated expenditure

by the consulting engineering industry on salaries are shown in Table 10.4 for the period 1980 to 1997.

TABLE 10.4

Ratios and historic time series for estimated salaries

[Salaries in R 1000's]

Year	80	81	82	83	84	85	86	**87**	88
Ratio: salaries/fees	0.437	0.446	0.455	0.464	0.474	0.483	0.493	**0.503**	0.491
Salaries	240014	258587	236454	242549	236181	244319	236359	**250219**	331291

Year	89	90	91	92	**93**	94	95	96	97
Ratio: salaries/fees	0.480	0.469	0.458	0.447	**0.437**	0.428	0.420	0.411	0.403
Salaries	486035	684911	737601	667518	**720770**	641964	647053	701690	819973

10.6.3 Profit margins

The census data shows that profitability (net profits as a percentage of fee income) declined from 10,9% in 1987 to 9,9% in 1993 in spite of the decline in the ratio of salaries to fee income during the same period as reported in 10.6.2. Ratios for the years between the censuses were interpolated and then extrapolated over the entire period (1980 to 1997), using the same methods as described in 10.6.1.

These estimated ratios were applied to the fee income values for the corresponding years to determine the estimated net profit for each year. The ratios and the resultant historic time series for estimated net profit are shown in Table 10.5 for the period 1980 to 1997.

TABLE 10.5

Ratios and historic time series for estimated net profit

[Profit in R 1000's]

Year	80	81	82	83	84	85	86	**87**	88
Ratio: profit/fees	0.099	0.100	0.101	0.103	0.104	0.106	0.107	**0.109**	0.107
Net Profit	54249	58058	52736	53736	51978	53411	51327	**53976**	72023

Year	89	90	91	92	**93**	94	95	96	97
Ratio: profit/fees	0.105	0.104	0.102	0.100	**0.099**	0.097	0.096	0.097	0.099
Net Profit	106489	151235	164142	149706	**162912**	145100	147975	165451	201354

10.6.4 Employment

Employment was chosen as a study area as the level of employment is an important indicator of the reaction of an industry to its external business environment. Changes in employment level reflect changing economic activity and productivity levels in an industry.

Ratios had to be established between the number of people employed and the amount of fees earned. It was found that nominal fee income did not correlate with the number of people employed, but that inflation adjusted fee income did correlate with employment figures. The census data shows a decrease in the number of people employed to earn R1 million in fees from 1987 (6,754) to 1993 (5,817). This can probably, as in the case of salaries (described in 10.6.2), be ascribed to the increasing use of information technology and the automation of design office functions during this period.

Ratios of people employed per inflation adjusted fee income earned for the years between the censuses were interpolated and then extrapolated over the

entire period (1980 to 1997), using the same methods as described in 10.6.1. These estimated ratios were applied to the inflation adjusted fee income for the corresponding years to determine estimated employment figures for each year. The ratios and the resultant historic time series for employment are shown in Table 10.6 for the period 1980 to 1997.

TABLE 10.6

Ratios and historic time series for estimated number of people employed

Year	80	81	82	83	84	85	86	**87**	88
Ratio: people/ inflation Adjusted fees	5.817	5.942	6.070	6.201	6.335	6.472	6.611	**6.754**	6.588
Number employed	24494	22932	17866	16403	14296	13236	9972	**10014**	10937

Year	89	90	91	92	**93**	94	95	96	97
Ratio: people/ inflation Adjusted fees	6.426	6.268	6.114	5.963	**5.817**	5.700	5.586	5.474	5.365
Number employed	13648	17879	16896	11717	**11558**	8960	8818	9338	10655

10.6.5 Ownership

Ownership was chosen as a study area as it was assumed that changes in company structure should be reflected in the number of owners as a proportion of the number of people employed. Changes in ownership trends could therefore provide another indication of how the industry reacted to the changing business environment.

The census data shows a decrease in the ratio of owners per employee from 0,055 in 1987 to 0,047 in 1993. This indicates growth of large firms during that period and possibly an increased gearing of the billable time of owners and management by employing more junior staff and non-professionals. This trend can further be an indicator that, during that period, firms were increasingly

being funded from sources other than own capital provided by owners, i.e. commercially borrowed capital.

Ratios of number of owners per person employed for the years between the censuses were interpolated and then extrapolated to cover the period 1980 to 1997, using the same methods as described in 10.6.1. These estimated ratios for each year are shown in Table 10.7 for the period 1980 to 1997.

TABLE 10.7

Historic ratios for estimated number of owners

Year	80	81	82	83	84	85	86	**87**	88
Owners/ total employees	0.047	0.049	0.050	0.051	0.052	0.053	0.054	**0.055**	0.054

Year	89	90	91	92	**93**	94	95	96	97
Owners/ total employees	0.053	0.051	0.050	0.049	**0.047**	0.047	0.046	0.045	0.044

10.7 Developing regional data series

Public sector capital expenditure data was captured per statistical region and reformatted to provincial data by matching statistical regions with new provincial boundaries as described in 10.4 [95]. The nominal or unescalated value of public sector capital expenditure per province per year and the corresponding national figure per year were used to calculate the proportion of the national construction work executed in each province during each year. The relative proportions per province per year are shown in Table 10.8.

TABLE 10.8

Proportion of construction industry activity per province [95]

YEAR	National	WC	EC	NC	FS	NW	NP	GP	Mpu	KZN
80	1.000	0.159	0.061	0.044	0.059	0.032	0.041	0.286	0.132	0.185
81	1.000	0.148	0.055	0.041	0.066	0.035	0.040	0.303	0.117	0.195
82	1.000	0.150	0.056	0.040	0.083	0.036	0.056	0.280	0.108	0.191
83	1.000	0.145	0.059	0.037	0.084	0.033	0.051	0.286	0.120	0.185
84	1.000	0.140	0.062	0.034	0.084	0.031	0.047	0.291	0.133	0.179
85	1.000	0.150	0.054	0.031	0.085	0.028	0.048	0.302	0.135	0.166
86	1.000	0.148	0.054	0.030	0.089	0.027	0.048	0.304	0.132	0.168
87	**1.000**	**0.176**	**0.068**	**0.028**	**0.077**	**0.031**	**0.056**	**0.283**	**0.114**	**0.168**
88	1.000	0.205	0.083	0.026	0.065	0.035	0.065	0.259	0.096	0.165
89	1.000	0.295	0.093	0.027	0.052	0.033	0.051	0.234	0.065	0.149
90	1.000	0.322	0.067	0.028	0.059	0.027	0.046	0.220	0.068	0.163
91	1.000	0.169	0.062	0.032	0.073	0.025	0.067	0.277	0.095	0.200
92	1.000	0.199	0.050	0.024	0.063	0.021	0.066	0.280	0.127	0.169
93	**1.000**	**0.161**	**0.049**	**0.021**	**0.056**	**0.017**	**0.063**	**0.275**	**0.126**	**0.232**
94	1.000	0.151	0.051	0.025	0.056	0.036	0.038	0.162	0.105	0.377
95	1.000	0.154	0.039	0.027	0.060	0.035	0.120	0.211	0.117	0.237
96	1.000	0.185	0.045	0.083	0.056	0.056	0.051	0.189	0.099	0.236
97	1.000	0.185	0.081	0.030	0.084	0.059	0.053	0.264	0.065	0.180

Note: Abbreviations used are explained in List of Abbreviations appended hereto.

These proportions were used to estimate provincial time series similar to the national time series contained in 10.6.1 to 10.6.5. The provincial time series data is included in Annexure 1.

10.8 Conclusion and recommendations

Historic national and provincial time series were successfully constructed from very limited available secondary data using simple methods. These historic time series can now be used for rendering the primary data obtained from industry surveys useful to the industry within the shortest possible time. Chapter 9 described the initial surveys and Chapter 11 the survey process that was used to collect primary data through further regular industry surveys.