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COMPARATIVE DEMOGRAPHICS OF THE WITWATERSRAND BRANCH OF THE SOUTH AFRICAN INSTITUTE OF INDUSTRIAL ENGINEERS

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ABSTRACT

This paper researches demographic characteristics of members of the Witwatersrand branch of the South African Institute of Industrial Engineers. It draws comparisons between members and other groups of graduates concerning age, highest educational qualification, geographical place of employment, sector and type of industry. Then the type of tasks that IEs undertake is discussed both within and outside "engineering".

OPSOMMING

Die demografiese eienskappe van lede van die Witwatersrandse tak van die Suid-Afrikaanse Instituut van Bedryfsingenieurs word in die artikel ontleed. Verskille in ouderdom, hoogste akademiese prestasie, geografiese gebied waar in diens, asook sektor en tipe nywerheid, tussen lede en ander gegradueerders word bespreek. Daarna is die aktiwiteite, wat bedryfsingenieurs onderneem, beide binne en buite "ingenieurswerk" bespreek.

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1 INTRODUCTION AND IMPORTANCE.

The South African Institute of Industrial Engineers (SAIIE) comprises members who belong to four regional centres. These centres are Northern Transvaal (including Pretoria), Witwatersrand (including Johannesburg and the Vaal Triangle), Western Cape and Natal.

For such an organisation to succeed it must provide services that people need. If the organisation does not provide services other organisations arise, or alternative arrangements are made to provide these services. Organisations that do not provide such services become irrelevant. Such services depend upon the needs of these people. These people are referred to as the target market.
Needs of this target market may be obtained directly by requesting information (e.g. see Anon [2, pp. 42-48]) or it may be inferred. Inferences can be made from comparing the target market with other groups on specific characteristics. The characteristics may be sociological, psychological or demographic. Social characteristics consider groups of people such as families, or those groups bound by similar cultural and social interests, or lifestyles. Psychological variables are more concerned with individual factors such as perception, learning, motivation, personality, attitudes and values or beliefs. Demography is the study of people in the target market. It is concerned with the composition, distribution, changes and movement of people. Changes include measures of entry into the organisation, leaving and moving between centres within the organisation. Important variables in such studies include age, sex, and duration spent in the organisation.

The target market serviced by the SAIIE are people involved

in industry, educational institutions, and the profession. Sperotto [8, paragraph 2] sees the central target audience to be members, and the members of the Witwatersrand branch of the SAIIE is the target market selected.

Comparisons are drawn with various groups of engineers and graduates. These have been abbreviated to facilitate reading. The meaning of the abbreviations are given in Table 1.

Table 1
Abbreviations used for various groups

Abbreviation	Meaning
WitsIE	Members of the Witwatersrand branch of the South African Institute of Industrial Engineers.
I.E.	White male graduate industrial engineers.
I.E.+	White male graduates who are described as agricultural, electrical/mechanical, industrial, metallurgical, mining and other.
Eng.	White male graduates who are described as chemical, civil, electrical, mechanical and structural engineers only.
Eng.+	White male graduates who are described as all engineers. They are also called graduate engineers by van Blaricum [5].
Umps	All white male graduates.

Comparative statistics may be of interest to members and helpful to those establishing a programme of action for the SAIIE Witwatersrand branch.

2 DEMOGRAPHICS.

The demographics considered in this study are age, highest educational qualification, geographic place of employment, sector and type of industry. Then the type of tasks that IEs undertake is discussed both within and outside "engineering". Virtually all Industrial Engineers are males (1 female in the Witwatersrand branch). Comparisons are made where relevant information could be found.

2.1 Age

An age profile of all graduate white male engineers may be compared to those industrial engineers in the Witwatersrand branch in Table 2.

Table 2
Age Profiles of Engineers

	Graduate Engineers		Wits IEs	
Age years	Number	Percentage	Number	Percentage
Over 65	82)			
60-64	145)	9,1	9	5,7
55-59	220	8,8	8	5,0
50-54	151	6,1	9	5,7
45-49	215	8,6	8	5,0
40-44	258	10,4	19	11,9
35-39	365	14,7	16	10,1
30-34	489	19,7	45	28,3
25-29	511	20,5	43	27,0
20-24	52	2,1	2	1,3
Total	2489	100,0	159	100,0
Blank			4	
Total			163	
	(Source:[5, p.17]		Source: [7])	

It may be seen in Table 2 that the distribution of ages in the Witwatersrand branch has greater percentages in the 25 to 34 year age group than graduate engineers in general. The average age of the Industrial Engineer in the Witwatersrand branch is younger than the SA graduate engineer in general. The results may be indicative of a relatively new institution. There is a lack of members in the 20 to 24 year age category. Such results may be cause for concern as, in general, the proportion of people in younger groups is increasing with time. The 2,1% quoted for the general group should be regarded as a lower bound for Industrial Engineers in the Witwatersrand branch.

2.2 Qualifications

Table 3 contains an analysis of the highest qualifications obtained. Note that diplomas are counted below degrees. Post graduate diplomas e.g. GDE is counted in with Bachelor degrees.

Table 3
Qualifications of Engineers

	Graduate Engineers		Wits IEs	
Highest Qualifications	Number	Percentage	Number	Percentage
Dr.	100	2,8	3	2,5
M.	470	13,1	28*	23,0
B.	2818	78,3	66	54,1
Dip.	209	5,8	25	20,5
	3597	100,0	122	100,1
Blank			41	
Total			163	
	(Source:[5, p.84]		Source: [7])	

(* Of these degrees 21 are MSc or variants e.g. MSc(Eng) and MPhil.; 7 are MBA, MBL or MCom.)

The table indicates that there is large percentage of people who did not supply information concerning their qualifications in the target market. The main group who did not supply information are students. The average qualification of those stating their qualifications is above that of a conventional Bachelor's degree. Virtually all Bachelor's degrees in engineering are the equivalent of a conventional honours degree. In addition some have post-graduate diplomas beyond the Bachelor's degree in engineering but are still classified with Bachelor's degrees. When compared with graduate engineers in general there is a larger proportion of members with Masters and Diploma qualifications. A quarter of Masters degrees are outside engineering science.

Some regard the highest qualification as more important in one sector of employment than others. (For example only

lecturers should proceed to higher degrees.) Data are collected on the relative proportion of degrees for white male engineers in SA in Table 4.

Table 4
Qualifications by Sector for Graduate Engineers

Highest Qualification	Public No.	Public % of group	Private No.	Private % of group	Self Employed No.	Self Employed % of group	Total No.
Dr.	41	3,8	42	2,1	17	3,3	100
M.	124	11,4	272	13,7	74	14,2	470
B.	862	78,9	1563	78,8	393	75,4	2818
Dip.	65	6,0	107	5,4	37	7,1	209
	1092	100,1	1984	100,0	521	100,0	3597

(Source: [5, p.84])

The table indicates that qualifications are equally important to engineers in all sectors of employment.

2.3 Location

The geographic distribution of industrial engineers and other white male graduates are given in Table 5 below.

Table 5
Location of Engineers

Type of Engineer	Jhb., Witwatersrand & Vaal Triangle	Pretoria	Rest of Tvl.	Whole country	Not in Jhb. Wits, Vaal Triangle. %
	<---------- Numbers ---------->				
I.E.	15	14	0	43	65
I.E.+	210	75	90	498	58
Eng.	764	128	103	2063	63
Umps	5980	3586	1938	21450	72
(Source: [4 pp. 14-17; pp. 34-38])					
WitsIE	163			424	62

(Source: [7 and 1, p. 2])

From the table, two estimates of the proportion of industrial

engineers in the Johannesburg, Witwatersrand and Vaal Triangle area may be made. The first estimate is using van Pletzen's data [4]. It appears that 35% (100%-65%) of industrial engineers are in the geographic area served by the Witwatersrand branch. The second estimate is taken from internal records. From this 38% (100%-62%) of the IEs are to be found in the Johannesburg, Witwatersrand, Vaal triangle area. This is at the same concentration as other professional engineering bodies, but it is more concentrated than other white male graduates. (Endnote 1)

Industrial engineers and other white male graduates find employment in specific sectors. Summarized information is given in Table 6 below.

Table 6
Sectorial Employment of Engineers

Type of Engineer	Public sector	Private sector	Self-employed	Whole country	Not in Public sector. %
	<---------- Numbers---------->				
I.E.	6	37	0	43	86
I.E.+	105	342	51	498	79
Eng.	720	1051	292	2063	65
Umps	8005	8553	4892	21450	63
(Source [4, pp. 14-17])					
WitsIE (Source: [7])	15	104			87

From Table 6 two estimates of the percentage of industrial engineers in the private and self-employed sector may be made. These estimates are 86 [4] and 87% [7] respectively. There is a higher proportion of IEs in the private/ self employed sector than other engineers or graduates.

Within specific sectors engineers find employment in particular industries. IEs are compared with all other graduate engineers in Table 7.

Table 7
Industrial Employment of Engineers (Numbers)

	IEs	All other Grad. Engs.	Total
Agriculture	0	16	16
Mining	4	165	169
Electricity	3	187	190
Building & Const.	0	303	303
Manufacture	31	411	442
Transport	1	144	145
Commerce	1	18	19
Finance	0	5	5
Medical Services	0	3	3
Business Services	3	516	519
Other personal services	0	1	1
Protection services	0	31	31
Govt. services	3	636	639
Not indicated	1	5	6

(Source [5, pp. 36-39])

Table 7 indicates that industrial engineers are found mainly in the manufacturing industry. (Endnote 2)

2.4 Tasks that IEs undertake

Table 8
Tasks undertaken by Industrial Engineers

Task	Number	Number	% Wits IEs (Total)	% WitsIEs Ec. active
Students	33			
Eng. in Train.	9			
Total learners		42	25,8	
Blank		16	9,8	
			35,6	
Economically active				
Prod./Indus. Eng	20			
Engineer (Other)	17			
Total Engineers		37	22,7	35,3
Managers	17			
Chief Exec./Dir.	19			
Total management		36	22,1	34,3
Consultants	12			
Lecturers	6			
Total support		18	11,0	17,1
Others e.g. analyst				
Supt., councillor		14	8,6	13,3
Total		163	100,0	100,0

Wits IEs described themselves as undertaking specific jobs. This information is summarised in Table 8.

Table 8 shows that about one third of economically active members are found in engineering, one third in management, and one third elsewhere.

Two groups are analyzed further, i.e. those in engineering, and those in management/consulting.

IEs in engineering work.

Industrial engineers are likely to undertake tasks that are similar to that of the average engineer. An analysis undertaken by the HSRC shows the proportion of time that engineers spend in different tasks. (See [5])

These are summarised in the Table 9.

Table 9
Time spent by Engineers in Various Tasks

Task	Percentage of time
Communication	14
Project management	13
Middle management	13
Administration	12
Development of design	11
Preliminary investigation	10
Detail design	6
Estimating	5
Investigating and evaluating	4
Maintenance	4
Research	3
Installation	1
Error in calculation	4
Total	100

(Derived from [6, pp. 19-21])

This table shows that, when used as engineers, about three fifths of time is spent in engineering tasks. Other tasks such as management, administration and communication take up a considerable amount of time. These areas receive little, if any, formal time by engineering educationalists.

IEs in other occupations

When members are not used as IEs they undertake diverse occupations. In order of percentage undertaking these are managers/owners/directors and then consultants.

The 1984 median income levels are given in Table 10.

If income is an important indicator, then Table 10 indicates that a reason for working in indirectly related IE occupations is the better employment opportunities. This is not the sole reason, or there would be no lecturers! (Endnote 3)

Table 10
Median Annual Incomes of Selected Occupations

Selected Occupation	Age Group	Median Annual Income Rand	Source
Industrial Engineers	25-29	20580	[5, p.35]
Industrial Engineers	30-34	31000	[5, p.35]
Private sector			
Management consultant	30-34	41000	[4, p.22]
General manager	30-34	43280	[4, p.21]
Self employed			
Manager	30-34	33000	[4, p.24]
Owner of business	30-34	36000	[4, p.24]
Public sector			
Lecturer	30-34	24380	[4, p. 19]

3 CONCLUSIONS

The membership of the Witwatersrand branch:-

* is virtually all male with predominance in the 25-35 year age group.
* is as concentrated in the Witwatersrand area as other engineering graduates.
* work mainly in the private sector or are self employed as engineers or managers in the manufacturing sector.
* spend a considerable amount of time outside the area of pure engineering. Activities which take up much time

include communication, middle management and administration.

There seems to be a split in terms of qualifications when compared to all white male graduate engineers. There seems to be a greater proportion of diplomas and Masters degrees than in other engineers.

From these conclusions members fall mainly into the self-motivated or innovative group of "Sociomonitor". (see Blem et al. [3, pp. 139-150])

The Witwatersrand committee of the SAIIE may benefit by using this information when deciding on programmes for this segment of the SAIIE.

REFERENCES

[1] AGM- Minutes of the 1989 Annual General Meeting of the SA Institute of Industrial Engineers.

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[4] MN-108, van Pletzen J., The wage structure of White male graduates in 1984, HSRC, 1984.

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[6] MN-112, Cilliers G., Benutting van elektriese, elektroniese en meganiese ingenieurs HSRC, 1985.

[7] Roll: Membership roll of the SA Institute of Industrial Engineers in the Witwatersrand, dated 6th July 1989.

[8] Sperotto F., 1989, Working Paper to Members of the SAIIE Council dated 1st August, 1989.

ENDNOTES

1 Geographical location of industrial engineers within the Witwatersrand area.

Type of Engineer	Jhb.+Rand. Number	Wits.+Vaal Number	Other Number
I.E.	8	7	
Eng.+	482	358	
(Source [4 pp. 14-17; pp. 34-38, p. 44])			
WitsIE	62	70	31
(Source [7])			

The records of the SAIIE the location of IEs within the Witwatersrand area can be further refined, and are given below.

Area	Number	Total Number	Percentage
Western Tvl.	1		
West Rand	2		
Florida/Roodepoort	3		
West of Jhb.		6	3,7
Johannesburg		55	33,7
Randburg	7		
Sandton	17		
North of Jhb.		24	14,7
East Rand	7		
Edenvale/Bedfordview	7		
Germiston Wadeville	6		
Boksburg/Benoni	9		
Alberton	2		
Secunda	3		
East Tvl	2		
East of Jhb.		36	22,1
Modderfontein/Kelvin /Kempton Park/ Halfway House		7	4,3
Vaal Triangle		10	6,1
Other Pretoria, Carnavon, U.K. etc.		6	3,7
No. Information		19	11,7
Total		163	100

2 The organisations where there are many Wits IEs are:-

Employer	Number		Percentage
Student/	32		
National Service	5		
		37	22,7
Consulting	20		
University	5		
		25	15,3
ESCOM	6		
ISCOR	4		
Parastatals		10	6,1
Private sector			
Large numbers > 4 IEs			
AECI	10		
GEC	5		
Subtotal		15	9,2
Small numbers		69	42,3
Subtotal		156	95,7
Blank		7	4,3
Total		163	100,0

The largest employer of IE's are private sector organisations which employ only one or two IEs.

3 A table of engineering salaries is given below. It compares median age, hours worked per week and income in private and public sector for 1984.
The lower figures for industrial engineers may be attributed to the lower age. It may also be argued that the term "Industrial Engineer" may have been misunderstood in 1984 and includes persons in occupations such as Work Study etc.

	Public Sector				Private Sector			
Engineer Type	No. in sample	Age yrs.	Hrs. per week	Income p.a.	No. in sample	Age yrs.	Hrs. per week	Income p.a.
Agricultural	18	37	36	27150	12	37	46	34880
Chemical	23	33	37	27270	116	34	37	32300
Civil	422	36	36	30430	415	35	37	32500
Electrical	191	37	36	33470	268	31	37	32000
Elec/Mech	8	53	42	31740	14	56	39	64500
Industrial	6	29	37	22040	37	32	37	28740
Mechanical	82	40	36	33820	223	35	38	31300
Metallurgy	7	29	36	24000	28	36	38	30100
Mining	3				57	40	43	40470

(Source [4, Table 6, p. 14])

BOOK REVIEW

International Handbook of Production and Operations Management, edited by R. Wild, Casssell: London, 1989.

The book's objective is:-
"to identify, describe and examine the principal issues and topics relating to effective Management of Production and Operations systems."
The book's stated purpose is to complement, and not complete with, available texts.

The book is in eight sections. Although Wild Claims it to follow a "quasi life cycle approach", it is a book of readings. The book places thirty five chapters in eight parts. The parts are policies and objectives (4), facilities and capacities (4), Technologies (6), research, design and development (2), planning and control (7), quality and service (4), human resources (7), and maintenance and renewal (1). The forty two authors of these chapters are from England (23), USA (6), Canada (3), Germany, Israel and South Africa (2 each). (Single authors come from Ireland, Netherlands, Norway and Switzerland.) South Africans write the first and last chapters of the book. Wild only contributes the introduction. Many authors want to associate with him. These include Steven Wheelwright of Harvard, Alistair Nicholson of the London Business School, and Samuel Eilon of Imperial College and Omega fame. Only one or two contributions are not well polished. However the contributions are current studies. People who wish to understand modern developments will find options rather than narrow beliefs. The readings are mainly free from jargon and mathematics.

There is no uniform style and no preliminary writing on each part. The book lacks an overall framework. As few want to read this type of book from cover to cover, this is not a disadvantage. There is an adequate index, essential to this type of book. Readers must use the index and chapter headings to find subjects of interest. This type of reading may not be the norm for some senior managers. However academics and senior students are well versed in studying in this manner.

Academics and practitioners in production, operations and general management should welcome this book. While the book is not useful for junior students, senior students and managers should read this book. the book bridges the town and gown. It bridges under-graduate textbooks and formal research literature. It bridges technology and management. It bridges manufacturing and general management. In summary the book builds bridges.

Anyone person, seriously trying to improve productivity or considering automating, would find the book valuable.

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