Chapter 6:   Analysis and discussion of results

6.1 Introduction

The purpose of the current chapter is to present the empirical research results. The aim of the empirical section of the research was primarily to establish whether the intervention (CIO training model) had a significant effect on the likely commercial success of an innovation, as measured by *The Innovator ©*. The two treated groups were measured against a control group without the necessary intervention undergone.

The *first* section will endow with a demographic profile of the respondents, comparing the experimental and control groups.

The *second* section converse the formation of certain "factors" on which the control and experimental groups will be compared. The reliability of each factor will be elaborated upon in this section.

The *third* section compares the control and experimental groups on these factors (as tested in the *Innovator ©* - see Addendum), and establishes if statistically the experimental groups differ from the control group.

The *first* section also provides descriptive information on each question allowing for more qualitative and in-depth interpretation.

6.2 Demographic profile of the sample

Blanche and Durrheim (1999:95) states that one of the most important conditions for experimental research is that the participants who receive one level of the independent variable are equivalent in all ways to those who receive to other levels of the independent variable. In other words the control group and the experimental groups must exhibit the same demographic characteristics.

The gender composition of the total sample, and that of the control and experimental groups, is given below.

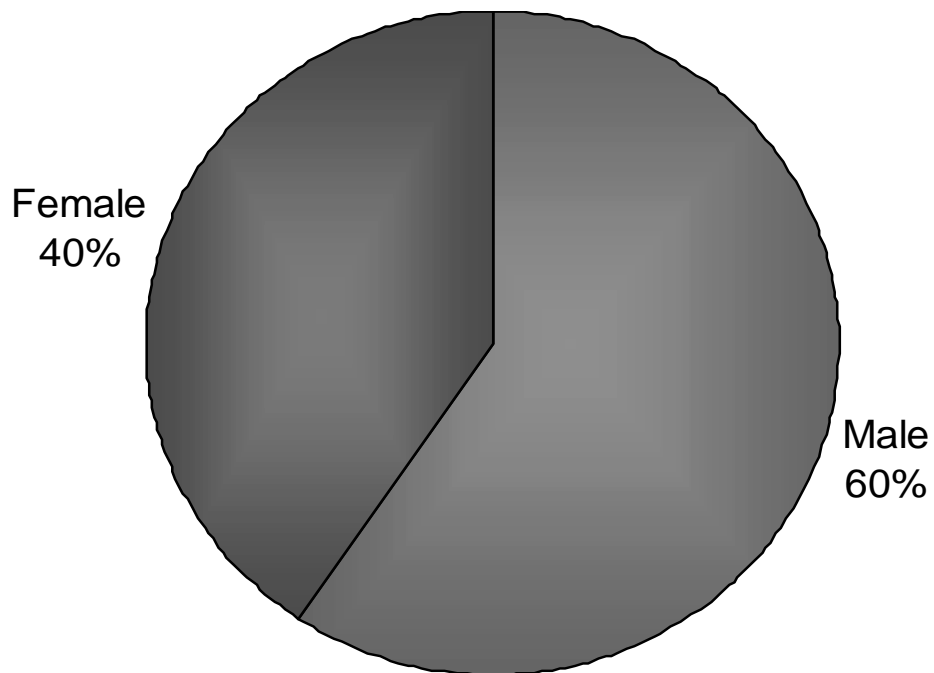**Figure 17 Gender composition of the sample**

Table 19 Gender composition of the control and experimental groups

	Group 1		Group 2		Group 3	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Male	13	59.09	45	65.22	26	52
Female	9	40.91	24	34.78	24	48
Total	22	100	69	100	50	100

No significant difference exist between the three groups in terms of their gender composition (Chi-square = 2.106; p = 0.349)

The average age of each group is given below in Table 6.2.

Table 20 Average age of respondents in the control and experimental groups

	N	Minimum	Maximum	Mean	Std. Deviation	F	Sig.
1	22	20	22	20.55	0.67	3.21	0.043
2	69	19	23	21.26	1.04		
3	50	19	31	21.50	2.11		

A post hoc Bonferoni test has shown that group 3 is significantly older on average than group 1. Group 3 is a diverse group in terms of age, with ages varying to a large extent (large standard deviation). The oldest respondent being 31 years while in the other groups the oldest respondent is 22 to 23, contributes to this group having the highest average age. Although the control group is slightly older on average, age is not considered a nuisance variable that needs to be controlled as age does not really correlate with the scores on the factors.

The home language of the total groups is provided below in Table 6.3.

Table 21   Home language of respondents (n = 141)

| Language	Frequency	Percentage
English	47	33.3
Sepedi	10	7.1
Northern-Sotho	7	5.0
Tswana	5	3.5
Afrikaans	50	35.5
French	1	.7
Siswati	1	.7
Xhosa	3	2.1
South-Sotho	6	4.3
Zulu	4	2.8
Isendebele	1	.7
Chinese	3	2.1
Venda	2	1.4
German	1	.7

With the aim of comparison between the three groups, the language groups were combined into 4 groups; Afrikaans, English and African and Other. The languages German, Chinese and French (Other) were excluded from any analysis as they are, even combined, too small to facilitate stable statistics.

Figure 18   Home language for the different groups (total n = 136)
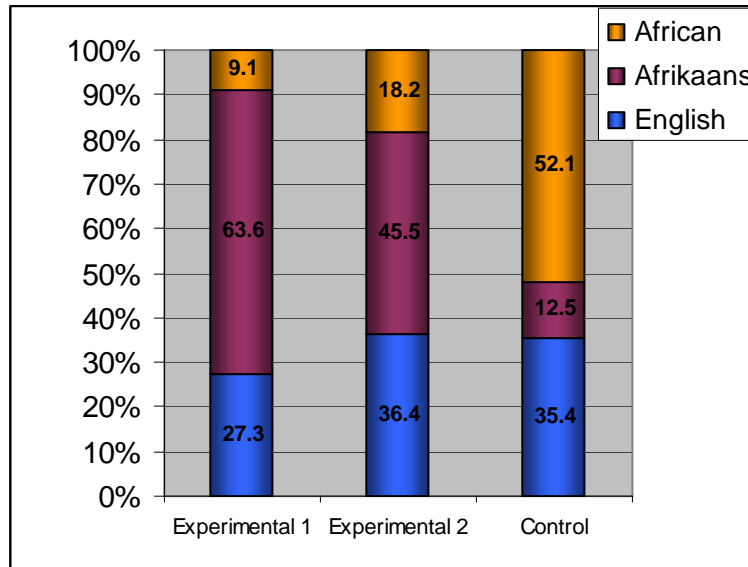
The experimental 1 and 2 show very similar language profiles, yet the control group has a notably higher amount of respondents speaking African languages. This difference is statistically significant (Chi-square = 39.92 ; p = 0.000). This profile is reflected in the race composition and there are significant differences between the three groups in terms of race (Chi-Square = 28.42 p = 0.000). Caucasian is described race group of European descent.

Figure 19   Race composition of the test groups (n = 139)
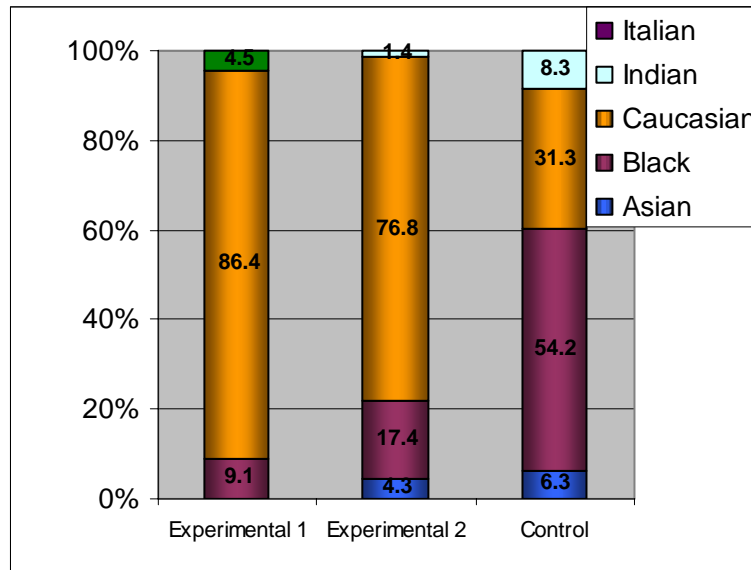
The degrees for which respondents were enrolled for is given below in table 6.4. The test groups do differ greatly in this regard, as it was part of the experiment to create two experimental groups based on their choice of degree.

Table 22 Degree enrolled for (n =108)

Qualification	Frequency	Percent
B.Com – Informatics	19	17.59
B.Com – Financial management	3	2.78
B.Com – Business management	22	20.37
Diploma – Business administration	2	1.85
B.Com – Own Choice	15	13.89
BA - Social work	6	5.56

B.Com – Marketing	9	8.33
B.Com - Economics	2	1.85
B.Com - Human resource management	1	0.93
Diploma - Pharmacy management	1	0.93
B.Com - Communication management	2	1.85
B.Com - Tourism	3	2.78
BSc - Engineering	2	1.85
B.Com – Entrepreneurship	20	18.52
B.A. – Publishing	1	0.93

The year of study also differ between the groups, with the Experimental 1 group consisting all of second year students (enrolled for the full time B.Com Entrepreneurship) while the other two groups are mostly third and forth year students (Experimental group 2 – CIO module by choice; Control group – No CIO intervention).

Table 23 Year of study of the test groups (n = 140)

	Experimental 1		Experimental 2		Control	
	Frequency	%	Frequency	%	Frequency	%
2nd year	22	100	3	4.40	0	0
3rd year			58	85.29	38	76
4th year			6	8.82	11	22
5th year			1	1.47	1	2

Table 24 Current entrepreneurial ventures (n = 49)

	Frequency	Percent
Art	4	8.16
IT	6	12.24
Telecommunication	2	4.08
Funeral service	1	2.04
Retail	16	32.65
Service	10	20.41
Tourism	2	4.08
Clothing	2	4.08
Medical	2	4.08
Other	1	2.04
Entertainment	2	4.08
Sport	1	2.04

49 respondents have one or more entrepreneurial venture. The figure below gives an indication of the extent to which each of the test groups undertakes entrepreneurial ventures.

Figure 20   Extent of entrepreneurial activity (n = 49)
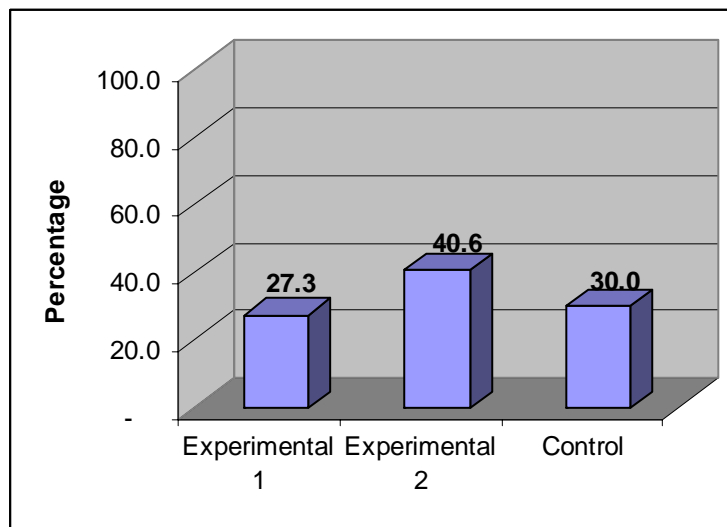
6.3 Factor creation and reliability

The factors were created on the basis of a theoretical framework. Each of the suggested factors was subjected to an item analysis as part of establishing the internal reliability. The factors were: Effects on society (legality; safety; environmental impact and societal impact); Business risk (technical/functional feasibility; production feasibility; stage of development; development cost; payback period; profitability; marketing research; research and development); Analysis of demand (potential market; product life cycle; potential sales; likely trend in market; stability of demand and potential product-line expansion); Market acceptance (learning; need; dependence; visibility; promotion, distribution and after-sale service) and Competitive advantage (appearance; function; durability; price; existing competition; new competition and protection).

6.3.1 Item analysis

The Cronbach's alpha for each factor was calculated. Each item's contribution to that Alpha is shown by indicating what the Alpha of the factor will be if that question is left out of the factor. If the Alpha increases by a large margin, when leaving out the question, to the discretion of the researcher, it is decided to leave that question out of any further analysis.

The item analysis for the first factor, Effect on society, is given below in Table 25 for full descriptions of the questions see the questionnaire in *Addendum A.*

Table 25 Item analysis for the factor: *Effect on Society*

Question number	Question description	Alpha if item deleted
1	Legality	.7232
2	Safety	.7117
3	Environmental impact	.7118
4	Societal impact	.7201
	Cronbach Alpha for the factor = 0.7712	

The factor "Effect on Society" shows a high internal reliability of 0.77.
None of the questions would, by their exclusion, increase the reliability
and all the questions were therefore used to create the final factor.

A factor is created by obtaining the mean scores over all the questions
in the item.

Table 26 Item analysis for the factor: *Business Risk*

Question number	Question description	Alpha if item deleted
5	Technical/functional feasibility	.8477
6	Production feasibility	.8493
7	Stage of development	.8402
8	Development cost	.8475
9	Payback period	.8528
10	Profitability	.8682
11	Marketing research	.8515
12	Research and development	.8515
	Cronbach Alpha for the factor = 0.867	

A particularly high internal reliability is seen for the factor "Business Risk", with all the items contributing to the reliability.

Table 27 Item analysis for the factor: *Analysis of demand*

Question number	Question description	Alpha if item deleted
13	Potential market	.7838
14	Product life cycle	.8047
15	Potential sales	.7888
16	Likely trend in market	.7835
17	Stability of demand	.8105
18	Potential product-line expansion	.7945
Cronbach Alpha for the factor = 0 .822		

Once again a very high internal reliability was obtained for the factor "Analysis of demand". None of the items were excluded, as all contribute well to the overall alpha.

Table 28 Item analysis for the factor: *Market Acceptance*

Question number	Question description	Alpha if item deleted
19	Learning	.6776
20	Need	.7024
21	Dependence	.7650
22	Visibility	.7234
23	Promotion	.6942
24	Distribution	.7076
25	After-sale service	.6828

Cronbach Alpha for the factor = 0.707

The factor "Market Acceptance" obtained a slightly lower, yet still acceptably high, internal reliability consistency value of 0.704. All the items once again work well towards the final alpha and they were all included in the final factor.

Table 29 Item analysis for the factor: *Competitive Advantage*

Question number	Question description	Alpha if item deleted
26	Appearance	.7499
27	Function	.7337
28	Durability	.7494
29	Price	.8117
30	Existing competition	.7655
31	New competition	.7881
32	Protection	.8003
Cronbach Alpha for the factor = 0.7712		

The internal validity of the factor "Competitive Advantage" may possibly be improved from an already high value of 0.77 to a value of 0.81 by the exclusion of the item "Price". The Cronbach alpha of 0.77 is considered high and a good indicator of internal reliability. It is decided to include the item in the final analysis.

As a summary on the reliability of the questionnaire it can be said that all the factors created show high internal reliability consistency, and all items contribute fairly well to each factor.

The Chi – square is also presented to indicated the nominal variables with significant differences

Table 30:   Chi-square test for differences between the three test groups in terms of gender

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.1	2	0.349
Likelihood Ratio	2.1	2	0.349
Linear-by-Linear Association	0.841	1	0.359
N of Valid Cases	141		

Table 31: Chi-square test for differences between the three test groups in terms of home language (3 main groups)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.4	4	0.000
Likelihood Ratio	29.8	4	0.000
Linear-by-Linear Association	4.4	1	0.035
N of Valid Cases	136		

6.4 Comparing the test groups on the factors of the likely commercial success of an innovation (*The Innovator* ©)

In Chapter 5 (Research procedures and methodology), the importance of controlling for nuisance variables were discussed.

In section 6.2, the demographic composition of the sample, it was observed that the three test groups are equal in terms of gender composition. Gender would therefore not be a nuisance variable, yet the groups did differ with regard to language and race compositions.

For a variable to present a sufficiently large problem to be considered a nuisance variable, it should also show a relationship with the test variables (in the present study the factors).

Table 32 below presents the ANOVA results, comparing the language groups in terms of the *The Innovator* © factors. Only the three main language groups were used for this ANOVA.

Table 32 Comparing the language groups in terms of the factors

	Sum of Squares	df	Mean Square	F	Sig.
Effect on Society	4.65	2	2.32	3.52	0.033
Business Risk	3.74	2	1.87	2.74	0.068
Analysis of Demand	4.78	2	2.39	3.53	0.032
Market Acceptance	2.23	2	1.11	2.45	0.090
Competitive Advantage	6.05	2	3.02	6.02	0.003

It is in terms of the factors Effect on Society, Analysis of Demand and Competitive Advantage where there are significant differences between

the three language groups in terms of their scores on *The Innovator ©* factors.

The Bonferroni post-hoc test found that the differences are between the African and the Afrikaans, and the African and the English speakers. The Afrikaans and English speakers tend to obtain higher scores on these factors than the African speakers.

As the control groups has a high percentage African speaking respondents, relative to the two experimental groups, this may influence any differences found in between the control and experimental groups and language should be considered a nuisance variable.

The three groups also differed in terms of racial composition, with the control group being more racially diverse.

Table 33 below provides the results of a comparison of the African and Caucasian race groups in terms of *The Innovator ©* factors. Only these groups are compared as the other race groups are too small in numbers.

Table 33 Comparing the race groups African and Caucasian in terms of *The Innovator © * factors

|	Sum of Squares	df	Mean Square	F	Sig.
Effect on Society	5.79	1	5.79	9.80	0.002
Business Risk	4.06	1	4.06	6.31	0.013
Analysis of Demand	5.95	1	5.95	9.04	0.003
Market Acceptance	2.30	1	2.30	4.83	0.030
Competitive Advantage	5.57	1	5.57	10.98	0.001

All the factors show significant differences between the two groups at the 0.05 level of significance.

The Caucasian race group scored consistently higher on all the factors. As the experimental group mostly consisted of Caucasian respondents and the control group had a large percentage African respondents, this may lead to an artificial difference between the experimental and control group, i.e. not due to the experimental effect.

Race is therefore considered a nuisance factor that will be controlled for when comparing the experimental and control groups.

A graphic plot of the mean scores on each of the factors gives an indication of the difference between the groups

Figure 21   Mean scores of the three groups on *The Innovator* ©
**   factors**
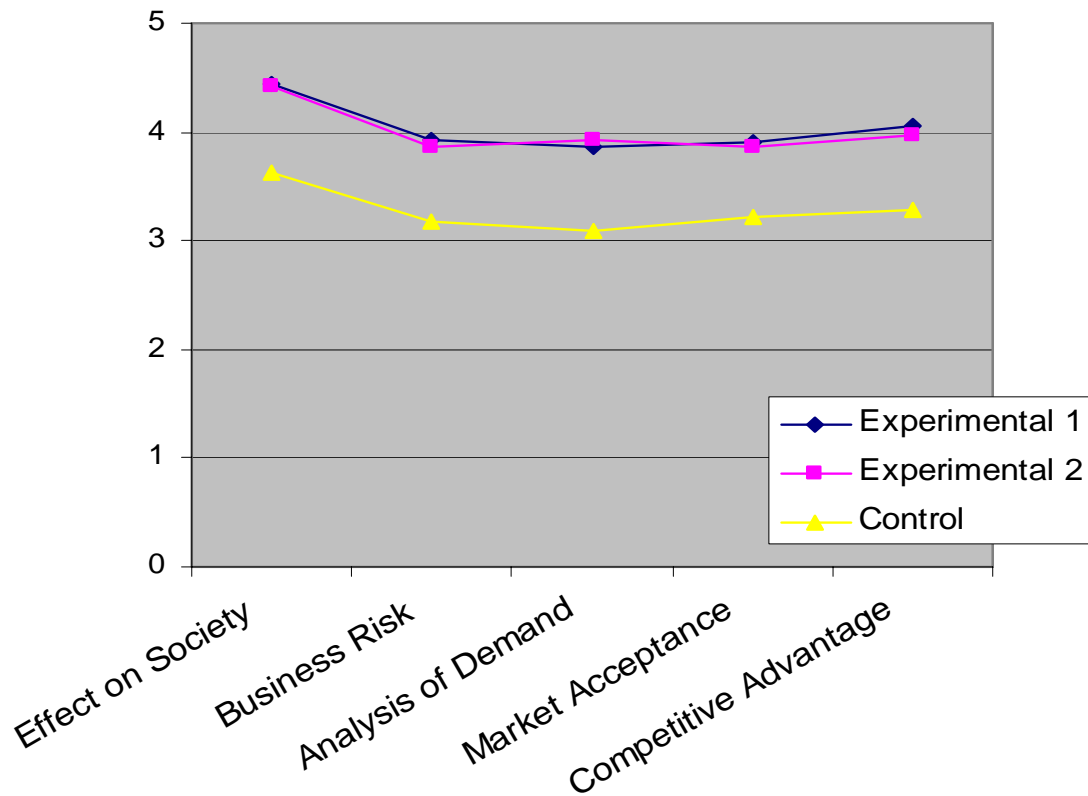
It is clear from the figure above that the control group scored much lower on all the factors than the two experimental groups. Experimental group 1 and Experimental group 2 appear very close to one another.

The table below indicates that there are indeed significant differences between the control and experimental groups. The variables "language" and "race" were controlled for in the ANOVA analysis.

Table 34   Comparison of the three test groups on
***The Innovator* © factors – ANOVA**

	Sum of Squares	df	Mean Square	F	Sig.
Effect on Society	13.9	2	7.0	14.5	0.000
Business Risk	12.1	2	6.0	11.4	0.000
Analysis of Demand	12.8	2	6.4	11.5	0.000
Market Acceptance	10.3	2	5.1	13.3	0.000
Competitive Advantage	11.5	2	5.8	13.6	0.000

All factors show a significant difference between the factors. To identify between which of the three groups the differences are, a post hoc Bonferroni test was done. An alternative method, to aid in interpretation is to conduct a t-test between each of the groups. The results are given below in Table 35.

Table 35 Size of the effect: Eta Squared

	Eta	Eta Squared
Effect on Society	0.47	0.222
Business Risk	0.42	0.174
Analysis of Demand	0.48	0.226
Market Acceptance	0.43	0.189
Competitive Advantage	0.47	0.219

The factors where the effect, difference between the experimental groups and control group, is the most significantly found in the **Effect on Society**, **Analysis of Demand** and **Competitive Advantage** factors.

All the factors show relatively high effect sizes. The difference between the groups is not only significant but also practically large.

Table 36   Comparison of the three test groups on
          The Innovator © factors – Independent t-test

	Groups 1 and 2		Groups 1 and 3		Groups 2 and 3	
	t	p-value	T	p-value	t	p-value
Effect on Society	0.13	0.894	3.54	0.001	5.61	0.000
Business Risk	0.44	0.659	3.27	0.002	4.83	0.000
Analysis of Demand	-0.53	0.598	3.51	0.001	5.92	0.000
Market Acceptance	0.22	0.826	3.38	0.001	5.03	0.000
Competitive Advantage	0.77	0.446	3.72	0.000	5.52	0.000

Between groups 1 and 2 no real difference is seen, but between both groups 1 and 3 and between 2 and 3 there are significant differences.

6.5   Discriminant analysis

To confirm the results of the ANOVA, a discriminant analysis was executed as well. It was previously found that no significant differences exist between experimental groups 1 and 2.   Some differences do appear to exist between the experimental groups and the control group however. In order to explore these differences further, it was decided to join the two experimental groups and compare them to the control group on the five factors, using a stepwise discriminant procedure.

Table 37   Descriptive statistics of factors

Group Statistics					
Dependant variable		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
Experimental	Effect on Society	4.4313	.47444	91	91.000
	Business Risk	3.8846	.55286	91	91.000
	Analysis of Demand	3.9139	.58656	91	91.000
	Market Acceptance	3.8001	.44013	91	91.000
	Competitive Advantage	3.9950	.44489	91	91.000
Control	Effect on Society	3.6276	1.04473	49	49.000
	Business Risk	3.1913	1.02022	49	49.000
	Analysis of Demand	3.0952	.95682	49	49.000
	Market Acceptance	3.1905	.84465	49	49.000
	Competitive Advantage	3.2891	.90366	49	49.000
Total	Effect on Society	4.1500	.81895	140	140.000
	Business Risk	3.6420	.81699	140	140.000
	Analysis of Demand	3.6274	.83216	140	140.000
	Market Acceptance	3.5867	.67598	140	140.000
	Competitive Advantage	3.7480	.72411	140	140.000

In the ANOVA table below, the smaller the Wilks's lambda, the more important the independent variable to the discriminant function. Wilks's lambda is significant by the F test for all variables.

Table 38: Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
GROUPA	.779	39.086	1	138	.000
GROUPB	.835	27.270	1	138	.000
GROUPC	.778	39.326	1	138	.000
GROUPD	.814	31.609	1	138	.000
GROUPE	.782	38.418	1	138	.000

All the factors are important in the table above. In the Table of Correlations below it is however clear that high inter-correlations exists between the 5 factors so that a stepwise procedure would not include them all, and was therefore not included in this analysis.

Table 39:   Pooled Within-Groups Matrices (Covariance and correlation)

		Effect on Society	Business Risk	Analysis of Demand	Market Acceptance	Competitive Advantage
Covariance	Effect on Society	.526	.322	.313	.238	.255
	Business Risk	.322	.561	.252	.310	.250
	Analysis of Demand	.313	.252	.543	.238	.283
	Market Acceptance	.238	.310	.238	.374	.265
	Competitive Advantage	.255	.250	.283	.265	.413

	Effect on Society	1.000	.592	.585	.536	.548
	Business Risk	.592	1.000	.457	.675	.519
Correlation	Analysis of Demand	.585	.457	1.000	.527	.598
	Market Acceptance	.536	.675	.527	1.000	.675
	Competitive Advantage	.548	.519	.598	.675	1.000
a The covariance matrix has 138 degrees of freedom.						

With regards to the prediction of group membership, table 40 classified the results as follows:

Table 40: Classification results

Classification Results(a)					
		Group	Predicted Group Membership		Total
			Exp.	Control	
Original	Count	Exp.	87	4	91
		Control	28	22	50
	%	Exp.	95.6	4.4	100.0
		Control	56.0	44.0	100.0
a 77.3% of original grouped cases correctly classified.					

It may be concluded that the differences between the experimental and control group can be effectively described in terms of factors a and c.