A STUDY INTO THE RATIONALE, DESIGN AND EVALUATION OF A SPECIFIC DECISION SUPPORT SYSTEM IN COMPENSATION PLANNING

Presented to the

University of Cape Town

in fulfilment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

by

Trevor Arthur Wegner

April 1987

ACKNOWLEDGMENTS

I wish to express my sincere thanks to all who made this research possible. In particular, I wish to thank my two supervisors, Professor Arthur Money and Professor David Tromp for their valuable suggestions and encouragements.

This thesis is dedicated to my wife, Shirley, and daughters Sally and Maryanne for their infinite patience and support over the past few years. My parents also deserve thanks for their support.

I certify that the thesis is my own work and all references are accurately reported.

....

TREVOR ARTHUR WEGNER

ABSTRACT

The application of newly developed information technology to managerial decision making has given rise to a new discipline known as Decision Support Systems (DSS). While considerable development of DSS has taken place since the mid-seventies, in such areas as applications, conceptual clarification of goals and characteristics, and developmental methodology, there are still certain areas which remain relatively unexplored. Two such issues are :

(i) in the **field of** *application*, the compensation planning area within the human resource discipline has been overlooked in DSS design and development methodology ; and

(ii) in the *evaluation methodology* area, there is a lack of a formal evaluation approach to DSS which concentrates on *value* rather than *cost*.

This research addresses both of these issues by formulating the following two objectives :

Objective One : to demonstrate the application of DSS concepts to the area of compensation planning within the human resource management field; and

Objective Two : to examine and propose an evaluation methodology appropriate for assessing the effectiveness of a proposed specific DSS application in compensation planning.

The research is conducted within the conceptual framework of the iterative design process of the DSS Development Life Cycle model as proposed by Meador, Guyote and Keen (1984). These phases involve *planning*, *research*, *analysis*, *design*, *construction*, *testing*, and *evaluation*. Each phase is related to the application area of compensation planning.

The major *findings* of the study can be summarised as follows.

- Both a literature study and an empirical study has established that there is a significant lack of application of information technology to support strategic human resource decision making in general and compensation planning in particular.

- These same surveys do, however, identify a need for such decision support in human resource decision making in general and compensation planning in particular.

- Decision Support Systems, by virtue of its characteristics and design and development methodology, is an appropriate tool for supporting strategic decision making in compensation planning.

- An understanding by compensation planners of the theoretical concepts of motivation and their integration into the top-down decision making approach to compensation planning, can provide an effective design specification for a prototype compensation planning DSS.

- A prototype non industry-specific microcomputer based DSS which reflects user-defined needs and incorporates appropriate DSS design and development principles can be built in the area of compensation management.

- The effectiveness of the prototype DSS in compensation planning can be gauged through the quantification using conjoint measurement and analysis of perceived DSS intangible benefits and costs.

The primary *recommendations* are for :

- the immediate implementation of DSS technology to the broader area of human resource management in a manner similar to that outlined for compensation planning;

- the implementation of the proposed evaluation methodology, not only to DSS in compensation planning, but in any DSS application area as the approaches should be identical;

- the introduction of computer appreciation courses both in-company and through centres of learning orientated towards the human resource practitioner;

- the inclusion of the compensation planning DSS developed in the study into programmes of learning to fufill the role both as a decision support tool in practice and as a training tool;

- the enhancement through a form of expert decision support systems design of the compensation planning DSS with the inclusion of employee benefits;

- the translation of the proposed evaluation methodology into an expert system format for ease of use by decision makers.

CONTENTS

	page
TITLE	i
ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
CONTENTS	vii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF APPENDICES	xvii
ATTACHMENT (COMPLAN Diskette - Inside Back Cover)	

CONTENTS

		page
CHAPTER 1	INTRODUCTION	1
1.1	Background	2
1.2	Research Objectives and Hypotheses Formulation	5
1.3	Scope and Structure of the Study	9
1.4	Limitations of the Study	13
1.5	Summary	15
CHAPTER 2	COMPUTERS IN HUMAN RESOURCE MANAGEMENT WITH SPECIFIC REFERENCE TO COMPENSATION PLANNING	17
2.1	Introduction	18
2.2	Computers and Human Resource Management : A Literature Study	18
2.3	Computers and Human Resource Management : An Empirical Study in South Africa	23
2.4	Summary and Conclusion	50

CHAPTER 3 DECISION SUPPORT SYSTEMS : A REVIEW OF ITS ROLE, DESIGN FEATURES AND FUTURE TRENDS 54

3.1 Introduction 55

3.2 A Framework for Information Systems 56

3.3 Information Structures 60

3.4 Design Considerations for DSS 65

3.5 The Development Approach to DSS 80

3.6 A Taxonomy of Decision Support Systems 83

3.7 Trends and Research in the Field of DSS 85

3.8 Summary and Conclusion 94

CHAPTER 4 REVIEW OF COMPENSATION MANAGEMENT PART 1 : ITS IMPORTANCE AND THEORIES 98

4.1 Introduction 99

4.2 Definition of Compensation 100

4.3 The Importance of Compensation 101

4.4 Compensation and Motivation 107

4.5 Summary and Conclusion 120

CHAPTER 5	REVIEW OF COMPENSATION MANAGEMENT PART 2 : DESIGN CONSIDERATIONS	123
5.1	Introduction	124
5.2	Strategic Considerations	125
5.3	Technical Design Considerations	135
5.4	Summary and Conclusion	147
CHAPTER 6	THE COMPENSATION PLANNING MODEL	152
6.1	Introduction	153
6.2	The COMPLAN Model Objectives	154
6.3	The COMPLAN Design Features	155
6.4	The COMPLAN Model Structure	158
6.6	Summary and Conclusion	188
CHAPTER 7	TOWARDS AN EVALUATION METHODOLOGY FOR DSS : LITERATURE STUDY AND METHODOLOGY	191
7.1	Introduction	192
7.2	Evaluation Research	192
7.3	Formative Evaluation in DSS	194
7.4	Summative Evaluation in DSS	195
7.5	Summary and Conclusion	218

CHAPTER 8 FORMATIVE AND SUMMATIVE EVALUATION APPROACHES : RESEARCH FINDINGS 223

8.1 Introduction 224

8.2 Analysis 224

8.3 Summary 257

CHAPTER 9 CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH 261

9.1 Introduction 262

9.2 Restatement of Research Objectives and Hypotheses 262

9.3 Conclusions 264

9.4 Recommendations for Further Research 277

9.5 Implications of Research 281

9.6 Summary 283

BIBLIOGRAPHY 285

APPENDICES 296

LIST OF TABLES

page

Table 2.1 : Distribution of Sample By Company Size 28

Table 2.2 : Distribution of Sample Across Economic Sector 28

Table 2.3 : Distribution of Respondents Showing Division of Personnel Resources Between Planning and Administrative Activities 31

Table 2.4 : Levels of Current Computer Usage In Human Resource Management 33

Table 2.5 : Levels of Desired Future Computerisation In Human Resource Management 37

Table 2.6 : Distribution of Perceived Benefits of Computerisation In Human Resource Management 40

Table 2.7 : Response Distribution To Quotation 44

Table 2.8 : Level and Nature of Computer Usage In Compensation Planning 45

Table 2.9 : Relationship Between Computer Usage In Compensation Planning and the Degree of Planning Effort 46

Table 2.10 : Relationship Between the Presence of Reporting Systems And the Usage of Compensation Planning Models 47

Table 2.11 : Desired Future Computerisation in Compensation Planning 49

LIST OF FIGURES

		page
Figure 1.1	: DSS Development Life Cycle	11
Figure 3.1	: Degree of Structuredness Across Decision Types	58
Figure 3.2	: Management Activities and Information Requirements	60
Figure 3.3	: Adaptive Design Framework	67
Figure 3.4	: Three Levels of DSS Technology	72
Figure 3.5	: Components of a DSS	76
Figure 5.1	: Alternative Pay Level Policies	132
Figure 5.2	: Probable Relationships Between Pay Level Policies and Objectives	133
Figure 6.1	: Flowchart of the Compensation Planning Model	159
Figure 6.2	: Main Menu of the COMPLAN Model	160
Figure 6.3	: Salary Database Edit Menus	163
Figure 6.4	: Illustration of the Addition of a Salary Record	164
Figure 6.5	: Illustration of the Deletion of a Salary Record	165
Figure 6.6	: Illustration of the Changing of a Salary Record	166

Figure 6.7 : Illustration of the Addition of a Salary Scale 167

Figure 6.8 : Illustration of the Deletion of a Salary Scale 168

Figure 6.9 : Illustration of the Changing of a Salary Scale 169

Figure 6.10 : Review of Current Salary Structure 171

Figure 6.11 : Graphical Display of Current Salary Structure 172

Figure 6.12 : The Scenario Selection Menu 173

Figure 6.13 : Summary of Parameter Options Selected 177

Figure 6.14 : Parameter Option Setting - Data Source Option 178

Figure 6.15 : Parameter Option Setting - Midpoint Option 179

Figure 6.16 : Parameter Option Setting - Curve Fitting Option 179

Figure 6.17 : Parameter Option Setting - Grade Spread Option 180

Figure 6.18 : Parameter Option Setting - Employee Spread Option 180

Figure 6.19 : Comparative Cost Analysis Schedule 182

Figure 6.20 : Graphical Display of Proposed Salary Structure 183

Figure 6.21 : Graph of Current and Proposed Salary Structures 184

Figure 6.22 : Schedule of Spread of Employees Across Grades 185

Figure 6.23 : Histogram of Employee Spreads for Organisation 186

Figure 6.24 : Histogram of Employee Spreads By Grade 187

Figure 8.1 : Literature Survey of Perceived DSS Benefits 231

Figure 8.2 : Benefits Identified from Empirical Study Using the Delphi Approach 232

Figure 8.3 : Dendrogram of Benefits from BMDP2M 234

Figure 8.4 : Benefit List and Designated Cluster From BMDP2M 235

Figure 8.5 : Benefit Groupings for Conjoint Analysis 236

Figure 8.6 : Fractional Factorial Design for a 3x4x4 Model 237

Figure 8.7 : Utility Values for Respondent Four from Conjoint Analysis 239

Figure 8.8 : Relative Importance of Benefit Groups for Respondent Four 240

Figure 8.9 : Statistics for Relative Importance Measures For each Benefit Group Across All Respondents 241

Figure 8.10 : Utility Sets for *Most Important* and *Null* Benefit Combinations 244

Figure 8.11 : Matched Pairs Test of Benefit Set (A_2 B_3 C_2) 245

Figure 8.12 : Nonparametric Test Results for Example One 245

Figure 8.13 : Matched Pairs Test Results of Benefit Combination (A_1 B_1 C_1) 247

Figure 8.14 : Matched Pairs Tests for Benefit (A_2) 248

Figure 8.15 : Correlations Between Utilities for the *No Cost* and the *Cost* Scenarios 250

Figure 8.16 : Matched Pairs Test for Difference in Benefit Group Means between the Two Cost Scenarios 251

Figure 8.17 : Matched Pairs Test of Benefit Sets Against Null 252

Figure 8.18 : Correlations Between Conjoint and Self-Explicated Benefit Utilities for Individual Respondents 253

Figure 8.19 : Dendrogram of Respondents from BMDP2M 255

Figure 8.20 : Correlation and Regression for Clusters 257

Figure 8.21 : Correlations for Sub-clusters of Cluster One 258

Figure 9.1 : Possible Analytical Hierarchy Process Formulation for Establishing DSS Effectiveness 280

LIST OF APPENDICES

		page
1.	Questionnaire on Computers in Human Resource Management	296
2.	Instructions to Use Demonstration Copy of the Prototype COMPLAN DSS	303
3.	Questionnaire for Formative Evaluation Study	306
4.	Questionnaire for Benefit Segmentation Study	316
5.	Questionnaire for Summative Evaluation Study : Benefit Ranking Without Cost Considerations	320
6.	Questionnaire for Summative Evaluation Study : Benefit Ranking With Cost Considerations	328
7.	Questionnaires for Summative Evaluation Study : Self-Explicated Ratings Method	330

CHAPTER 1

INTRODUCTION

1.1	Background	2
1.2	Research Objectives and Hypotheses Formulation	5
1.3	Scope and Structure of the Study	9
1.4	Limitations of the Study	13
1.5	Summary	15
	References	16

1.1 BACKGROUND.

In the field of business management, two significant trends have manifested themselves over the past decade. One has been major advances in computer technology and software. The field of Information Systems, in particular has drawn on these developments and has culminated in new dimensions. The other trend has been the growing complexity of decision making especially at the strategic level. Rapidly changing environmental conditions to which management responses are required coupled with the need to consider a growing number of factors impinging on the decision process, has contributed to this complexity (Steiner and Miner 1986 : 208).

Decision Support Systems (DSS) represents a merging of these two trends. Decision Support Systems can be distinguished from the more traditional Management Information Systems mainly through their focus on supporting semistructured and/or ill-structured decision making tasks which predominate at the strategic level.

While considerable development of DSS has taken place since the mid-seventies, in such areas as applications, conceptual clarification of goals and characteristics, and developmental methodology, there are still certain areas which remain relatively unexplored (Blanning 1983, Bonczek, Holsapple, Whinstone 1984, and Keen 1986).

In the area of applications, the literature reports on DSS uses in a variety of organisational areas but with one exception. The discipline of human resource management appears to have been overlooked. A review of applications of computer-based models, to assist the strategic decision making process in particular, indicate that the areas of finance, forecasting, diversification, insurance, production/engineering and marketing are well served (Naylor 1979, Naylor 1982, Hogue and Watson 1983 : 18). None of these studies reported any applications in the human resource field. Various studies have however focused specifically on empirical reviews of Human Resource Informations Systems (HRIS). The majority of applications of HRIS as reported by amongst others, Mathys and LaVan (1982), Richards-Carpenter (1982), Davis and Olson (1984), and DeSanctis (1986) occur at the operational and record keeping level. The use of computers in human resource managerial decision support and planning are, to a large extent, nonexistent.

The sub-area of compensation within the human resource discipline is among the most commonly computerised functions. However, its level of computerisation is almost exclusively at the administration level (DeSanctis 1986). The role of the computer to support compensation management and planning does not appear in reported studies of applications. Thus a contribution could be made to the human resource management discipline through research directed at decision support applications. One of the aims of this study then, is to promote the application of decision support concepts in the human resource field through a specific application in the area of compensation planning.

Another area of DSS research, namely that of DSS evaluation, does not appear to be satisfactorily resolved in the literature. While concensus exists amongst DSS researchers of the need to evaluate the effectiveness of DSS, an acceptable methodology has yet to be proposed (Bennet 1983 : 13). Effectiveness involves establishing value of a proposed DSS to justify continued expenditure (ibid : 7). This entails discovering the decision maker's perception towards the proposed system (ibid : 2). Apart from the value analysis approach proposed by Keen (1981) which offers a broad framework within which both costs and intangible benefits can be accommodated in a single decision process, this area of DSS methodology has not received much attention.

The value analysis approach does offer a useful basis for evaluating DSS effectiveness. However, more specific guidelines within the context of value analysis would provide a consistent and verifiable approach to DSS evaluation. This study therefore also seeks to contribute to DSS methodology on evaluation through the investigation of a quantitative approach which incorporates the numerous intangibles associated with such evaluation decisions.

1.2 RESEARCH OBJECTIVES AND HYPOTHESES FORMULATION.

The background presented above has identified two specific aspects of DSS which require further research. They are firstly, the application of DSS design and development theory to the field of human resource management of which compensation planning is an important activity; and secondly, an investigation into an objective evaluation approach to the effectiveness of DSS. These two research areas are selected as the theme for this dissertation.

Two specific statements of objectives can thus be formulated. They are :

Objective One : to demonstrate the application of DSS concepts to the area of compensation planning within the field of human resource management; and

Objective Two : to examine and propose an evaluation methodology appropriate for assessing the effectiveness of a proposed specific DSS application in compensation planning.

These two objectives provide the focus for the specific contribution of this research study. It is the intention of this research to :

- highlight the shortcomings of present human resource planning practices to use available information technology to assist with their decision making tasks;

- demonstrate, through the development of a prototype DSS in the area of compensation planning, the feasibility of incorporating this available information technology into their decision making process; and

- augment the DSS body of knowledge with an evaluation methodology for establishing objectively the effectiveness of a proposed specific DSS, while accounting for the multiplicity of intangibles involved with a DSS evaluation decision.

Since DSS occur within the context of a specific application area, relevant issues of the application discipline will be presented. In this regard, this study will also investigate the current situation of the application of information technology to the area of human resource management in general and the area of compensation management in particular.

The various research sub-objectives that can thus be formulated from the primary objective statements are the following :

- the establishment, both through the literature and empirically, of the state-of-the-art of, and the need for, the computer in the human resource functional area in general and compensation management in particular;

- a literature review of DSS design and development concepts to provide the basis for the prototype DSS application in compensation planning;

- a literature review of compensation management theory and practices to identify relevant design parameters.

- the application of DSS design and development methodology to a prototype of a non-industry specific microcomputer based Decision Support System in the field of compensation planning; and

- an investigation into a quantitative evaluation approach on DSS effectiveness with specific reference to a prototype of a compensation planning model.

These research sub-objectives can be translated into specific research hypotheses. They are :

Hypothesis One : There is a significant lack of application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Hypothesis Two : The need exists for the application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Hypothesis Three : A literature review of DSS methodology can establish the appropriateness of this discipline to compensation planning.

Hypothesis Four : A literature review of the field of Compensation Management can promote an effective design specification for a prototype compensation planning DSS.

Hypothesis Five : A prototype non industry-specific microcomputer based DSS which will reflect user-defined needs and incorporate appropriate DSS design and development principles can be designed and developed in the area of compensation management.

Hypothesis Six : The effectiveness of the prototype DSS in compensation planning can be gauged through the quantification and analysis of perceived DSS intangible benefits and costs.

1.3 SCOPE AND STRUCTURE OF THE STUDY.

This study will be conducted within a DSS Design and Development Life Cycle framework. The framework proposed by Meador, Guyote and Keen (1984 : 125) and shown in figure 1.1 provides a useful structure for the study.

The study will focus on the rationale, design, development, and evaluation of a specific DSS in the area of compensation management. Each of these phases of the DSS Development Life Cycle can be associated with the research study.

As seen from Figure 1.1, the PLANNING phase involves a user needs assessment and problem diagnosis. CHAPTER 2 is concerned primarily with this task. The rationale for the application in the area of human resource management is provided through an examination of the literature on the use of computers in this discipline. In addition, the literature findings are augmented with the results of a survey conducted amongst selected South African organisations into the role of the computer within this functional area with specific reference to the compensation planning process. The survey also identifies potential DSS application areas. Thus hypotheses ONE and TWO can be examined on the basis of the evidence provided in this chapter.

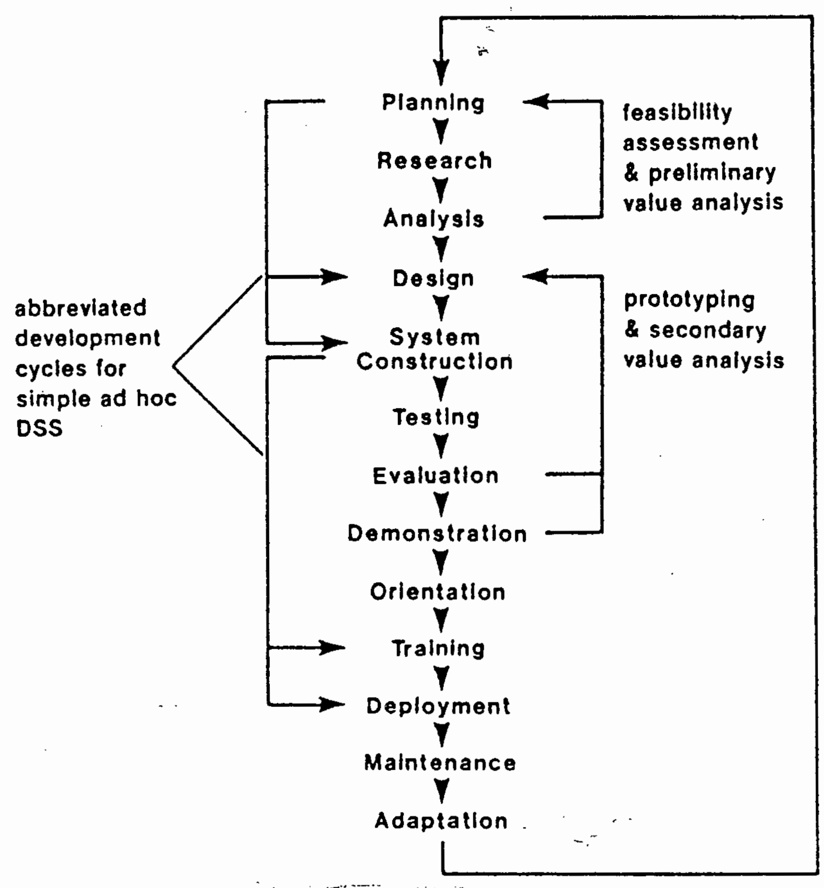
The RESEARCH phase, as described by Meador, Guyote and Keen (1984 : 124), and formulated in terms of hypothesis three, relates to the identification of relevant fundamental approaches for addressing user needs. This issue is addressed in CHAPTER 3. Here, the appropriateness of DSS versus the traditional Management Information Systems approach to decision support is examined. In addition, the concepts of DSS design and development are considered in view of the intended design of a prototype DSS in compensation planning.

A contextual ANALYSIS of the proposed application area is seen as the third phase of the DSS Development Life Cycle. This is translated into a review of the field of Compensation Planning as presented in CHAPTERS 4 and 5. Chapter 4 outlines the importance of compensation planning. It also reviews the advocated theories to develop an appreciation of the role of compensation in contributing towards worker performance and motivation. CHAPTER 5, on the other hand, identifies the strategic and technical design features relevant to the compensation planning process. Collectively then, the reviews conducted in these two chapters, namely chapters 4 and 5, relate to Hypothesis FOUR.

DESIGN (detailed specification of the system components, structure and features), SYSTEM CONSTRUCTION (technical implementation of the design), and SYSTEM TESTING (collection of data on system performance) are the next three phases of the DSS Development Life Cycle after planning, research and analysis. CHAPTER 6, drawing on criteria and procedures identified in chapters 3, 4 and 5, documents these three phases as the DSS design concepts are applied to the compensation planning process.

The resultant prototype DSS model is illustrated with hypothetical, but realistic remuneration data using a 13 grade Peromnes system. Support for hypothesis FIVE can therefore be considered on the basis of the Model presented in this chapter.

FIGURE 1.1 : DSS DEVELOPMENT LIFE CYCLE.



SOURCE : Meador C L, Guyote M J, Keen P G W (1984) p. 125.

EVALUATION and DEMONSTRATION comprise the last two phases of the DSS Development Life Cycle prior to the operational deployment of the full system capability for all members of the user community. Up to and including this phase, iterative development takes place. Prototyping and secondary value analysis to assess user acceptance characterises these two phases.

In CHAPTERS 7 and 8 the evaluation methodologies currently employed are investigated. Thereafter, a revised methodology incorporating intangibles in a quantitative approach is proposed. A review of existing evaluation approaches together with the methodology of the proposed approach is given in chapter 7. An empirical illustration of the proposed approach with specific reference to the compensation planning model is presented in chapter 8. The research presented in chapters 7 and 8 then, provide evidence for investigating hypothesis SIX.

Conclusions, recommendations and implications for the entire study are reported in chapter 9.

1.4 LIMITATIONS OF THE STUDY.

There are a number of limitations which define the boundaries of the proposed study.

- The remaining phases of the DSS development life cycle as presented by Meador, Guyote and Keen (ibid:125), pertain to the implementation of a DSS within a specific organisation. Further, the life cycle should also be viewed as part of a longitudinal study where user learning results in system adaptation over time to accomodate changed circumstances.Both these aspects (viz. implementationin a specific environment and longitudinal research) are beyond the scope of this research. This study focuses only on the initial stages of the adaptive design process as identified by Keen and Gambino (1983:153). Thus the latter phases are not applicable in the context of this study.

- The study embraces two disciplines, namely the area of DSS and that of Human Resource Management. The emphasis is on the application of DSS concepts to a specific application area, namely, that of compensation planning in Human Resource Management. For this reason, no attempt is made to provide a comprehensive review of compensation theory and practices. While chapters 4 and 5 are devoted to this topic, the intention is only to outline issues which relate to the design and development of a decision support system in compensation planning.

1.5 SUMMARY.

The application of newly developed information technology to managerial decision making has given rise to a new discipline known as Decision Support Systems. Many areas of the evolving discipline still need to be more thoroughly researched. In particular, the focus will be on the application of DSS design and development methodology to the unexplored, yet potentially rewarding area of compensation planning within the human resource discipline; and on an investigation of a quantitative decision approach to the evaluation of such systems with specific reference to the compensation planning system. The initial phases of the DSS Development Life Cycle which involves an iterative design and development procedure, will provide the framework for this study.

REFERENCES

1. Blanning, R.W. 1983. What is Happening in DSS ? INTERFACES. Volume 3 : 71 - 80.

2. Bonczek, R.H., Holsapple, C.W., Whinston, A.B. 1984. Developments in Decision Support Systems. Advances in Computers. Volume 23 : 141 - 175.

3. Davis, G.B., Olson, M. 1984. Management Information Systems : Conceptual Foundations. Second Edition. New York. McGraw-Hill.

4. DeSanctis, G. March 1986. Human Resource Information Systems : A Current Assessment. MIS Quarterly. Volume 10(1) : 15 - 27.

5. Hogue, J.T., Watson, H.J. June 1983. Management's Role in the Approval and Administration of Decision Support Systems. MIS Quarterly. Vol. 7(2) : 15 - 26.

6. Keen, P.G.W., Gambino, T.J. 1983. Building a Decision Support System : The Mythical Man-Month Revisted. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addision-Wesley. Chapter 7.

7. Keen, P.G.W. June 1986. Decision Support Systems : The Next Decade. IFIP WG 8.3 Working Conference on Decision Support Systems : A Decade in Perspective. Noordwijkerhout, The Netherlands.

8. Mathys, N., LaVan, H. 1982. A Survey of the Human Resource Information Systems (HRIS) of Major Companies. Human Resource Planning. Vol. 5(2) : 83 - 90.

9. Meador, C.L., Guyote, M.J., Keen, P.G.W. June 1984. MIS Quarterly : 117 - 129.

10. Naylor, T.H. January - February 1982. Effective Use of Strategic Planning, Forecasting, and Modeling in the Executive Suite. Managerial Planning.

11. Naylor, T.H. 1979. Corporate Planning Models. Massachusetts. Addison-Wesley.

12. Richards-Carpenter, C. May 1982. Computers in Personnel - New Needs, New Methods, New Opportunities. Personnel Management. Vol. 14(5) : 26 - 30.

13. Steiner, G.A., Miner, J.B. 1986. Management Policy and Strategy. New York. MacMillan.

2.1 INTRODUCTION.

This chapter examines the role of the computer as a decision support tool in the human resource management field. In terms of the DSS Development Life Cycle model discussed in chapter one, this chapter concentrates on the planning aspect which involves user needs assessment and problem diagnosis. This examination proceeds through initially, a literature study of computer applications in human resource management, and secondly through an empirical survey of selected South African organisations. The sub-field of compensation planning, in particular will be investigated. The resultant need for further application of information technology to this discipline can then be established.

2.2 COMPUTERS AND HUMAN RESOURCE MANAGEMENT : A LITERATURE STUDY.

Computer-based information systems, utilising strategic models and simulation techniques, are already regarded as an indespensable tool for generating information for decision making in most areas of management such as finance, marketing and production. Their use in organisations has been shown to be widespread. Both Christy and Watson (1983 : 48) and Ginter and Rucks (1984 : 15) separately reported about a 90 percent usage of such tools in surveyed organisations. A review of application areas by amongst others, Hogue and Watson (1983 : 18) and Naylor (1979, 1982) indicate that the areas of finance, production/engineering and marketing are well served. These findings are supported by Shim and McGlade (1984 : 887) who report that financial forecasting/planning models are the most common applications of planning models.

The human resource area, on the other hand, appears to be lagging behind in the application of new information technology to decision making. This contributes to the loss of both credibility and status according to Ivy (1982 : 1) and Manning (1983 : 74,75). Fitz-Enz (1982 : 6-14) has stressed the necessity for the human resource field to support its actions with reliable, quantified information rather than intuitive reasoning alone. In order to establish "Personnel in the driving seat of corporate development, there is a need for them to prove their effectiveness through the successful use of the new and better tools available to record, measure and enhance the performance of the organisation" (Manning 1983 : 77). "To fully achieve", according to Iwanski (1985 : 11), "personnel managers must use the same measurement tools line managers use".

A review of the survey literature on the use of computer models in management decision making in the human resource field reveals a general lack of application. To illustrate, a number of studies are discussed.

A survey by Richards-Carpenter (1982 : 30) conducted on over 1000 companies in the United Kingdom, revealed that the majority of organisations had no computerised personnel systems, yet more than 80 percent expressed the need for such systems. This need also served as the theme for the First national Conference and Exhibition of Computers in Personnel (1982) which was jointly sponsored by the Institute of Personnel Management and the Institute of Manpower Studies in the United

Kingdom. The need to use the computer in Personnel activities has also been expressed in the United States. The theme for the Thirteenth Annual International Conference on Human Resource Management Systems (1982) focused on 'Computer-based Human Resource Systems'.

In their survey, Christy and Watson (1983 : 48) established that only 10 percent of organisations surveyed made use of such tools in the human resource area. Hogue and Watson (1983 : 18), on the other hand, while surveying all functional areas, did not report on applications in the human resource field at all.

Studies conducted since 1980 indicate, according to DeSanctis (1986 : 16), that 40 percent of all business firms have human resource information systems. An examination of the nature of these Human Resource Information Systems reveal that the majority of applications occur at the operations and record keeping level followed by ad hoc database retrieval and routine reporting. The use of computers in managerial decision support and planning is limited (DeSanctis 1986 : 19). These findings are consistent with several prior studies (Richards-Carpenter 1982; Mathys and LaVan 1982; Klatt, Murdick and Schuster 1985 : 648) as well as with patterns of usage noted for MIS systems in general (Hennessey 1979).

Where planning models have been developed in the human resource field, the identified application areas are in manpower planning, training projects and pension fund investment (Shim and McGlade 1984 : 887; DeSanctis 1986 : 19). The application of computers to the area of compensation is present in almost every survey. However, its role is limited to being primarily administrative (DeSanctis 1986 : 18). This focus on administrative reporting systems and technical issues has led Greene and Roberts (1983 : 79) to state that "this narrow perspective has caused compensation practitioners to overlook, or underemphasise, the strategic and motivational implications of the way compensation programs are designed". Further, they "look forward to the day when the more technical issues constitute much less of a demand on productive time".

Thus the use of computers in the human resource field appears to be still largely of an administrative nature. This is particularly so in the compensation field. The need for more planning systems has been identified by researchers such as Richards-Carpenter (1982) and DeSanctis (1986 : 25). The area of compensation management is one of a number of potential areas of planning models. Russ (1984:29) describes the potential value of spreadsheets as a compensation modelling tool. He concludes though, that "currently, there are few good sources of information on the applications of personal computers in the compensation field, and no software is designed specifically for the compensation field" (ibid : 33).

Thus, from the literature, there appears to be a need for a computer based decision support tool to aid the compensation executive in his function. Such an approach does not replace the need for human judgement. It merely shifts the emphasis in compensation management heavily away from the mechanical operations and focuses strongly on the planning element with respect to policy formulation and execution as desired by Greene and Roberts. Manning (1983 : 77) supports this view by calling for "a coherent and relevant body of technology to support Personnel's role in the strategic process". This shifts the focus of application beyond the mere administrative activities. Studies by Ivy (1982) and Willie and Hammon (1981) have identified numerous areas of human resource management in which a computer based decision support system can be of use. The area of compensation management is one such area.

The literature study has identified the human resource field as an area underdeveloped with respect to the use of computers in a decision support role. Specifically, the sub-field of compensation planning has received little attention from the application of information technology advances to management decision support. Yet the literature does indicate a need for such applications. The next section presents the results of an empirical study conducted on selected South African organisations to establish the state of the art within these companies with respect to computers in human resource management.

2.3 COMPUTERS AND HUMAN RESOURCE MANAGEMENT : AN EMPIRICAL STUDY IN SOUTH AFRICA.

In South Africa, there is little published information on the role of computers in human resource management. Duursema (1984 : 16) however, summarises the position clearly by stating that "in a competitive business environment no organisation - in the long term - can afford to do without computerised personnel systems. The question is not whether to computerise, but how to obtain the best return on the investment".

To assist in identifying how and where development should proceed, a pilot field study is conducted on selected South African organisations. It should be noted that the field study is only an exploratory survey intended to augment the literature study. The nature of this augmentation involves :

- verifying trends observed in studies reported in the literature,

- providing an indication of the extent to which a similar problem exists concerning the use of computers in the human resource field within a selection of South African organisations, and

- establish the need for and nature of computerised decision support systems in human resource management.

Given the exploratory nature of this pilot survey, a strict probability sampling process was not employed. Rather, a judgemental sampling process was used where respondent organisations were selected on the basis of their likelihood of employing a computer in any aspect of human resource management. In judgement sampling, the sample elements are purposively selected because it is felt that they are representative of the population of interest .... and could offer some perspective on the research question (Churchill 1979 : 301).

The pilot study sought to identify current and potential computer usage in the human resource field in general and the specific contribution that computers can make to the area of compensation management in particular.

More specifically, the pilot survey was designed to achieve the following objectives :

- the identification of areas in human resource management where the computer is currently being used;
- the identification of areas in human resource management where future computerisation (or assistance from the computer) is most desired;
- the establishment of benefits derived from current computerisation in the human resource function; and finally
- the current and potential role of the computer in compensation planning.

2.3.1 THE SAMPLING PROCESS.

The sampling process presented by Tull and Hawkins (1976 : 154) has been applied to this study.

Initially, the *target market* was identified as human resource units within all South African organisations who are currently using a computer in any aspect of human resource work. For the purposes of this exploratory survey, a judgemental sampling process has been employed whereby only organisations more likely to use a computer in any aspect of human resource work have been identified.

For this purpose, two sources were used to specify the *sampling frame*. The primary source was the Johannesburg Stock Exchange (JSE) Handbook for all listed companies. A secondary source used was the Institute of Personnel Management (IPM) mailing list for organisations not listed on the JSE. The purpose of the IPM mailing list was to identify unlisted local and international organisations operating in South Africa, who currently may use computers in the human resource field.

The human resource department within each company identified in the sampling frame would represent a *sampling unit*. Since the sampling frame comprised only 300 organisations of which approximately 80 percent were JSE companies and the remaining 20 percent being unlisted local and foreign based companies, it was decided to survey the entire sampling frame.

2.3.2 THE QUESTIONNAIRE.

A structured questionnaire was designed to elicit the desired information pertaining to the stated objectives. The questionnaire consisted of three sections.

The first section gathered company demographics which would allow for establishing the profile of the response sample.

The second section identified both current and desired usage of the computer in the human resource field in general together with derived benefits from computerisation.

The third section dealt specifically with the current and potential role of the computer in the compensation area.

The initial questionnaire was piloted among five organisations and resulted in minor modifications. A copy of the final questionnaire is included in Appendix 1.

This questionnaire was mailed to the senior human resource person in each of the identified organisations.

2.3.3 ANALYSIS OF RESULTS.

Of the 300 companies selected, 91 responded. The final response rate was therefore 30 percent. No follow-up study was conducted on the non-respondents as the survey was only of a pilot nature and the response level is considered adequate from a mailed survey.

The results will be discussed under three sections :

- firstly, the sample profile is established,
- secondly, the findings regarding the current and potential application of computers in human resource management, and associated perceived benefits are presented, and
- finally, the findings concerning the role of computers in compensation planning are discussed.

2.3.3.1 SAMPLE PROFILE.

Initially, a profile of the response sample was determined. Two demographic factors, namely *company size* as measured in terms of the number of employees and *economic sector* were used. Table 2.1 shows a relatively even spread of respondents across all sizes of companies as measured in terms of the number of employees. Thus each size of company appears adequately represented.

TABLE 2.1 : Distribution of Sample By Company Size.

Number of Employees	%
Less than 1000	20
1001 to 3000	31
3001 to 5000	19
More than 5000	30

The spread of respondents across economic sector was examined in relation to the actual relative size of each sector. Table 2.2 presents the comparison which yields significantly similar distributions.

TABLE 2.2 : Distribution of Sample across Economic Sectors.

Sector	Sample %	Population %
Mining	6	18
Financial	18	21
Stores / Services	13	10
Industrials	57	47
Public Corp.	6	4

Thus each economic sector and size of company appears to be reasonably represented. Consequently the response sample can be regarded as a representative subset of major companies within the South African economy employing computers in the human resource area.

2.3.3.2 FINDINGS REGARDING THE CURRENT AND POTENTIAL APPLICATION OF COMPUTERS IN HUMAN RESOURCE MANAGEMENT.

This section deals with the findings regarding the use of computers in the broad field of human resource management and considers four issues.

- A general assertion concerning the degree of emphasis placed on planning activities within the human resource field is investigated.

- It identifies areas in human resource management where the computer is *currently* being *used*, and highlights those areas where there is minimal usage.

- It identifies areas in human resource management where *future computerisation* (or assistance from the computer) is most *desired.*

- Finally, it establishes *benefits derived* from current computerisation in the human resource function.

The findings from each of these areas are now presented together with concluding remarks.

(i) EXAMINATION OF A GENERAL ASSERTION REGARDING THE DEGREE OF EMPHASIS ON HUMAN RESOURCE PLANNING.

An initial question attempted to gauge the emphasis that human resource departments placed upon planning as opposed to the carrying out of administrative tasks. The assertion is made regularly - and referred to in the literature section above - that those in human resource management devote too little time and resources to both short term and long term planning for the optimal use of the organisation's human assets. Conversely, too much effort is directed towards historical record keeping and other administrative chores.

The measure used was the approximate breakdown of personnel resources allocated between these two pursuits. Table 2.3 summarises the percentage of respondents per activity for each category of resources allocated.

The results appear to substantiate the claim. Less than one- third of all respondents devoted more than half of their personnel resources to management and planning, while over two-thirds spent most of their effort on administrative activities.

TABLE 2.3 : Distribution of Respondents showing Division of Personnel Resources between Planning and Administrative Activities.

% of Total Resources	Management and Planning (%)	Administrative Activities (%)
Less than 25%	33	3
26 to 50 %	38	29
51 to 75 %	26	42
More than 75%	3	26

(ii) CURRENT COMPUTER APPLICATIONS IN HUMAN RESOURCE MANAGEMENT.

The use of computers in the field of human resource management can be divided into three broad areas, namely the *administrative* role, which is mainly the capture and replay of data (record keeping), *reporting* systems and *planning and modelling* systems.

Within each category of application, a number of distinct activities were defined in the questionnaire. Table 2.4 shows the percentage of respondents who are using the computer either *considerably*, *partly*, or *not at all* in each of the specific application areas.

(a) ADMINISTRATIVE APPLICATIONS :

As expected, the use of the computer for basic payroll processing is widespread. Eighty-three percent of all respondents have their payroll system on computer.

The capture of personal data for employee records also appears to be well advanced. However such data appears to be limited largely to basic demographic (72 percent) and job related statistics (73 percent). The capture of employee qualifications data (48 percent) is gaining ground, but that of job performance related data (useful for manpower planning) is not being undertaken by at least two-thirds of all respondents.

The computerisation of labour relations data is almost non existent. Only 7 percent of all respondents have moved into this area of human resource computerisation.

(b) REPORTING SYSTEMS :

Reporting systems essentially involve massaging historical data, such as that captured for administrative record-keeping purposes, to extract summaries, identify trends and relationships. The information generated relates mainly to the internal environment of an organisation.

TABLE 2.4 : Levels of Current Computer Usage in Human Resource Management.

	Extent of Present Usage: Not at all	Extent of Present Usage: Partly	Extent of Present Usage: Considerable	Total Usage response - average (partial + considerable)	
1 Administrative					
- Basic Payroll Processing (cheques)	17	5	78		
- Employee Records: Data capture					
• demographics (name, age, address, marital status, sex, etc.)	28	8	64	76%	
• job related (title, salary, time in job, grade, pension, med. aid)	27	13	60		62%
• qualifications (academic, skills, experience, courses completed)	52	17	31		
• job performance (merit awards, promotability ratings, training needs identified, etc.)	67	20	13	41%	
• labour relations (discipline, grievance, data, etc.)	93	4	3		
2 Reporting Systems					
- salary analysis reports	33	19	48		
- labour costing/budgeting reports	38	23	39	59%	
- salary survey reports	52	22	26		
- age analysis reports	48	16	36		
- labour turnover analysis reports	55	21	24		37%
- skills inventory and analysis reports	73	15	12		
- merit award identification reports	78	8	14		
- promotion potential reports	79	16	5	28%	
- managerial potential identific report	83	12	5		
- training needs identification reports	85	11	4		
- labour grievance analysis reports	95	4	1		
- Other					
3 Planning Systems					
- manpower planning models	75	19	6		
- compensation planning models	81	12	7		
- career path planning models	88	12	0	17%	
- organisation charting models	86	9	5		
- succession planning models	85	13	2		
- Other					

The reporting systems presented in Table 2.4 can be divided into two groups. The first group of reports (i.e. salary analysis reports, labour costing and budgeting reports, and salary survey reports) are used mainly for *compensation planning*, while the second group of reports (i.e. age analysis reports, labour turnover analysis reports, skills inventory reports, merit award identification reports, promotion potential reports, managerial potential identification reports, and training needs identification reports) form the basis for *manpower planning*.

On the whole, compensation reporting systems (59 percent) are more prevalent amongst respondents than manpower planning reporting systems (28 percent).

Within compensation reporting systems, salary analysis reports (67 percent) and labour costing and budgeting reports (62 percent) are used by more respondents than are salary survey reports (48 percent).

Manpower planning reports are confined mainly to age analysis reports (52 percent), and labour turnover analysis reports (45 percent). By far the majority of respondents (between 73 and 85 percent) are not using reporting systems that convey qualifications and job performance-type information. This can be linked to the low percentage of respondents who have captured this type of data at the administrative level. Without a well-developed data base (as set up at the administrative level), it is difficult to develop sound reporting systems.

The absence of labour grievance analysis reports (95 percent) is also symptomatic of the non-existence of a suitable labour relations data base.

(c) PLANNING AND MODELLING SYSTEMS :

Planning systems are future-orientated. They build on assumptions and somewhat ill-defined relationships to project into the future. Their role is to examine the likely outcomes of possible future events. Historical data is often the basis for these projections.

As seen from Table 2.4, computerised planning systems in the human resource field appear to be even more scarce than reporting systems.

At least three-quarters of all respondents have not progressed towards the use of computerised human resource planning systems. The only areas where there has been some progress is in manpower planning models (25 percent) and compensation planning models (19 percent). Even then, in the majority of these cases, the development has been only partial.

Apart from the absence of suitable data bases which are also necessary for planning and modelling systems, there is also a lack of commitment to human resource management and planning where such systems would be used (as established above).

(iii) DESIRED FUTURE COMPUTERISATION IN THE FIELD OF HUMAN RESOURCE MANAGEMENT.

Respondents used the same set of application areas as shown in Table 2.4 to indicate their preference for future computerisation of their human resource activities. The results shown in Table 2.5 are based upon the number of respondents who have as yet not computerised in the given application area. These percentages measure the intensity and direction which future computerisation in human resource management must follow.

(a) ADMINISTRATIVE APPLICATIONS :

In the *administrative* field, the clear preference is for augmenting the employee data base with firstly, job performance data (66 percent), and secondly, qualification-related data (54 percent).

The majority of respondents (67 percent) do not yet feel the need to capture labour relations data on the computer.

TABLE 2.5 : Levels of Desired Future Computerisation in Human Resource Management.

Application Areas	Would like %	Averaged % responses
1 Administrative		
- Basic Payroll Processing (cheques)	12	
- Employee Records: Data capture		
o demographics (name, age, address, marital status, sex, etc.)	32	
• job related (title, salary, time in job, grade, pension, med. aid)	41	
• qualifications (academic, skills, experience, courses completed)	54	60%
• job performance (merit awards, promotability ratings, training needs identified, etc.)	66	
• labour relations (discipline, grievance, data, etc.)	33	
2 Reporting Systems		
- salary analysis reports	33	
- labour costing/budgeting reports	34	32%
- salary survey reports	29	
- age analysis reports	29	
- labour turnover analysis reports	49	
- skills inventory and analysis reports	55	
- merit award identification reports	37	
- promotion potential reports	54	46%
- managerial potential identific report	46	
- training needs identification reports	53	
- labour grievance analysis reports	29	
- Other		
3 Planning Systems		
- manpower planning models	57	
- compensation planning models	58	
- career path planning models	49	53%
- organisation charting models	50	
- succession planning models	51	
- Other		

(b) REPORTING SYSTEMS :

Reporting systems derived from the augmented data bases mentioned above (i.e. job performance data and qualifications data) are most desired by the respondents. Such desired reporting systems include skills inventory reports (55 percent), promotion potential reports (54 percent), training needs identification reports (53 percent), labour turnover analysis reports (49 percent), and managerial potential identification reports (46 percent).

In aggregation, the desire for manpower planning-related reporting systems (46 percent), is greater than the desire for compensation planning-related reports (32 percent). This is understandable due to the fact that compensation planning reports are currently more prevalent than manpower planning reports. (Refer to Table 2.4 which reflects this position.)

(c) PLANNING AND MODELLING SYSTEMS :

The demand for a number of *planning and modelling* systems is consistently high. At least half of all respondents who currently have no specified computer-based planning system in human resource management would like to introduce it into their organisations.

The greatest need is for compensation planning models (58 percent) and manpower planning models (57 percent).

The trend for future computerisation in human resource management is clear. The first step is to enhance the existing employee data bases with job performance- and qualifications-related data. Such data provides the basis for expanding reporting systems in the areas of compensation planning and manpower planning. Since reporting systems are primarily historically orientated, the need for modelling capabilities in planning systems has been clearly expressed.

Thus while respondent organisations still see themselves as administratively orientated, they recognise the need to increase their emphasis on planning as shown by the expressed desire for greater computer-based reporting and planning systems.

(iv) PERCEIVED BENEFITS FROM COMPUTERISATION OF THE HUMAN RESOURCE FUNCTION.

While it is not always possible to measure in strict economic terms the benefits obtained from the use of computers in human resource management, it is possible to guage the value of using computers from the perceptions of the persons involved. Consequently respondents were presented with a list of benefits widely advocated in the literature and requested to express their own views on possible benefits. Table 2.6 summarises the benefits and the percentage respondents associated with each benefit.

The benefits can be divided into two categories namely *operational* benefits and *management* benefits. The former includes the more easily observable and measurable benefits such as clerical savings, smoother administration, improved timeliness of reports, and more accurate information.

Management benefits are less tangible and more difficult to measure. These include better control over the human resource activities, improved planning in human resource activities, easier decision making, and more time for managerial and planning activities.

TABLE 2.6 : Distribution of Perceived Benefits of Computerisation In Human Resource Management.

Benefits	%	Average % Responses
No significant improvements	0	
Clerical Savings	55	
Smoother Administration	54	55
Improved report timeliness	57	
More Accurate Information	52	
Better personnel control	35	
Improved personnel planning	30	
Facilitates decision making	36	35
More managerial/planning time	37	

Without exception, the *operational* benefits (55 percent) were highlighted by more respondents than the *management* benefits (35 percent). This is indicative of the level of computerisation which currently exists in human resource management. The majority of computer applications are currently at the administrative level (as seen from Table 2.4) where operational benefits are most obvious. At the management levels, the use of computers in decision support - such as reporting systems and more importantly, planning and modelling systems - is at a relatively low level. Consequently, the perceived benefits to management have yet to be realised.

To conclude then, the practice of human resource management in selected South African organisations, as represented by the response sample of 91 organisations, appears to be characterised by the use of computers mainly to replace a number of administrative chores. The development of computer-based information systems to support human resource decision making at the tactical level is less well-developed (as shown by the moderate use of reporting systems) and are almost non-existent at the strategic management level who would depend more on the information generated from planning and modelling systems which evaluate alternative scenarios.

However the need to move towards greater emphasis on planning and management of the human resource is recognised and the desire for decision aids to support this process has been strongly expressed.

2.3.3.3 FINDINGS REGARDING THE ROLE OF COMPUTERS IN COMPENSATION PLANNING.

The use of computers in compensation planning has been selected for further research. More specifically, this section examines the nature of the current computer usage in compensation planning and identifies the desired future association between them. Three issues are considered.

- Firstly, a *general assertion* concerning the state of the art with respect to compensation planning in selected South African organisations is examined.

- Next, the *current usage level* of computers in compensation planning, together with the nature of applications is identified.

- Finally, *future developments* of computers in this field as perceived by the compensation practitioners are established.

The findings in each of these areas are now presented together with concluding remarks.

(i) EXAMINATION OF A GENERAL ASSERTION WITH RESPECT TO COMPENSATION PLANNING.

Prior to establishing the incidence of computers in compensation planning in greater depth, a general assertion about the development and maintenance of compensation structures was tested.

It is believed that the devising of a compensation structure for an organisation is seldom a one-off, clearcut exercise which is both rational and fair. Both Smith (1984 : 1) and Whittington (1984 : 19/11) are of the opinion that all too often the approach to remuneration in industry is piecemeal and uncoordinated resulting in considerable harm to an organisation. Hackett (1979 : 171) views the normal process as a "series of updates and re-thinks, all of which are inevitably coloured by the history of what has gone before". To observe the extent to which compensation planners believe that this process can take place in a fair and rational manner, the following quotation was presented to respondents requiring their personal attitude to be expressed.

> "Rapid and often unstructured growth in organisations as well as labour pressures frequently result in pay decisions being made on an ad hoc basis with little idea of the longer term financial implications nor internal consistency. Consequently, discrepancies tend to creep into the salary structure, resulting in frequent dissatisfaction, and persistent demands for salary increases, and greater parity".

Table 2.7 summarises the responses showing the percentage of respondents per category.

A clear majority (79 percent) supported this statement. This highlights the problems that compensation planners face in the design of compensation structures to meet changing needs.

TABLE 2.7 : Response Distribution to Quotation.

Attitude	%
Strongly Disagree	4
Disagree	17
Agree	55
Strongly Agree	24

(ii) CURRENT USAGE LEVEL OF COMPUTERS IN COMPENSATION PLANNING.

The extent to which the computer is used in any way in the esign and/or review process of a company's compensation structure is moderate. Only 40 percent of all respondents who have access to computing facilities use them in this way. Table 2.8 shows the responses to the direct question on usage.

These results confirm the data given in Table 2.4 on current computer usage levels for reporting systems from which a similar usage level can be deduced based upon the *considerable* category.

TABLE 2.8 : Level and Nature of Computer Usage in Compensation Planning.

Usage	%	Nature	%
Yes	40	Historical Data Analysis	58
		Elements of Costing	24
		Modelling / Simulation	18
No	60		100

The involvement of the computer is limited primarily to analysing and reporting historical data. As shown in Table 2.8, historical reporting systems constitute the major use of computers in compensation planning (58 percent).

The use of a computer in a simulation or projective mode is largely undeveloped. Only 18 percent of respondents report any progress in this direction. Again, reference to Table 2.4 shows that most of this development is only partial.

Of interest, is the trend that emerges between the level of planning effort in personnel management activities (Table 2.3) and the nature of computer usage in compensation planning. A crosstabulation - as shown in Table 2.9 - indicates that an increase in the level of planning effort is consistent with moves towards more sophisticated computer applications in compensation management.

Further, it is useful to establish whether well-developed reporting systems are pre-requisites for the development and use of planning and modelling systems. This relationship is examined for compensation planning systems. Table 2.10 shows the proportion of respondents from each usage category for compensation planning models who have well-developed reporting systems. Only reporting systems relevant to compensation management were selected for this analysis. These include salary analysis reports,labour costing and budgeting reports, and salary survey reports.

TABLE 2.9 : Relationship between Computer Usage in Compensation Planning and the Degree of Planning Effort.

Planning Effort %	Role of the Computer			
	Historical Data Analysis %	Elements of Costing %	Modelling/ Simulation %	% of Total
<= 25	72	14	14	33
26 - 50	58	17	25	38
51 - 75	40	50	10	29
>= 75	0	0	0	0

There is a clear relationship between the availability of *good reporting systems* and the *use of compensation planning models*. It is more likely that an organisation with an advanced reporting system in compensation will have developed into planning models than an organisation with inadequate reporting procedures.

TABLE 2.10 : Relationship between the Presence of Reporting Systems and Usage of Compensation Planning Models.

Usage Level of Compensation Planning Models	% of Each Usage Level with Well-developed Reporting System in Compensation	% of Total
Not at All	26	81
Partially	70	12
Considerably	88	7

Thus the progression into planning models is more likely to occur if an organisation has had extensive experience with reporting systems. Such experience can expose the shortcomings of reporting systems as historical information generators only and now recognise the need for supplementary information of a projective nature which leads to the developement of planning and modelling systems. It is therefore reasonable to assume that an organisation must initially mature through reporting systems before being able to benefit from the more advanced modelling systems.

(iii) THE FUTURE OF COMPUTERS IN COMPENSATION PLANNING.

The preceeding analysis has established a low level of involvement of computers in the compensation planning process. Considerable use is made by only 38 percent of all respondents of computerised compensation reporting systems, while less than 7 percent report the use of computerised compensation planning systems. The need for more computer involvement in compensation planning was expressed by nearly 60 percent of those without this facility.

The nature of this future development is shown in Table 2.11. The need is clearly for a form of interactive graphics facility which allows planners to experiment with alternative scenarios (82 percent). The screen-displayed output would consist of both tabulated financial information and graphics of the resultant compensation structure. The integration of graphics and financial analysis in interactive mode was most preferred as the desired future development of computers in compensation planning.

The use of the computer as a costing device for proposed structures was requested by 72 percent of respondents, while the ability to produce pay distributions was desired by 67 percent of respondents.

TABLE 2.11 : Desired Future Computerisation in Compensation Planning.

Possible Development	% in Favour
Computer Cannot be of Any Assistance	0
Use Computer to Cost out a Proposal	72
Use Computer to Produce Visual Displays of Proposed Alternative Structures	59
Use Computer to Produce Visual Displays With Interactive Facilities to Alter Inputs	82
Use Computer to Produce Pay Distributions	67

To conclude, the direction of future computer involvement in compensation planning is clear. The role is one of decision support. The form of this decision support is the ability to evaluate alternative compensation structures interactively using a keyboard-and-screen facility and examining the output in both tabular and graphic format. The existence of business graphics facilities on both mainframes and mircrocomputers to varying degrees of sophistication and user-friendliness makes the attainment of the stated future need possible with the currently available technology.

2.4 SUMMARY AND CONCLUSION.

The literature review presented arguments identifying the human resource function as generally lacking in professionalism and calling for greater familiarity with, and involvement in the use of, quantitative tools which enhance the quality of decision making. A review of field studies has also confirmed the relatively low level of application of computers to human resource decision making. The majority of computer applications were in the administrative area.

A survey of human resource practitioners in selected South African organisations examined many of the descriptive assertions from the literature study. It also sought to establish the state of the art of computers in the human resource field in selected South African organisations.

The findings of the survey overwhelmingly support the assertions. The role of computers in most human resource departments is relegated to performing the traditional data processing activities associated with administration. Reporting systems for management are only partially developed, while planning systems are virtually non-existent.

Consequently, the support that management, and in particular top management, receive from the computer in terms of information generation for improved decision making is largely lacking. Such lack of support has the potential to manifest itself in terms of decisions which are ill-conceived, thus contributing to the non-professionalism image that is currently attached to the human resource function.

In a positive vein, this study has identified future areas of growth for human resource management in the information technology field. Practitioners appear aware of the need to develop decision support systems to enhance their decision making capabilities. This study has also identified the direction in which this development needs to take place particularly with respect to the area of compensation planning.

REFERENCES

1. Christy, D.P., Watson, H.J. October 1983. The Application of Simulation : A Survey of Industry Practice. INTERFACES Vol. 13(5) : 47 - 52.

2. Churchill,Jr. G.A. 1979. Marketing Research - Methodological Foundations. Second Edition. Illinois. The Dryden Press.

3. DeSanctis, G. March 1986. Human Resource Information Systems : A Current Assessment. MIS Quarterly. Vol. 10(1) : 15 - 27.

4. Duursema, W. November 1984. Should You Computerise the Personnel Function ? Manpower Journal. Vol. 3(7) : 16.

5. Fitz-Enz, J. May 1982. Quantifying Personnel.IPM Manpower Journal. Vol. 1(1) : 6 - 14.

6. Ginter, P.M., Rucks, A.C. June 1984. Strategic Models and Simulation : An Emerging Decision-Making Aid. Journal of Systems Management. 12-16.

7. Greene, R.J., Roberts, R.G. May 1983. Strategic Integration of Compensation and Benefits. Personnel Administrator. 79 - 82.

8. Hackett, P. 1979. Success in Management and Personnel. London. John Murray Publishers Ltd.

9. Hennessey, H,W, Jr. 1979. Computer Applications in Human Resource Information Systems. Human Resource Planning. Vol. 2(4) : 205 - 213.

10. Information Science Incorporated. Circular. Montvale, New Jersey, 15 September 1982.

11. Ivy, T. 1982. Personnel Computer Systems. London. MacGraw-Hill.

12. Iwanski, A.A.R. 1985. The Changing Scene in South Africa Today. IPM Journal. Vol. 14 : 10 - 11.

13. Klatt, L.A., Murdick, R.G., Schuster, F.E. 1985. Human Resource Management. USA. Charles E Merrill.

14. Manning, K. March 1983. The Rise and Fall of Personnel. Management Today. 74 - 77.

15. Mathys, N., LaVan, H. 1982. A Survey of the Human Resource Information Systems (HRIS) of Major Companies. Human Resource Planning. Vol. 5(2) : 83-90.

16. Naylor, T.H. January - February 1982. Effective Use of Strategic Planning, Forecasting, and Modeling in the Executive Suite. Managerial Planning.

17. Naylor, T.H. 1979. Corporate Planning Models. Massachusetts. Addison-Wesley.

18. Richards-Carpenter, C. May 1982. Computers in Personnel - New Needs, New Methods, New Opportunities. Personnel Management. Vol. 14(5) : 26 - 30.

19. Russ, H.L. May/June 1984. Information Technology 2 : Using Personal Computers to Increase the Productivity of Compensation Specialists. Personnel. Vol. 61(3) : 28-33.

20. Shim, J.K., McGlade, R. October 1984. The Use of Corporate Planning Models : Past, Present and Future. Journal of the Operational Research Society. Vol. 35(10) : 885 - 894.

21. Smith, I. 1984. The Management of Remuneration - Paying for Effectiveness. U.K. Gower.

22. Tull, D.S., Hawkins, D.I. 1976. Marketing Research : Meaning Measurement and Method. New York. MacMillan.

23. Whittington, G.P. 1984. Establishing the Exempt and Management Pay Structure. Handbook of Wage and Salary Administration. Rock M L (Editor-in-Chief) Second Edition. USA. McGraw-Hill. Chapter 19.

24. Wille, E., Hammond, V. 1981. The Computer in Personnel Work. London. Institute of Personnel Management.

25. Wolf, G., Leo, M. February 1980. A Systems Approach to Total Compensation. Business Management/Executive Compensation Report. Vol. 37(5) : 46 - 48.

CHAPTER 3

DECISION SUPPORT SYSTEMS :

A REVIEW OF ITS ROLE, DESIGN FEATURES AND FUTURE TRENDS

3.1	Introduction	55
3.2	A Framework for Information Systems	56
	3.2.1 Decision Categories	56
	3.2.2 Information Characteristics	59
3.3	Information Structures	60
	3.3.1 Management Information Systems	61
	3.3.2 Decision Support Systems	62
3.4	Design Considerations for Decision Support Systems	65
	3.4.1 Design Principles and Guidelines	65
	3.4.2 Technological Design Issues	70
	3.4.3 The Architecture of DSS	74
3.5	The Development Approach to DSS	80
3.6	A Taxonomy of Decision Support Systems	83
3.7	Trends and Research in the Field of DSS	85
3.8	Summary and Conclusion	94
	References	95

3.1 INTRODUCTION.

The need for the application of newer information technologies to the field of human resource management in general and compensation planning in particular was established in chapter 2. The next phase of the DSS Development Life Cycle is concerned with *application research.* Here relevant fundamental approaches for addressing user needs and available resources are identified (Meador, Guyote and Keen 1984 : 124). In this context, the structures designed to manage this information resource are reviewed. They have generally been referred to as Management Information Systems (MIS). However, in recent years, the term Decision Support Systems (DSS) has been increasingly used to describe the structure appropriate for the provision of information for management decision-making.

Since the focus of this study is on computer-based models to aid management decision-making, this chapter will review the concept of DSS. Within this field, a number of issues will be considered.

Firstly, a framework for decision-making within an organisation will be presented to identify the contribution of DSS to this area.

Secondly, a review of the characteristics of DSS will serve to distinguish it from the more traditional MIS approaches and provide the rationale for a distinctive design and development strategy.

Thirdly, it is appropriate to consider the design and development alternatives since this thesis, in part, involves the construction of a specific DSS in the area of compensation planning.

Finally, as a pointer to the future, trends in DSS development will be briefly reviewed.

3.2 A FRAMEWORK FOR INFORMATION SYSTEMS.

Since information systems exist to support decision making, it is necessary to consider the issues involved in their design. As McCosh, Rahman and Earl (1981 : 35) remind us, a "framework can help systems designers avoid providing inappropriate information for decision-making". Two important issues, then, in formulating a framework are

- the decision type, and
- the information characteristics.

3.2.1 DECISION CATEGORIES.

Decision making has been classified into broadly two categories. It is important to understand these classifications as they influence the nature of the information system required to support each broad class of decision types.

The two classification schemes are presented by Anthony (1965) and Simon (1960).

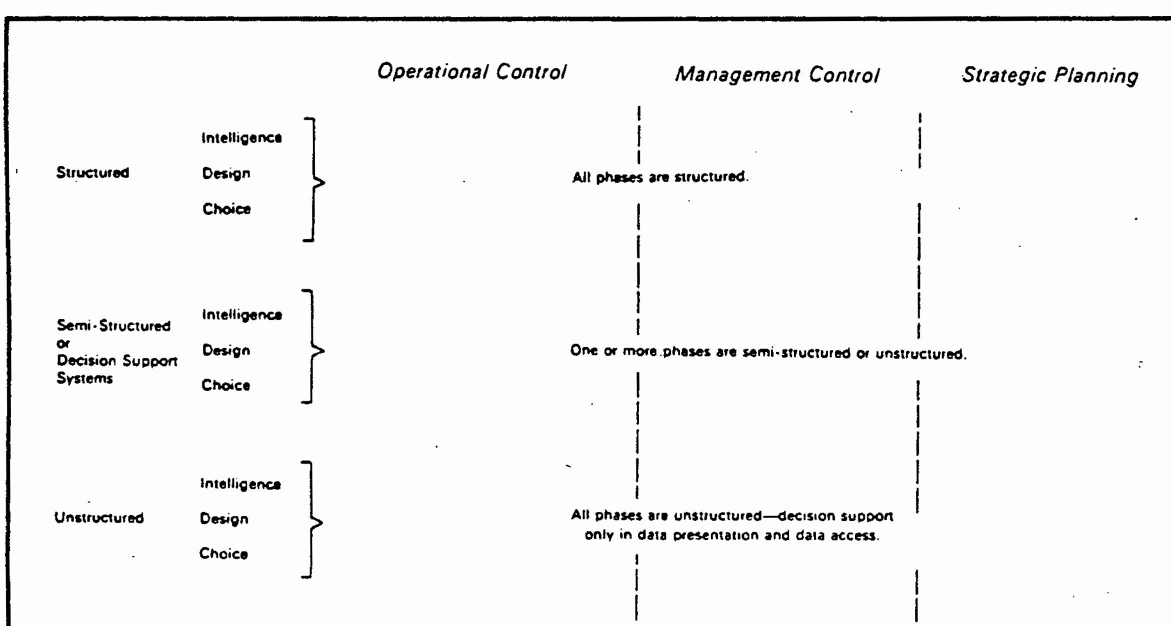
Anthony (reported in Carlson 1983 : 16) distinguished between decisions of a planning nature and of a control nature. The progression from control-based decisions toward planning decisions reflects an increasing time frame, reduced repetitiveness, increased uncertainty, greater risk and greater resources. However, Anthony makes it clear that distinctive boundaries for these categories do not exist; rather, they lie on a continuum (McCosh and Scott Morton 1978 : 35).

Simon, on the other hand, classified decisions by the degree of structuredness in a decision process. Structuredness relates to the extent to which the decision process can be described in detail prior to the decision. Unstructuredness, can occur as a "result of novelty, time constraint, lack of knowledge, large search space, need for nonquantifiable data etc" (Carlson 1983 : 16). As with Anthony's classification, the degree of structuredness in a decision is relative. In effect, as our decision-making ability and computational aids improve, so the boundaries of structure move (McCosh et al 1981 : 37).

Within each decision type, the phases of intelligence, design, and choice as a further means of understanding the decision making process can be identified (Radford 1978 : 56). This now implies that "a fully structured decision is one where all three phases of intelligence, design and choice are structured. Conversely, an unstructured problem is unstructured in all phases, whilst a problem with both structured and unstructured phases is semi-structured" (McCosh, Rahman and Earl 1981 : 37).

A synthesis of the work of Anthony and Simon by Gorry and Scott-Morton (1971), and shown in Figure 3.1, underscores an important point, namely that structured decisions are not confined to the operational decision types. Each decision type - whether it be at the strategic, control or operational level - has varying degrees of structuredness inherent within it.

FIGURE 3.1 : Degree of Structuredness Across Decision Types.



Source : McCosh,A.M., Scott Morton, M.S. (1978) p. 13.

3.2.2 INFORMATION CHARACTERISTICS.

A number of researchers have used Anthony's classification as a basis for relating managment decision making to information requirements. Gorry and Scott-Morton (1971), Kantor (1977 : 8), O'Brien (1979 : 327), and Thierauf (1982 : 14) amongst others, emphasise the progression of information requirements from micro, historical, internal data orientation at the operational management level to the macro, external, futures orientation at the strategic management level. As McCosh et al (1978 : 5) point out, "this difference is not simply a matter of aggregation, but can be found in the fundamental character of the information needed by managers in these areas".

Figure 3.2 is illustrative of the differing information requirements across the various decision types.

The combination of information requirements and decision types provides a valuable framework for information systems design. This framework should assist systems designers in providing appropriate information structures to support the various decision types.

3.3 INFORMATION STRUCTURES.

Three information structures are identified (Moore and Chang 1983 : 178, Sprague and Carlson 1982 : 9). They are EDP/TPS (Transaction Processing System), MIS and DSS. This review will consider only the latter two structures.

FIGURE 3.2 : Management Activities and Information Requirements.

Management Levels	*Primary Activities*	*Activity Results*	*Activity Examples*	*Information Requirements*
Strategic management	Long-range planning Determine organizational resource requirements and allocations	Goals Objectives Policies Long-range plans and other strategic decisions	Policy on diversification Social responsibility policy Major capital expenditure policy	Forecasts Simulations Inquiries External reports One-time reports Condensed internal reports
Tactical management	Allocate assigned resources to specific tasks Make rules Measure performance Exert control	Budgets Procedures Rules and other tactical decisions	Personnel practices Capital budgeting Marketing mix	Forecasts and historical data Regular internal reports Exception reports Simulations Inquiries
Operational management	Direct the utilization of resources and the performance of tasks in conformance with established rules	Directions Commands Actions and other operational decisions	Production scheduling Inventory control Credit management	Regular internal reports Detailed transaction reports Procedures manuals Current and historical data Programmed decisions

Source : O'Brien, J.A. (1979) p. 327.

3.3.1 MANAGEMENT INFORMATION SYSTEMS.

One of the earlier criticisms against DSS was the absence of a conceptual framework as distinct from MIS. The model presented by Gorry and Scott-Morton (1978) and illustrated in Figure 3.1 provides a useful basis for distinguishing between MIS and DSS. Most MIS development, it is argued, has been in the 'structured / operational control' cell where the decisions are more easily understood, easier to mechanise, and more readily cost-justified (McCosh et al 1981 : 38). This perspective is endorsed by Radford (1973 : 81) and Thierauf (1983 : 15-23) amongst others, who characterised MIS as emphasising *structured information flows* for the purpose of *management control*. The nature of the periodic reports reflects a mainly backward looking philosophy. Notwithstanding the progression toward real-time MIS with its ability to respond with immediate feedback on present operations (useful in modifying future plans), its principle drawback, from a management viewpoint, is its inability to generate 'futures' information for long range strategic planning.

This narrow perspective of classical MIS, as presented by Thierauf, is further endorsed by Keen (1980 : 15), Vazsonyi (1978 : 74; 1982 : 76) and Watson and Hill (1982 : 86). Management Science and MIS, they argue, has tended to focus its attention on a fairly rigid set of structured problems and has thus become unnecessarily narrow in its application. There has also been a tendency towards 'over-sophisticating' the means - the tools of the system - to the detriment of the end objective - serving the decision maker.

The conclusion then, on the role of MIS in decision making is that it serves management's needs only in a limited sense.

3.3.2 DECISION SUPPORT SYSTEMS.

Referring to Figure 3.1, it is argued that greater contributions to organisation effectiveness can be gained through the development of information structures in other than the *structured / operational* cell. Cells, notably in the semi-structured area are considered appropriate (McCosh and Scott Morton 1978 : 38). This grey area between the structured and unstructured decision types, it is argued, is appropriate for the positioning of DSS. It is here "where the system alone, or the manager alone, does not make as effective a decision as the two in combination that justifies the term Decision Support Systems" (ibid 1978 : 7,14).

Conceptually, Keen and Scott-Morton (1978 : 1) view DSS as "focus(ing) on managers' decision making activities and needs while extending their capabilities". Unlike MIS, DSS are not designed to solve problems; it lets individuals exploit their own skills in problem solving ..by stimulating changes in user thinking" (Keen and Gambino 1983 : 152).

More specifically, DSS implies the use of computer technology to *semistructured* tasks with the aim of

- supporting, rather than replacing, managerial judgement, and
- improving the effectiveness of decision making rather than its efficiency.

This description of DSS was first advocated by Keen and Scott-Morton (1978 : 1) and endorsed by numerous researchers since (Stabell 1983 : 225; Bennet 1983 : 1; Vazsonyi 1982 :76; Watson, Hill 1983 : 82; Sprague, Carlson 1982 : 6).

To elaborate, the focus is on

- less well structured, underspecified problems,
- use of models and/or analytic techniques,
- ease of use by noncomputer people,
- interactive mode of operation, and
- flexibility and adaptibility.

In contrast to the classical MIS, DSS is seen as refocusing attention and efforts on the end objective which is to serve the decision maker (Vazsonyi 1982 : 76). Even the role of the computer has changed. As Thierauf (1982 : 4) points out, the development of DSS has meant the movement of the computer out of the data processing centre and into the manager's office. The computer has become the manager's 'silent partner' for supporting more effective decision making.

While accepting that "there are sometimes boundary calls between a DSS and a MIS with sophisticated special features, Watson and Hill (1983 : 82) argue that in general, a growing number of people can tell the difference".

Continuing research and debate (such as the one intiated by Naylor 1982 : 92 - 94) has tended to clarify differences between DSS and MIS. These appear to be the following:

- DSS addresses mainly unstructured problems while MIS concentrates on the area of structured problems
- DSS places less emphasis on structured information flows by encouraging flexibility, adaptability, and quick response
- DSS is user initiated and controlled as opposed to a MIS which is managed by systems specialists
- DSS is orientated more towards the personal decision making styles of individual managers, and
- DSS focuses more on planning than control of organisation activities.

The distinction is best summarised by Watson and Hill (1983 : 87) and Sprague and Carlson (1982 : 9). The latter sees DSS as "evolving from the coelescence of information technology and OR/MS approaches in the form of interactive modelling". It is not intended to replace EDP and

MIS - rather its role is complementary. As Watson and Hill indicate, "DSS has emerged to coexist with MIS". By so doing, DSS and MIS will provide the information base from which all levels of management can benefit for planning and control purposes.

3.4 DESIGN CONSIDERATIONS FOR DECISION SUPPORT SYSTEMS.

This section will discuss design issues that have been distilled from the ideas and experiences of many researchers within the DSS movement. Only the broad design concepts used by various researchers will be presented, while detail can be obtained from the respective references. This section will consider initially the *principles* that have been formulated with respect to DSS design; secondly the *technological* aspects of design; and finally, the *architecture* of DSS.

3.4.1 DESIGN PRINCIPLES AND GUIDELINES.

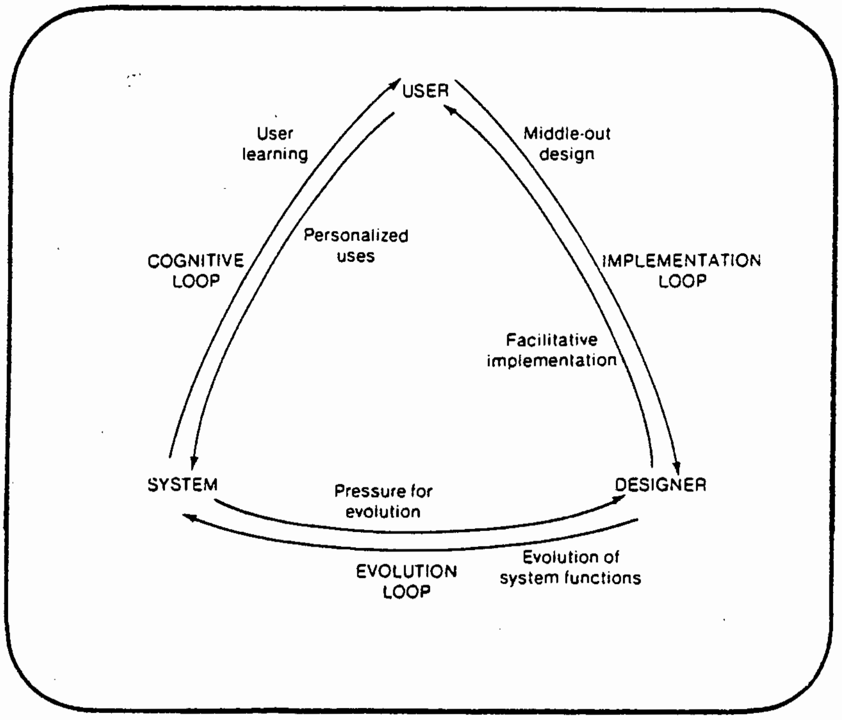
Moore and Chang (1983 : 173 - 174) synthesised ideas from existing DSS design frameworks and identified four principles. Their "meta-design" principles are intended as a guideline for individual DSS designs and emphasise the importance of the design objective of allowing for flexibility and adaptibility as mentioned above.

The four meta-design concepts relate to :

- a shift over time of the problem understanding and system design (i.e. System / problem migration);
- the expansion of system capabilities needed to match the decision maker's growing capacity to handle enhanced DSS options (i.e. Subset evolution);
- the progressive hardening up of system capabilities (i.e. "Soft" vs "hard" DSS capabilities); and
- the extent to which the interface system attempts to alter the user's decision making process (i.e. the "weak - strong" design continuum).

Implicit in these meta-design principles is the continual interaction between between the user, the designer, and the system. User learning can be seen both as an initiator and a product of DSS design. This *learning - adapting* cycle is the basis of the *adaptive design* framework proposed by Keen and Gambino (1983 : 152) and shown in Figure 3.3.

FIGURE 3.3 : Adaptive Design Framework.



Source : Bennett, J.L. (1983) p. 153.

Each of the meta-design principles can be associated with one or more of the elements of the adaptive design framework.

The *cognitive loop* emphasises the role of the DSS to stimulate changes in the user's problem solving process (similar to the "weak - stong" design continuum); and the ability of the DSS to adapt to such changes resulting from user learning (i.e. problem migration and subset evolution).

The *implementation* loop refers to the relationship between the designer and the user. All meta-design principles are involved in ensuring that the system is responsive to the user and helps stimulate exploration and learning. The 'middle-out' design which is an evolutionary design approach and used in the adaptive design model, is consistent with the principles of problem migration, subset evolution, and soft-hard capabilities - all of which imply close user involvement and feedback.

The *evolution loop* is clearly synonomous with both the principles of problem migration and subset evolution. Both recognise that user learning, the middle-out design and close user involvement combine to make the initial system obsolete, and its evolution essential.

Thus the key features which characterise a DSS design may be summarised as :

- close user involvement
- an evolutionary approach
- an active interface system
- stimulation of user learning
- initiation of changes to system design.

The implication for DSS design is that it must be an evolutionary, flexibile and adaptive approach.

These above principles describe the design environment within which specific DSS should be developed. More specific guidelines on how to proceed with a particular DSS are given by Sprague and Carlson (1982 : 20-21). Their framework is designed to be consistent with the decision making activities of users. They describe the process as consisting of :

- specific *representations* (graphs, tables) to assist in conceptualisation;
- *operations* on these representations to support Intelligence, Design and Choice activities in decision making;
- *memory aids* to support the use of representations and operations, and
- *control aids* to help the decision makers control their decision support.

This decision orientated approach to DSS design as advocated by Sprague and Carlson - and supported by Stabell (1983 : chapter 10) - should contribute to the stated DSS goal of increased decision making effectiveness rather than efficiency.

3.4.2 TECHNOLOGICAL DESIGN ISSUES.

On the technological level (i.e. hardware/software) , the design of DSS can proceed at three levels (Sprague and Carlson 1982 : 10-11). They are:

- Specific DSS
- DSS generators, and
- DSS tools.

These vary both in the nature and range of tasks that they can perform and in the levels of the technical ability of the users.

(i) SPECIFIC DSS.

The system, comprising an assembly of hardware and software, that accomplishes the work is referred to as a Specific DSS. It allows a decision maker or group of decision makers to deal with a specific set of related problems. The system capabilities will have been drawn from the remaining two technological levels, namely DSS generators and DSS tools.

(ii) DSS GENERATORS.

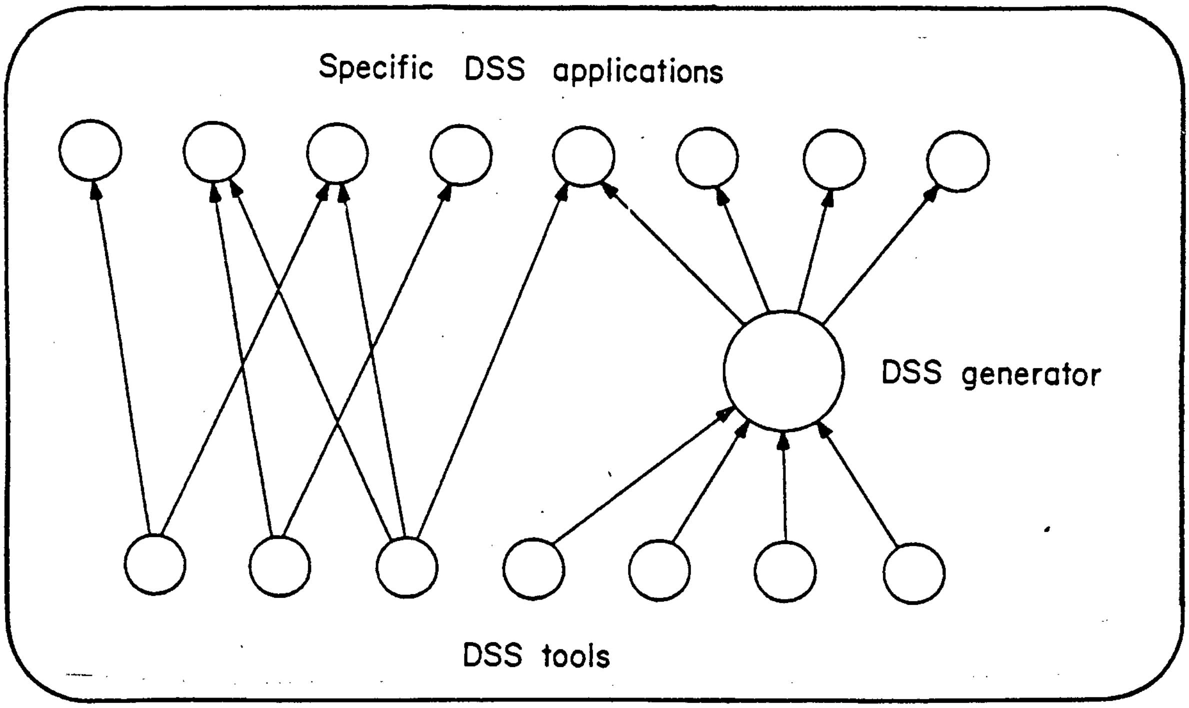
This is a package of related hardware and software that provides a set of capabilities allowing a specific DSS to be built quickly and easily. DSS generators have evolved via special-purpose languages and include planning and modelling languages with some report generation and graphic display capabilities. As noted from the properties and components of fourth-generation languages, this area of software development is facilitating the development of DSS generators (Martin 1985 : 37-38).

(iii) DSS TOOLS.

DSS tools are the hardware and software building blocks that may be used for the construction and development of a specific DSS or DSS generator. DSS tools include special-purpose languages, improvements in operating systems to support conversational type models, colour graphics, compilers, file management systems, data base management systems, etc.

The relationships between these three levels of a DSS are illustrated in Figure 3.4. As illustrated, the development of a specific DSS application can be initiated either at the DSS generator level or through the use of the DSS tools themselves. However, since it is the nature of decision support systems to evolve and hence requires flexibility in model design, the use of DSS tools becomes unwieldy and costly to implement. On the other hand, the use of DSS generators are ideal for direct user involvement in the evolution process. The objective of the DSS generator is thus to shorten the development time needed for creating a specific DSS and to encourage manager-user participation in the process as outlined above.

FIGURE 3.4 : Three Levels of DSS Technology.



Source : Sprague, Jr. R.H., Carlson, E.D. (1982) p. 12.

The DSS objectives of "getting started", user-involvement, quick feedback, and fast turnaround (Hurst, Ness, Gambino and Johnson 1983 : 125 ; Keen and Gambino 1983 : 134) are better served from the use of DSS generators than DSS tools. However Stabell (1983 : 231) warns against the over-concentration on the use of DSS generators which, because they are designed for a large number of decision situations, may be less suited to a specific decision situation and its requirements.

Although these three levels of technology are very useful for classification purposes, they are not necessarily distinct. Software packages such as IFPS, ISSPA, IRIS, BRANDAID, IMS (Keen 1981 : 2) are available for use in building decision suppport systems and can be considered as both DSS generators or DSS tools. They perform the role of a DSS generator when they allow fast and relatively easy construction of specific DSS, but the existence of graphic and report generation capabilities in these packages are functions of DSS tools.

As shown in the adaptive design framework, there are a number of parties involved in a DSS application. While the adaptive design framework highlighted only two such parties, namely the user and the designer, a third member can be added - namely a technician/'toolsmith'. The manager/user/decision maker is the person responsible for the decision and its consequences; the designer assembles the necessary capabilities from the DSS generator or tools to configure the specific DSS with which the user interacts directly; the toolsmith develops new DSS tools.

As Sprague and Carlson (1982 : 13) note, the roles do not align with individuals on a one-to-one basis. The appropriate role assignment generally depends on the following factors:

- the scope of the problem,
- the technical expertise of the individuals, and
- the nature of the technology available.

3.4.3 THE ARCHITECTURE OF DSS.

Thusfar the discussion has concentrated on the broader design issues which may be termed the design environment (i.e. principles of design, levels of technology and personnel involvement). In terms of a specific design however, a number of components can be identified in a typical DSS.

Sprague and Carlson (1982 : 27) identifies three components of a typical DSS system, namely :

- a data subsystem,
- a model subsystem, and
- a dialog subsystem.

The dialog component integrates the two other components into a single system as well as managing the interface between the user and the system. Figure 3.5 illustrates the configuration diagramatically. A similar system architecture is used by Keen and Gambino (1983 : 140) who define a system structure as consisting of a dialog manager, a data management system, and analytical commands. The commands initiate action from the system. In this sense the command-based structure is synonomous with the model subsystem term used by Sprague and Carlson. A third classification of DSS elements is given by Bonczek, Holsapple and Whinstone (1984). They describe a DSS as consisting of:

- a language system;
- a knowledge system; and
- a problem processing system.

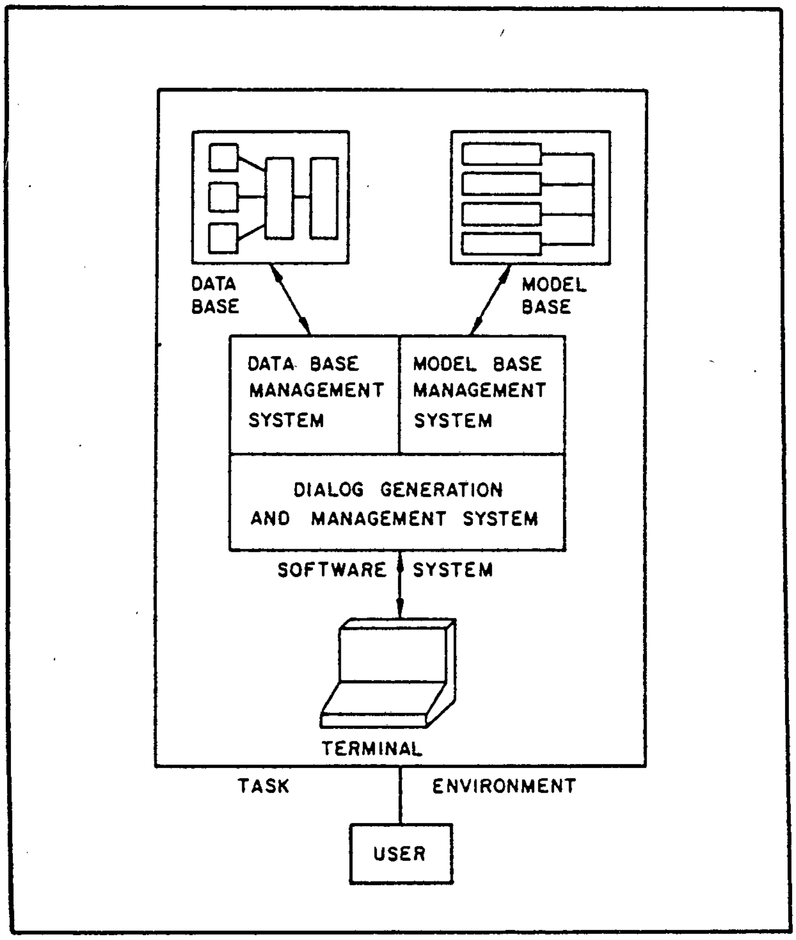
To a large extent, these three components map one-to-one onto the components identified by Sprage and Carlson. Some aspects and capabilities required in each of these components are now discussed.

(i) THE DATA SUBSYSTEM.

Access to data is central to DSS (Bennet 1983 : 10). The data base subsystem provides the data requirements of a DSS.

The field of database management and database technology is well-developed and its importance and application in the DSS environment is well understood. The database subsystem should provide a wide range of capabilites, but on the other hand, both Moore and Chang (1983 : 191,201) and Keen and Gambino (1983 : 151,168) warn against the dangers of attempting to develop too sophisticated a data management system too early in the DSS development process. Keen and Gambino see data management as a main constraint in DSS

FIGURE 3.5 : Components of a DSS.



Source : Sprague, Jr. R.H., Carlson, E.D. (1982) p. 29.

development involving high software overhead, while Moore and Chang see attempts to develop a DSS "with fully integrated access to existing large-scale corporate databases as misdirected and leading to costly software developments and to premature hardening of the DSS design" (Moore and Chang 1983 : 191). A sophisticated database management capability is also seen as leading to "decreased managerial efficiency in information access" (ibid : 201).

Two important requirements of the data subsystem are:

- the development of a database which is "logically separate from other operational databases" in order to be flexible enough to allow rapid additions and changes in response to unanticipated user requests, and

- the ability of the database to be augmented by external data sources and subjective data "to provide a much richer set of data sources than are usually found in typically non-DSS applications" (Sprague and Carlson 1982 : 32).

(ii) THE MODEL SUBSYSTEM.

This subsystem contains the modelling or analytical components of a DSS. The models act on the database to provide the information required for the user's decision problem. This system should have capabilities to create new models, access and integrate the various model building blocks, interrelate models, and manage the model base with management functions analogous to database management (ie. mechanisms for storing, cataloging, linking, and accessing models) (Sprague and Carlson 1982 : 33).

(iii) THE USER-SYSTEM INTERFACE.

"As noted by Keen (1976), the user-system interface is not a *cosmetic* issue: to the user, the interface is the system" (Stabell 1983 : 224). Stabell further notes that "how the user should perceive and understand the system is an important aspect of the architecture". The way in which data and information are presented (ie. the screen layout) is of the utmost importance and must provide a meaningful framework within which the information is presented and in which inputs are given. As Sprague and Carlson (1982 : 29) note, "all the capabilities of the system must be articulated and implemented through the Dialog".

Most of the success of a DSS depends on the flexibility and usability of the user subsystem interface as it is through this interface that the user communicates with the DSS. Keen and Gambino (1983 : 143) describe *usability* which refers to the user-system dialog as their first rule of thumb for building DSS. Various interface designs have been proposed to achieve usability. Stabell (1983 : 224) refers to Carlson (1983 : chapter 2) and Bennet (1983 : chapter 3) who both recommend a "representation-centred" (i.e. menu-driven) approach; while Keen and Gambino (1983 : chapter 7) suggest a "verb-orientated" design; while he himself, (Stabell 1983 : 225) argues for an "active interface" design which identifies features that might direct changes in decision behaviour and that might facilitate user learning in terms of how decisions are made.

Bennett (1977 - reported in Sprague and Carlson 1982 : 30) divides the dialog experience into three parts :

- the action language - what the user can do in communication with the system;
- the display language - what the user sees; and
- the knowledge base - what the user must know in order to use the system effectively.

The "richness" of the interface will depend on the strength and variety of capabilities in each of these areas.

To conclude, some of the desirable capabilities of the user interface subsystem are : (Sprague and Carlson 1982 : 31)

- the ability to handle a variety of dialog styles;
- present data in different formats and media; and
- provide flexible support for the user's knowledge base.

The following section will consider ways in which the DSS architecture is applied in the development process.

3.5 THE DEVELOPMENT APPROACH TO DSS.

The development of computer-based information systems - as described in most MIS literature - have tended to follow the 'systems development life cycle' as described by Davis (1974 - reported in Moore and Chang 1983 : 180). DSS researchers, amongst them Sprague and Carlson (1982 : 15) and Moore and Chang (1983 : 181) believe that "its focus and purpose are inadequate for the task of building and implementing successful DSS". The 'systems life cycle' approach assumes a well-defined structure of a decision making process. This contrasts sharply with the lack of knowledge and constancy which characterises a DSS design process. Consequently, "the 'unstructured' nature of the decision-making problem and the computer's active role as a decision aid are driving forces neccesitating a different approach" (Moore and Chang 1983 : 173).

The DSS Development Life Cycle proposed by Meador, Guyote and Keen (1984 : 125) and illustrated in Figure 1.1 of chapter one, offers a framework which encompasses the essential characteristics of a DSS. Development of a DSS can be characterised by two stages: the Iterative stage, and the Adaptive stage (Sprague and Carlson 1982 : 15-16). The distinction is primarily one of time and nature.

In the short term the development of a specific DSS proceeds with short, rapid feedback from users to ensure that development is proceeding correctly. The typical systems development process of analysis, design construction and implementation are merged into a single step and repeated iteratively until a relatively stable system has evolved which meets the initial needs of the end-user.

Over time, the initial system evolves for reasons of user learning, technology, active design interface, etc., as described by the meta-design principles. This adaptive approach, as described by Simon (1980 - reported in Sprague and Carlson 1982 : 16) can be viewed over three time horizons:

- in the short run, the system allows search for answers within a relatively narrow scope;
- in the intermediate time horison, the system learns by modifying its capabilities and activities; and
- in the long run, the system evolves to accommodate much different behaviour styles and capabilities.

These two characteristics can be related to the DSS Development Life Cycle Model of Meador, Guyote and Keen (1984 : 125). The tasks of planning, research, analysis, design, construction, testing, evaluation and demonstration are performed iteratively in the short term, while the latter tasks comprise the adaption phase of DSS development.

The adaptive system is regarded as the modus operandus with respect to the development of DSS. It is alternatively referred to as an 'evolutionary' or 'middle-out' approach (Stabell 1983 : 225). Each term implies that "the 'final' system must evolve through usage and learning .... and it is applicable as a development strategy only to situations where the 'final' system cannot be predefined" (Keen and Gambino 1983 : 134,153). This, according to Keen and Gambino, has substantial implications for the choice of a design architecture and an implemetation strategy. The continual involvement of the end user from an earlier stage of system design and development is a basic premise of the adaptive process and is reiterated by many DSS researchers (Dyer and Mulvey 1983 : 109; Keen and Gambino 1983 : 168).

Stabell (1983 : 228) argues for a more decision-orientated approach within the adaptive process. This decision emphasis will "provides direction to system development by indicating what impacts to monitor and what choices to make in order to direct the evolution of both decision making and system". He argues that "if there is no clear idea of the content and direction of the changes to be achieved, an adaptive approach can fall into a 'usability trap' - the development of systems that are usable and used, but not very useful". He sees a more active role for the DSS builder as an agent for changing how decisions are made to achieve increased decision making effectiveness which he sees as the principle objective for DSS development (ibid : 225). This view is consistent with the meta-design principle of the "strong-weak design continuum. In conclusion, Stabell (ibid : 231) advocates a more customised adaptive approach with greater attention to the decision processes involved.

This broad framework of DSS development is encapsulated in the DSS Development Life Cycle advocated by Meador, Guyote and Keen (1984 : 125). The steps involved were subjected to an empirical investigation among identfied DSS users. The survey established that *planning*, *evaluation* and *orientation of top level users* phases were all activities that were ineffectively performed, while the more technical, DP-oriented tasks of *design and construction* were the best performed tasks. This implies that resources were committed to these technical tasks whereas they might have better spent on the more important tasks of planning and evaluation. These results lead Meador et al to conclude that the more ill-defined tasks in DSS development are being avoided with the resultant misallocation of resources.

3.6 A TAXONOMY OF DECISION SUPPORT SYSTEMS.

The first major empirical study of DSS was a survey by Alter (1980 - reported in Carlson 1983 : 17) of fifty-six different DSS. From the survey, two general categories of DSS were identified : data orientated systems, and model orientated systems. Data-orientated systems "provide functions for data retrieval, analysis, and presentation". Model-orientated systems on the other hand, "provide accounting, simulation, or optimisation models to help make decisions".

In a more recent study, Huff, Rivard, Grindlay and Suttie (1984 : 21) examined 131 DSS in Canada. The objective was to determine the current appropriateness of Alter's taxonomy.
They identified eight categories of DSS. They are:

- file drawer system,
- tailored data analysis systems,
- general data analysis systems,
- analysis information systems,
- accounting models,
- representational models,
- optimisation models,
- suggestion models.

In terms of Alter's taxonomy, the first four categories can be labelled data-orientated models as they are essentially data retrieval and analysis type systems representing an extension of the typical EDP/MIS systems. The latter four categories reflect the OR/MS models and systems.

This gives a very clear indication of how DSS are evolving from the coelescence of information technology and OR/MS in the form of interactive modelling. DSS is the convergence point of these two approaches.

3.7 TRENDS AND RESEARCH IN THE FIELD OF DSS.

The DSS field is very interdisciplinary. Areas from which it is drawing contributions include database management, language processing, operations research and modelling, artificial intelligence, formal logic and cognitive psychology. However, each field's full contribution has not yet been realised. As Bennet (1983 : 14) comments on summarising the state of art of the design and development approaches to DSS, "it is clear that the concepts and techniques used to construct DSS have many years of evolution ahead."

The field of DSS has advanced from the description of the features of specific systems to areas of research within the field. The original works on DSS by Keen and Morton (1978), Alter (1980), Sprague and Carlson (1983 : 17) and Hurst, Ness, Gambino and Johnson (1983 : 111) developed a theoretical basis for DSS from empirical studies of existing DSS.

Now however, distinct research areas are emerging within the field. Specific fields of research as identified by Bonczek Holsapple and Whinston (1984) include:

- work involving frameworks and formalisms for understanding and designing the internal aspects of DSS;

- the identification and invention of tools and techniques for building DSS; and

- an examination of the behavioural aspects of the interface between a DSS and a decision maker.

A further important development is the contribution of artificial intelligence research to DSS (Gorry and Krumland 1983 : chapter 9). Expert systems (ES) constitute a subset of artificial intelligence (AI) and it is being realised that AI and ES have potential practical applications in the world of management (Blanning 1984a).

The intention is not to present an exhaustive list of research being done in the DSS field. Instead, based mainly on Bonczek et al (1984) and Blanning (1983), the main research areas will be highlighted. Amongst the more important issues are : behavioural aspects in DSS, DSS development tools, evaluation of DSS, and artificial intelligence and expert systems.

(i) BEHAVIOURAL ISSUES IN DSS.

Since DSS interact with individual users more so than traditional MIS, the impact of personal, environmental and DSS characteristics on decision making and on the success of DSS is the major thrust of behavioural research on DSS. Specific research areas relate to cognitive style (i.e. the manner in which people process information) and decision making styles and procedures. As Stabell (1983 : 258) notes, "understanding the cognitive dimension of the decision process is key to the design of the interface in a computer-based DSS".

Further behavioural aspect are the problems encountered in the introduction of DSS into organisations. The coordination of participants (namely the user, designer and the system), and the use of DSS to stimulate creativity are also receiving attention.

(ii) DSS DEVELOPMENT TOOLS.

Although many commercial tools are available for the development of DSS, more work is required on specific aspects such as logic programming, database management systems, DSS generators, model management systems and information management systems. These areas of research aim at improving the design, development and effectiveness of DSS. Five research areas are highlighted.

Firstly, since many DSS applications are concerned with `logical inferences in addition to numeric computations, it is important that logic development programming languages become available to support these logic processes. Martin (1985 : 119) sees fourth generation languages as eventually developing into rule-based systems and human language processing.

Secondly, while research into data base management per se is well advanced as shown by the discussion presented by O'Brien (1985 : 400 - 414), further research is necessary on the integration of data base systems into DSS. Both Keen and Gambino (1983 : 151) and Moore and Chang (1983 : 192,201) allude to the current constraining effects of data base systems on DSS design and development.

Thirdly, an obvious area of research in the DSS field with respect to development tools is the development of DSS generators. Comprehensive DSS generators will have far reaching implications for DSS builders as such generators will simplify the task of construction. The same tool could be used regardless of the application area. Bonczek et al (1984) describe research into DSS generators as proceeding in three different directions, namely

- generalised problem-processing systems
- software tools for knowledge fusion, and
- DSS development systems.

DSS generators are capable of contributing much to the rapid development of DSS and there is still much scope for software products that can be used as DSS generators.

Fourthly, models, like data, are an important organisational resource that should be managed effectively. Therefore the need exists to develop model management systems with the functions of new model creation and integration, model maintenance, and model base management with functions analogous to data base management (Sprague and Carlson 1982 : 33).

Two approaches being pursued are :

- the use of data base management approaches ; and
- relational data management approaches.

Research in the area of artificial intelligence is also seen as impacting considerably on the model management area (ibid : 35).

Lastly, the importance of a synthesis of data management and model management in DSS has long been recognised. The need to integrate data retrieval and calculation procedures has long existed. Research is in progress with the aim being a unified framework for information management in a DSS.

(iii) EVALUATION OF DSS.

Managers often make decisions about computer applications, DSS included, not by means of comprehensive cost-benefit analysis, but by basing their decisions on intuition or by looking at similar applications in other organisations. In the case of DSS however, the use of the traditional cost-benefit approach is inappropriate due to the intangible nature of the benefits.

Bennet (1983 : 13), in a review of DSS research papers, acknowledges that there is no accepted method for evaluation. While many researchers in DSS allude to the difficulties of evaluation, there appears to be limited progress in this area. A fuller discussion on the evaluation of DSS will be presented in chapters 7 and 8.

(iv) ARTIFICIAL INTELLIGENCE, EXPERT SYSTEMS AND DSS.

Blanning (1984a) predicts that "one of the major changes that will occur in DSS research and practice during the next decade will be the development of intelligent DSS and most of these will be in the form of expert systems for managers". This statement reflects the thoughts of many working in the field of DSS.

Artificial Intelligence is a subfield of computer science concerned with enabling computers to mimic the characteristics that make people seem intelligent. The goal of AI research continues to be the production of computer programs exhibiting intelligent behaviour (Gorry and Krumland 1983 : 217). The direction of this AI research has mainly been directed towards "knowledge-base" technology often also referred to as expert systems (Martin 1985 : 408-409). Many expert systems exist particularly in the areas of mathematics, chemistry and medicine (Fiegenbaum and McCorduck 1984 : appendix B). "One of the most famous medical expert systems is MYCIN - a system for diagnosing a certain class of infectious diseases" (Martin 1985 : 409).

However, while individual successes have been achieved, progress is limited and the lessons learnt, according to Gorry and Krumland (1983 : 217) have been largely negative.

Since the development of expert systems depend on 'knowledge acquisition' (Negotia 1984), the problems for management are more complex. The difficulties lie with the quantification of management expertise. To progress in this field, theories of decision-making, behavioural, physchological, and multiple criteria decision making which identify, explain, and take advantage of the human judgemental biases, will have to be adopted as a base for successful expert systems for management design.

While the expectations for expert systems for management are high, the constraints must be recognised. Blanning (1984b) acknowledges that the application of expert systems to even a limited set of reasonably well-structured management problems are still in their infancy and fairly primitive. He feels we may have to wait some time for full expert systems for management. This is the view too, of Gorry and Krumland (1983 : 218) who warn against too much optimism by indicating that "although artificial intelligence research may provide some technological innovations to benefit DSS design, the solution of the substantive intellectual problems of artificial intelligence will not come in the near future". Therefore the ad hoc development of DSS for particular applications will remain the rule.

The Butler Cox Foundation (1983) identified, from an examination of 41 expert systems, seven limitations which are still valid today. They essentially relate to technological constraints and limited expertise. However, if the Japanese achieve their target of producing a fifth generation system - "in which inference processing, rule-based processing, knowledge bases, and natural human languages play a vital role" (Martin 1985 : 118) - then dramatic changes in the general area of information technology, artificial intelligence and expert systems are predicted.

To conclude, in a review of the next decade in Decision Support Systems, Keen (1986 : 35) identifies six issues still to be addressed by DSS researchers. They are :

What decisions really do matter in an organisation and how should we build a better environment to help decision makers handle them ?

How should we formulate and help solve 'wicked' problems that require representing values, ethics and aesthetics ?

How do creative people learn ? How should we design our DSS tools to facilitate a real dialog that stimulates learning ?

What is the role of modelling and quantitative methods in fostering creative thinking ?

What is the technical architecture for evolving DSS in a context of increasingly integrated technologies ?

How should we study and measure effectiveness, quality of decision making, learning and change ?

This research relates in part to the first and last issues.

3.8 SUMMARY AND CONCLUSION.

DSS reflect a philosophy, design and implementation approach that differs from that associated with the more traditional MIS. However, much research is still needed to establish DSS as a distinct discipline. The development of DSS generators is an area of great scope and potential. Of great potential value to DSS is the field of artificial intelligence and expert systems. The vision is toward an Expert DSS which will act more like an 'intelligent consultant' than a 'dumb assistant'. While success todate is limited, it is receiving considerable attention from researchers as can be witnessed from the proceedings of the TIMS XXVII conference (Brisbane, July 1986). The methodology reviewed in this chapter will provide the basis for the design of a specific DSS to be presented in chapter 6. The next two chapters will review the concepts of compensation management to provide the contextual framework for the development of the specific DSS prototype in compensation planning.

REFERENCES

1. Alter, S.L. 1980. Decision Support Systems : Current Practice and Continuing Challenge. Massachusetts. Addison-Wesley.

2. Anthony, R.N. 1965. Planning and Control Systems : A Framework for Analysis. Cambridge. Mass. Harvard Graduate School of Business.

3. Blanning, R.W. October 1983. What is Happening in DSS ? INTERFACES. Vol. 13(5) : 71 - 80.

4. Blanning, R.W. 1984a. Expert Systems for Management : Possible Application Areas. DSS-84 Transactions. Zmud, R.W. (Editor). North Carolina. Chapel Hill.

5. Blanning, R.W. 1984b. Knowledge Acquisition and System Validation in Expert Systems for Management. Human Systems Management. Vol. 4 : 280 - 285.

6. Bennett, J.L. 1977. User-oriented Graphics Systems for Decision Support in Unstructured Tasks. User-oriented Design of Interactive Graphics Systems. Treu, S. (Editor) New York. Association for Computing Machinery : 3 - 11.

7. Bennett, J.L. 1983. Overview. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. : Chapter 1.

8. Bonczek, R.H., Holsapple, C.W., Whinston, A.B. 1984. Developments in Decision Support Systems. Advances in Computers. Vol. 23 : 141 - 175.

9. Butler Cox Foundation. September 1983. Expert Systems. Report Series No. 37.

10. Carlson, E.D. 1983. An Approach for Designing Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (editor). USA. Addison-Wesley. Chapter 2.

11. Davis, G.B. 1974. Management Information Systems : Conceptual Foundations, Structure and Development. New York. McGraw-Hill.

12. Dyer, J.S., Mulvey, J.M. 1983. Integrating Optimization Models with Information Systems for Decision Support. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 5.

13. Feigenbaum, E.A., McCorduck, P. 1984. The Fifth Generation - Artificial Intelligence and Japan's Computer Challenge to the World. London. Pan Books.

14. Gorry, G.A., Krumland, R.B. 1983. Artificial Intelligence Research and Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 9.

15. Gorry, G.A., Scott Morton, M.S. Fall 1971. A Framework for MIS. Sloan Management Review. Vol. 13(1) : 55 - 70.

16. Huff, S.L., Rivard, S., Grindlay, A., Suttie, I.P. 1984. An Empirical Study of Decision Support Systems. INFORS. Vol. 22(1) : 21 - 39.

17. Hurst, E.G. Jr., Ness, G.N., Gambino, T.J., Johnson, T.H. 1983. Growing DSS : A Flexible Evolutionary Approach. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 6.

18. Kantor, J. 1977. Management-Orientated Management Information Systems. Second Edition. New Jersey. Prentice-Hall.

19. Keen, P.G.W. June 1986. Decision Support Systems : The Next Decade. IFIP WG 8.3 Working Conference on Decision Support Systems : A Decade in Perspective. Noordwijkhout, The Netherlands.

20. Keen, P.G.W., Gambino, T.J. 1983. Building a Decision Support System : The Mythical Man-Month Revisted. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 7.

21. Keen, P.G.W., Scott-Morton, M.S. 1978. Decision Support Systems: An Organisational Perspective. Mass. Addison-Wesley.

22. Keen, P.G.W., March 1981. Value Analysis : Justifying Decision Support Systems. MIS Quarterly. Vol. 5(1) : 1 - 15.

23. Martin, J. 1985. Fourth Generation Languages Volume 1 : Principles. New Jersey. Prentice-Hall.

24. McCosh, A.M., Rahman, M., Earl, M.J. 1981. Developing Managerial Information Systems. Hong Kong. MacMillan.

25. Meador, C.L., Guyote, M.J., Keen, P.G.W. June 1984. Setting Priorities for DSS Development. MIS Quarterly. Vol. 8(2) : 117 - 129.

26. Moore, J.H., Chang, M.G. 1983. Meta-Design Considerations in Building DSS. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 8.

27. Naylor, T.H. 1982. Decision Support Systems or Whatever Happened to MIS. INTERFACES. Vol. 12(4) : 92 - 94.

28. Negoita, C.V. 1984. Management Applications of Expert Systems. Human Systems Management. Vol.4 : 275 - 279.

29. O'Brien, J.A. 1979. Computers in Business Management : An Introduction. Revised Edition. Illinois. Richard D Irwin.

30. O'Brien, J.A. 1985. Computers in Business Management : An Introduction. Fourth Edition. Illinois. Richard D Irwin.

31. Radford, K.J. 1978. Information Systems for Strategic Decisions. Virginia. Reston.

32. Simon, H.A. 1960. The New Science of Management Decision. New York. Harper & Row.

33. Simon, H.A. 1980. Cognitive Science : The newest Science of the Artificial. Cognitive Science. Vol. 4 : 33 - 46.

34. Sprague, R.H. Jr., Carlson, E.D. 1982. Building Effective Decision Support Systems. New Jersey. Prentice-Hall.

35. Stabell, C.B. 1983. A Decision-Oriented Approach to Building DSS. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 10.

36. Thierauf, R.J. 1982. Decision Support Systems for Effective Planning and Control : A Case Study Approach. New Jersey. Prentice-Hall.

37. Vazsonyi, A. November 1978. Decision Support Systems : The New Technology of Decision Making ? INTERFACES. Vol. 9(1) : 72 - 77.

38. Vazsonyi, A. February 1982. Decision Support Systems, Computer Literacy, and Electronic Models. INTERFACES. Vol. 12(1) : 74 - 78.

39. Watson, H.J., Hill, M.M. October 1983. Decision Support Systems or What Didn't Happen with MIS. INTERFACES. Vol. 13(5) : 81 - 88.

CHAPTER 4

REVIEW OF COMPENSATION MANAGEMENT

PART 1 : ITS IMPORTANCE AND THEORIES

4.1 Introduction 99

4.2 Definition of Compensation 100

4.3 The Importance of Compensation 101

4.3.1 Compensation and the Employee 102

4.3.2 Compensation as a Cost Component 105

4.3.3 Compensation and the Economy 106

4.4 Compensation and Motivation 107

4.4.1 Compensation Theories 108

4.4.2 The Empirical Evidence 115

4.4.3 Compensation Theories and Their Relevance to Compensation Planning 117

4.5 Summary and Conclusion 120

References 121

4.1 INTRODUCTION.

As indicated earlier, this research study focuses on the application of DSS to the area of compensation planning within the human resource function. Phase three of the DSS Development Life Cycle (refer Figure 1.1) involves a contextual analysis of the application area to establish both system parameters and decision processes. This is implied in Stabell's (1983 : 234) model of decision research and reiterated by Keen (1986 : 21). This perspective is provided through a review of the literature on compensation management in this chapter and the next.

This chapter will examine the importance of compensation management to corporate effectiveness. Further, the theories of compensation which influence the objectives and strategies pursued will be briefly reviewed. Chapter 5, on the other hand, will examine the practice and design aspects of compensation systems. Issues of compensation objective-setting, and strategic and technical design considerations will be reviewed.

It is recognised that the field of compensation has been extensively treated in numerous texts and no attempt is made to review all the issues pertaining to it. This review is intended merely to provide a framework within which the area of compensation Decision Support Systems can be discussed.

Where appropriate, the discussion will be supplemented with information pertaining to the practice of compensation management in South Africa as identified from local literature.

4.2 DEFINITION OF COMPENSATION.

Compensation can be defined both in terms of its *components* (Ellig 1982 : 22 ; Milkovich and Newman 1984 : 3) and as a *process* undertaken by an organisation (Schuler 1981 : 261).

The *components* of compensation are essentially financial and non-financial in nature. The financial forms - which are the primary concern of this study - consists of base pay, merit awards, incentives, and cost of living adjustments. While Milkovich and Newman (1984 : 3) restrict their definition to include only monetary and near-monetary (extrinsic) rewards, Ellig (1982 : 22) broadens the definition to encompass intrinsic rewards too. The latter, referred to by Ellig as 'psychic income', are job related rewards such as recognition, responsibility, pride of membership etc. While not resulting in monetary benefits, Ellig (1982 : 22) sees intrinsic pay as reinforcing the retention capacity of direct pay (the 'extrinsic' rewards).

As a *process*, compensation is defined as "the activity by which organisations evaluate the contribution of employees in order to distribute fairly direct and indirect monetary .... and non-monetary rewards, within the organisation's ability to pay and legal regulations" (Schuler 1981 : 261).

In this research, the focus of compensation will remain on extrinsic rewards of a direct nature. Of the two major elements of direct compensation, namely *base wage* and *incentives*, the emphasis will be on the base pay system. Since the *process* definition describes the decision approach used in devising a compensation strategy for an organisation, and the *components* definition identifies the elements involved, both are appropriate in providing a framework for the DSS design.

With the focus of this research clearly established on the design of a direct compensation system, it is appropriate to examine the importance of compensation before proceeding with a review of the process of compensation planning.

4.3 THE IMPORTANCE OF COMPENSATION.

The importance of direct compensation can be examined from a number of different standpoints. At the individual level, the employee's view needs to be considered. At the organisational level, the employer needs to consider compensation as a significant cost component as well as a potential motivational device. Compensation also assumes importance on a national economic level. Each of these areas of importance will be discussed in the following sub-sections.

4.3.1 COMPENSATION AND THE EMPLOYEE.

The employee views pay as a necessity of life (Glueck 1979 : 282). It is seen as a return for services rendered or a reward for satisfactory or meritorious work and is then used to provide for their own and their families' needs. As such, pay to the employee is a "vital determinant of economic and social well-being" (Milkovich and Newman 1984 : 3).

An issue that impacts on the employee, but is also of considerable concern to the organisation, is the extent to which an employee experiences satisfaction with pay. Studies have shown that an immediate consequence of pay dissatisfaction is increased labour turnover and absenteeism (Nash and Carroll 1975 ; March and Simon 1958, Porter and Steer 1973, Hulin 1968, Dyer and Thierault 1976 - reported in Dyer, Schwab and Fossum 1978:234-241; Schuler 1981: 263).

The causes have also been well researched, but nevertheless remain a complex issue. References by Dyer et al (1978 : 238), Glueck (1979 : 286), Schuler (1981 : 263), inter alia, cite three factors as major determinants of employee pay satisfaction. They are:

- pay equity
- pay level, and
- pay adminstration practices.

In addition, three further determinants have been identified by Nash and Carroll (1979 - reported in Glueck 1979 : 286) as being community cost of living, education, and future expectations. The study by Tromp (1980) on South African executives verifies these major determinants of pay system and perceived pay equity, but augments them with empirically validated determinants of employee-related and organisation-related characteristics. The overall conclusion reached by these researchers is that if pay satisfaction is low, job satisfaction is low.

The significance of one of the determinants, namely pay level, has been extensively researched. Numerous studies positively link the amount of pay to such dependant variables as :

- pay satisfaction (Andrews and Henry 1963; Lawler and Porter 1963 - reported in Opsahl and Dunnette 1966 : 145 ; Tromp 1980);

- job satisfaction (Thompson 1939 ; Centres and Cantril 1946 ; Miller and Form 1951 ; Barnett et al 1952; Marriot and Denerly 1955; Smith and Kendall 1963 - reported in Vroom 1964); and

- need satisfaction (Porter 1962 ; Lawler and Porter 1963).

What these studies have however not established, according to Opsahl and Dunnette (1966 : 145), is "the degree to which the satisfaction is a result of the level of pay or the changes in job status, duties and priviledges that so often accompany higher pay".

Pay satisfaction should be distinguished from employee motivation. The two are not necessarily highly related as is pointed out by Opsahl and Dunnette (1966 : 145) and Schuler (1981 : 263). The relation between compensation and motivation (to be discussed in section 4.4) is a complex one which, in many instances, is not always clear or consistent (ibid : 265).

In conclusion, since the three major determinants of pay satisfaction are controllable factors within the compensation system, this suggests that organisations should strive to design and administer a compensation system that "increases the chances of getting both pay satisfaction and performance motivation" (ibid : 265). Such a system which serves both these outcomes will, according to Schuler, help meet the concerns of both the organisation and the individual.

4.3.2 COMPENSATION AS A COST COMPONENT.

In practice, compensation is arguably the single largest cost component of an organisation's operating expenditure. This statement is echoed by a number of researchers, inter alia Glueck (1979:282), Schuler (1981:261), Milkovitch and Newman (1984:3) and Henderson and Chandler (1984:54/1). The percentage of operating expenditure ranges from 10% to as high as 80% for service organisations. The modal percentage appears to be about 50% of total costs.

In the South African public sector, for example, the salary bill is approaching R10 billion, representing nearly 40% of total government spending for the 1984/85 fiscal year (Financial Mail, 15/2/1985:36-37). Further, a survey of SA organisations reveals a similar distribution of compensation related expenditure relative to total costs as found in the literature (Tromp & Wegner 1985:18). Organisations, the survey found, tend to be evenly spread across the 10% to 70% cost range.

Thus, from a financial point of view, the planning and controlling of this major expense item deserves regular and careful management attention. As Davis, Wyatt and Rosenfeld (1984:59/1) note, many US organisations came close to bankrupcy in the late 1970's as a result of rapidly rising labor costs and declining market shares which in turn forced managements' of the 1980's to focus attention on the compensation-related issue of productivity which is seen as vital to cost reductions. This issue is currently receiving close attention in South African organisations too. Therefore proper management of the compensation component is essential for future survival and growth of organisations.

4.3.3 COMPENSATION AND THE ECONOMY.

Compensation also assumes significance on a national economic level.

In the United States for the past 30 years, salaries and wages have equalled about 60 percent of the country's GNP (Glueck 1979 : 282). A comparable figure for South Africa is about 56 percent for the 1984 fiscal year (Statistical Economic Review in connection with the 1985/86 Budget WPB/85).

Apart from its absolute magnitude which establishes its significance, there is a further economic arguement for its importance. It is an important determinant of a country's economic well-being.

In a review article titled "Wages the Key", on the South African economy, wages are seen as being "perhaps the most important determinant not only of changes in the general level of economic activity, but also of increases in the money supply and in the level of prices" (Barclay's Business Brief - reported by the Financial Mail 15/2/85 : 40-41). Inflation and wages are also said to be directly related. The Business

Brief asserts that "both excessive increases in the money supply and in the inflation rate *originate in the annual salary and wage contracts* negotiated between employers and employees in the economy". Thus self discipline exercised by trade unions and the employees over wage increases can contribute significantly to lower money supply and inflation.

Thus the economic well-being of a national economy is determined to a large extent by the manner in which an organisation manages its compensation system.

4.4 COMPENSATION AND MOTIVATION.

Organisations employ labour to achieve their output objectives. However, employee performance plays a considerable role in realising the desired output objectives. Thus attention must be paid to those factors that influence employee attitudes, behaviours, and ultimately performance. Mahoney (1982 : 230) regards compensation administration and management as "an application of motivational theory" and believes "it is difficult to discuss compensation without appeal to motivational concepts and theories".

This section will therefore briefly review some of the major theories and empirical findings of the relationship between motivation and performance with particular emphasis on the role that compensation assumes in this process.

4.4.1 COMPENSATION THEORIES.

The literature identifies mainly three schools of thought. They are :

- the reinforcement theory of operant conditioning,
- the content theories, and
- the process theories.

Briefly, behaviouralists who subscribe to the reinforcement theory advocate that the association between remuneration and work effort is a learned behaviour. The content theorists, however, have focused their attention on *what* motivates the worker, while the process theorists concentrate on *how* workers are motivated. Each of these will now be expanded upon.

4.4.1.1 THE REINFORCEMENT THEORIES.

Much of the work on "money as a generalised conditioned reinforcer" was conducted by Wolf (1936), Cowles (1937), Dollard and Miller (1950), Skinner (1953), Brown (1961), Holland and Skinner (1961), Kelleher and Gollub (1962) (reported in Opsahl and Dunnette 1966 : 128). While the evidence suggests that money can assume properties as a secondary reinforcer, criticism is levelled against the operant conditioning approach mainly on the basis that "solid evidence of the behavioural effectiveness of such reinforcers is lacking, and what evidence there is has been based almost entirely on animal studies" (ibid : 128).

However, this school of thought is still being pursued. In recent studies, Luthans and Kreitner (1975 - reported in Henderson 1979 : 36) based their learning approach for explaining how to modify unacceptable employee workplace behaviour on the operant behaviour work of Skinner. They concluded that "in focussing on operant behaviour, designers and managers of reward processes must identify environmental limits, desired specific employee behaviours, and consequences of these behaviours from which they can then determine which consequences reinforce the desired behaviour".

4.4.1.2 THE CONTENT THEORIES.

The approach adopted by the content theorists sought to identify the needs of the worker and the organisational influences that can lead to need satisfaction.

The prime researchers of this approach have been Maslow (1954), Herzberg, Mausner and Snyderman (1959), Macgregor (1960), and McClelland (1965) (reported in Henderson 1979 : 29-33). The works of Maslow and Herzberg have received most attention.

Of Maslow's Hierachy of Needs theory, Lawler (1971 - reported in Milkovich and Newman 1984 : 274) concluded that "based on an extensive literature review ... pay can help esteem needs and physiological needs, but is less useful for satisfying autonomy and security needs, and is least useful for satisfying social and self-actualisation needs".

Herzberg's two factor theory has raised considerable controversy. Opsahl and Dunnette (1966 : 130), House and Wigdor (1967 - reported in Milkovich and Newman 1984 : 274), amongst others, criticise the theory for its inconsistency with the empirical evidence. However, Milkovich and Newman (1984 : 274) argue that it has been incorrectly interpreted and state in defence that it is "inappropriate to assume Herzberg relegated pay only to the status of a hygiene factor". They contend that "the original work by Herzberg also demonstrated that pay takes on significance as a source of satisfaction when it is perceived as a form of recognition or reward". In this respect, pay assumes a motivating role.

The conclusion from the content theories then, is that "money has the potential to serve several needs and because individuals differ in the importance of their needs, money can take on varying degrees of importance" (Schuler 1981 : 261).

4.4.1.3 THE PROCESS THEORIES.

"While it is apparent that pay can motivate behaviour, one category of which is job performance, it is not at all clear *how* organisations can use pay to achieve this goal" (Milkovich and Newman 1984 : 275). It is left to the process theorists to explain the mechanisms that lead to motivation.

There are essentially three theories that have been developed by the process theorists who include, inter alia, Festinger (1957), Adams (1963), Vroom (1964), Dunnette (1965), Locke (1968), Porter and Lawler (1968), and Lawler (1971) (reported in Henderson 1979 : 33). The three theories that have emerged to describe *how* motivation can be effected are :

- the Expectancy theory,
- the Equity theory, and
- the Goal-setting theory.

(i) THE EXPECTANCY THEORY :

Expectancy theory, alternatively known as Valence-Instrumentality-Expectancy (VIE) theory, is chiefly the result of the work of Vroom (1964) who advocates that "money acquires valence as a result of its perceived instrumentality for obtaining other desired outcomes" (Opsahl and Dunnette 1966 : 131). The rationale for this theory is that individuals evaluate alternative behavioural actions as *expected returns* and that the individual will choose the alternative that has the highest payoff or expected return. Mitchell (1978 : 162) comments that "while people obviously do not make these explicit calculations, they do appear to behave as if they were attending to these factors in the manner prescribed". Mitchell conducted a literature review of the expectancy theory in 1974 and concluded that "reviews of the literature are fairly encouraging".

In this model, the relationship between pay, performance and motivation focusses on the *instrumentality* of pay. in this context, the importance of money is seen in terms of its symbolic power in the market place. "The symbolic power of money", according to Gellerman (1963 - reported in Opsahl and Dunnette 1966 : 132) "is its market value". This view is supported by Milkovich and Newman (1984 : 278).

In accepting the constructs of the VIE model as valid (based on strong significant support of empirical evidence provided by Mitchell and Beach (1976 : 231-248 - reported in Mitchell 1978 : 162)), Mitchell also proposes a link between pay, performance and motivation. He sees this link as having essentially three implications for compensation management.

"Firstly, it is the anticipation of reward that is important.

Secondly, rewards need to be closely and clearly tied to those behaviors that are seen as desirable by the organisation.

Finally, since different people value different rewards, there should be some attempt at matching organisational outcomes with the particular desires of the individual employee."

(ii) THE EQUITY THEORY :

The above theories have focused only on the *absolute* amount of need satisfaction and the role of compensation in this process. However, as Henderson (1979 : 33) states, "the *relative* measures people make concerning the relationship between their workplace efforts and the reward they receive possibly have far greater impact on human behavior". This is a reference to the equity theory developed essentially by Adams (1963) based on the *cognitive dissonance* concept of Festinger (1957). This theory of social inequity focuses especially on wage inequity, how it arises, and means for reducing or eliminating it (Henderson 1979:34).

More specifically, the theory suggests that individuals compare their inputs and outcomes to those of some relevant other person in determining whether they are equitably treated. Perceived inequity results in attempts by the individual to restore equity. This motivation can take the form of either requesting additional rewards from the employer, or reducing the investment by doing less work and making fewer contributions (Henderson 1979 : 34 ; Milkovich and Newman 1984 : 278-279).

Other theorists who have advanced the idea that employees seek a just (equitable) return for their work effort include Sayles (1958), Zaleznik, Christensen and Roethlisberger (1958), Homans (1961), Jaques (1961), and Patchen (1961) (reported in Opsahl and Dunnette 1966 : 146). According to Opsahl and Dunnette (ibid : 146), a common feature of these theories is "the assumption that compensation either above or below that which is perceived by the employee to be *equitable* results in tension and dissatisfaction due to dissonant cognitions". Mahoney (1982 : 233) supports this view, but adds that it is a stimulus to action by the employee to restore equity.

An examination of the implications of this model for compensation management show that organisations must strive to reward people equitably, and employees see reward in a relative rather than an absolute sense (Mitchell 1978 : 164).

(iii) THE GOAL-SETTING THEORY :

This third category of process theories has been advocated by Locke (1968 : 157-189 - reported in Mitchell 1978 : 164). Locke argues that employees have certain goals they set for themselves and that organisations can have a strong influence on work behaviour by influencing the employee's goals.

Locke's theory is seen as tying together many of the theories on human motivation from the fields of both *content* and *process* theories (Henderson 1979 : 36). The implication of Locke's theory for organisations is that the other theories are only important insofar as they affect the worker's goals. The rationale is that goal setting is of paramount importance and that incentives and rewards, while they affect goal acceptance and commitment, are not the crucial factor; the goal is (Mitchell 1978 : 165).

To conclude the theoretical review of the various motivation theories, it is appropriate to consider the *concious choice behaviour* model presented by Mahoney (1982 : 230-234). According to Mahoney, concious behavioural choice underlies all the process and reinforcement theories and it is therefore relevant to discusss compensation and performance in terms of a behavioural choice model. This view is also shared by Hamner (1974). Mahoney demonstrates how the compensation functions of attraction, retention and performance can influence choice behaviour, thus clearly showing that "all employment compensation is contingent upon some behavior". This link between performance behaviour and reward has also been considered by researchers such as March and Simon (1958), and Porter and Lawler (1968) (reported in Henderson 1979 : 41-42). Both studies advocated a close linkage.

The following section will briefly consider the empirical evidence of the role of pay under the conditions of the various theories outlined above.

4.4.2 THE EMPIRICAL EVIDENCE.

An examination of some of the available empirical evidence should provide added insight into the validity of the different theories.

Milkovich and Newman (1984 : 281 - 290) present a review of empirical evidence which both supports and negates some of the research hypotheses advocated.

On the positive side, the authors indicate that "substantial evidence exists that management and workers alike believe pay *should* be tied to performance." Studies which support this view have been conducted by Georgopoulos, Mahoney and Jones (1957), Jones and Jeffery (1964), Green (1965), Lawler (1966), Schwab and Dyer (1973), and Dyer, Schwab and Theriault (1976) (reported in Milkovich and Newman 1984 : 283). What has not however been established, is whether "this link can be structured". Mitchell (1978 : 163) refers to empirical research conducted by Campbell, Dunnette, Lawler III and Weick (1970) which shows a relationship based on the equity theory approach between pay and the quality and quantity of output. Other studies reviewed by Mitchell (1978 : 164) show that "underpayment has greater motivating effects than overpayment".

While Glueck (1979 : 287) indicates that the majority opinion appears to support a link between pay and performance, he cites the view, though not yet empirically tested, of Meyer (1975) and Deci (1975) who argue that "if pay is tied to performance, the intrinsic rewards a person gets from doing a job well will be destroyed". There is, however, empirical evidence according to Greene and Padsakoff (1978 - reported in Milkovich and Newman 1984:283) suggesting that organisations are moving away from performance related compensation systems.

The evidence negating a link between pay and performance is largely the result of problems encountered in implementing and administering such a system according to Hamner (1975) and Meyer (1975). Hamner has identified six categories of problems, with supporting research evidence that make the implementation of a performance-contingent pay system difficult (Milkovich and Newman 1984 : 284).

4.4.3 COMPENSATION THEORIES AND THEIR RELEVANCE TO COMPENSATION PLANNING.

The question that may well be asked at this point is : "what is the learning value of the above theories and findings for compensation planners?"

Unfortunately, there is no clearcut concensus on the relationship between pay and performance. "Research that tries to give a yes or no answer to this question is misdirected" (Glueck 1979 : 287). Milkovich and Newman (1984 : 287-289) also acknowledge this lack of concensus and admit that a "pay-for-performance policy could take on varying levels of importance in the design of a compensation system". While the majority of research does attribute some importance to money as a motivator, the extent and nature of its influence is debatable. Whyte (1955 - reported in Hersey and Blanchard 1982 : 41) concludes that "money is not as almighty as it is supposed to be".

Some agreement, however, does exist that "pay alone will not lead to the achievement of high performance expectations" (Milkovich and Newman 1984 : 290). Lawler (1976 - reported in Heneman and Schwab 1978 : 227) criticises management for failing to take a systems viewpoint when considering approaches to improving organisational effectiveness. "Organisations", he argues, "are complex interrelated systems; to operate effectively, all subsystems must be in harmony. Changes in one important area, say the pay subsystem, requires changes in all the other areas to maintain the balance among all subsystems". The need for a systems approach to compensation planning is echoed too by Milkovich and Newman (1984 : 291,286) when they state that "compensation does not, and never will be able to exist in a vacuum. Even the best-designed compensation system will falter when other human resource systems are inadequately designed to meet organisational needs." Also, "money can be a motivator, but not to the exclusion of other factors".

Thus compensation must be seen as only one of a number of motivational forces which collectively must be harnessed to achieve desired behavioural practices. Such and similar views have been echoed by numerous researchers including Dunn and Rachel (1971 : 114), Meyer (1975), Sanzotta (1977), and Burgess (1984 : 58). Meyer, in particular, believes that too much emphasis is placed on money as a prime motivator of performance, and believes that more emphasis should be placed on the intrinsic rewards of jobs and the support of well-conceived human resource planning programs.

Since research has also established that individuals respond differently to different compensation systems, Lawler (1971 - reported in Milkovich and Newman 1984 : 281) suggests that compensation planners adopt a two stage approach to firstly identify groups with differential need strengths, and then to devise compensation systems that will meet those needs.

To assist compensation planners, Glueck (1979 : 287) suggests four areas for attention. Firstly, effort should be directed to identifying the range of behaviours which pay may affect positively or negatively. Secondly, the amount of change pay can influence; thirdly, the kind of employees that pay influences positively and negatively; and fourthly, the environmental conditions that are present when pay leads to positive and negative results. A similar framework to compensation planning is provided by Henderson (1979:42-44).

To conclude, it is Henderson's (1979 : 33) belief that an appreciation of a combination of the content and process theories "provide compensation managers with a broad theoretical perspective on design requirements for their compensation systems". "It is the manager who understands and applies compensation theory (who) will produce results far superior to those of the mass of present-day compensation managers who are still using outdated weapons that belong to the past century" (Dunn and Rachel 1971: 26).

4.5 SUMMARY AND CONCLUSION.

From the above review, it is clear that compensation assumes a pivotal role in contributing to the well-being of not only the employee, but the organisation and the national economy as well. Since the elements involved in compensation planning are controllable factors within the organisation, compensation designers have a major responsibility not only to their organisation in helping it to achieve its output objectives, but also to their employees and society as a whole. As a final remark, these areas of importance should not be seen in isolation to each other. Rather, they are all the consequences of compensation decisions viewed from different perspectives.

The focus of the next chapter will be on the compensation planning process viewed as a top-down approach. It begins with the statement of compensation objectives, framed within the context of strategic considerations, and ultimately translated into technical detail.

REFERENCES

1. Burgess, L.R. 1984. Wage and Salary Administration - Pay and and Benefits. USA. Charles E Merrill.

2. Davis, J.H., Wyatt, L.L., Rosenfeld, J.M. 1984. Supporting Business Strategy with Human Resource Inventory. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill : Chapter 59.

3. Dunn, J.D., Rachel, F.M. 1971. Wage and Salary Administration : Total Compensation Systems. New York. McGraw-Hill.

4. Dyer, L., Schwab, D.P., Fossum, J.A. 1978. Impacts of Pay on Employee Behaviors and Attitudes : an update. Perspectives on Personnel/Human Resource Management. Heneman III, H.G., Schwab, D.P. (Editors). USA. Richard D Irwin. : 234 - 241.

5. Ellig, B.R. 1982. Executive Compensation : A Total Pay Perspective. New York. McGraw-Hill.

6. Financial Mail. February 15 1985 : 36-37; 40 - 41.

7. Glueck, W.F. 1979. Foundations of Personnel. USA. Business Publications Inc.

8. Hamner, W.C. 1974. Reinforcement Theory and Contingency Management in Organisational Settings. Organisational Behavior : A Contingency Approach. Tosi, H., Hamner, W.C. (Editors). USA. St Claire Press.

9. Henderson, R.I. 1979. Compensation Management - Rewarding Performance. Third Edition. USA. Reston.

10. Henderson, R.I., Chandler, J.T. 1984. Compensation Programs for Public Employees. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). New York. McGraw-Hill : Chapter 54.

11. Hersey, P., Blanchard, K.H. 1982. Management of Organisational Behavior - Utilising Human Resources. New York. Prentice-Hall.

12. Keen, P.W.G. June 1986. Decision Support Systems : The Next Decade. IFIP WG 8.3 Working Conference on Decision Support Systems : A Decade in Perspective. Noordwijkerhout, The Netherlands.

13. Lawler III, E.E. 1981. Pay and Organisation Effectiveness. USA. Addison-Wesley.

14. Lawler III, E.E. 1978. New Approaches to Pay : Innovations that Work. Perspectives on Personnel/Human Resource Management. Heneman III, H.G., Schwab, D.P. (Editors). USA. Richard D Irwin. 226 - 234.

15. Mahoney, T.A. 1982. Compensation for Work. Personnel Management. Rowland, K., Ferris, G. (Editors). USA. Allyn and Bacon. Chapter 9 : 227 - 262.

16. Meyer, H.H. Winter 1975. The Pay-for-Performance Dilema. Organisational Dynamics. 71 - 78.

17. Milkovich, G.T., Newman, J.M. 1984. Compensation. USA. Business Publications Inc.

18. Mitchell, T.R. 1978. People in Organisations : Understanding their Behavior. USA. McGraw-Hill.

19. Nash, A.N., Carroll Jr, S.J. 1975. The Management of Compensation. USA. Brooks and Cole Publishers.

20. Opsahl, R.L., Dunnette, M.D. 1966. The Role of Financial Compensation in Industrial Motivation. Motivation and Management. Vroom, V.H., Deci, E.L. (Editors). U.K. Penguin Education. 127 - 159.

21. Sanzatto, D. 1977. Motivational Theories and Applications for Managers. USA. AMACOM.

22. Schuler, R.S. 1981. Personnel and Human Resource Management. USA. West Publishing Company.

23. Stabell, C.B. 1983. A Decision-Oriented Approach to Building DSS. Building Decision Support Systems. Bennet, J.L.(Editor). USA. Addison-Wesley. Chapter 10.

24. Statistical Economic Review in Connection with the 1985/86 Budget WPB/85.

25. Tromp, D. 1980. 'n Bedryfsielkundige Ondersoek na die Vergoeding van Bestuurlui in 'n Geselekteerde Groep Suid-Afrikaanse Ondernemings. Doctoral Dissertation. University of Stellenbosch.

26. Tromp, D., Wegner, T. February 1985. The Computer's Role in Personnel Management with specific reference to Compensation Planning. Occasional Paper 9. Stellenbosch University Business School.

27. Vroom, V.H. 1964. Work and Motivation. New York. John Wiley and Sons.

CHAPTER 5

REVIEW OF COMPENSATION MANAGEMENT

PART 2 : DESIGN CONSIDERATIONS.

5.1	Introduction	124
5.2	Strategic Considerations	125
	5.2.1 Environmental and Organisational Influences	125
	5.2.2 Compensation Objectives	127
	5.2.3 Compensation Policies	130
	- Pay Level Decisions	131
	- Pay Structure Decisions	133
5.3	Technical Design Considerations	135
	5.3.1 Establishing a Pay Policy Line	136
	5.3.2 Pay Structure Mechanics	137
	- Determination of Job Worth	138
	- Determination of Job Classes	139
	- Determination of Pay Ranges	141
	- Individual Pay Determination	143
	- Variations on the Pay Structure	145
5.4	Summary and Conclusion	147
	References	150

5.1 INTRODUCTION.

There are numerous ways in which the decision making process can be viewed. Thierauf (1982 : chapter 4) presents a concise review of the literature on the *decision making process*. From this it is clear that whatever the conceptual model used, an important initial step is *intelligence-gathering*. This involves a comprehensive understanding of the problem area. This chapter seeks to contribute to this intelligence-gathering exercise by reviewing the elements involved in the compensation planning process.

The proposed DSS in compensation planning is intended to assist primarily in strategic policy formulation and secondly with technical structure design. The strategic management process as presented by numerous researchers, amongst others, Glueck (1976 : 22) and Steiner and Miner (1986: 83) provides a useful framework for the review of the compensation planning process. This top-down approach results in a unified, coherent strategic plan that is not vague with respect to either corporate direction or corporate objectives and performance targets (Thompson and Stickland 1984 : 74).

5.2 STRATEGIC CONSIDERATIONS.

Environmental and organisational analysis is considered to be an important initial step in the formulation of strategies. Consequently, this section will identify various external and internal factors and briefly examine their influence on the formulation of compensation strategies.

5.2.1 ENVIRONMENTAL AND ORGANISATIONAL INFLUENCES.

The issues considered below are in no specific order of importance. Each strategic influence will only be mentioned, while more detailed discussion on the direction and extent of each influence can be found in the references provided. The following influences have been identified:

(i) the *market stage* of the organisation is found to exert an influence on the pay mix (Ellig 1982 : 15; Milkovich and Newman 1984 : 12);

(ii) different *levels within the organisation* are associated with different mixes of the compensation elements (Ellig 1982 : 20);

(iii) the choice of *compensation objectives* are considered to impact on the mix of compensation elements (Mahoney 1982 : 236; Ellig 1982 : 20);

(iv) *organisational culture and values* ,in particular, management style, is believed to exert an influence on the pay approach adopted by an organisation (Lawler 1976 - as reported in Heneman and Schwab 1978 : 233; Glueck 1979 : 296; Milkovich and Newman 1984 : 13; Carter and Shapiro 1984 : 44/2; and Hollerbach 1984 : 16/14);

(v) *employee considerations* appear important; (Opshal and Dunnette (1966 : 132) were amongst the first to consider the importance of personal characteristics such as preferences, perceptions, opinions and other responses as an important influence on pay systems design. Research by others, including Lawler and Hackman (1969), Lawler (1971), Milkovich and Delaney (1975), and Fragner (1975), support this view (Milkovich and Newman 1984 : 14);

(vi) research into *career stages* by Hall (1976), Schein (1978), Rush, Peacock and Milkovich (1980), and London and Strumpf (1982) (reported in Milkovich and Newman 1984 : 14) has established that base pay and benefits vary inversely with career progression;

(vii) the nature of the *union relationship* appear to affect the way compensation decisions are made (Foulkes 1980 : 153 - reported in Milkovich and Newman 1984 : 15-16; Tromp and Wegner 1985 : 21); and

(viii) the state of the *labour market and competitor employment practices* both at the local and national level is seen by Hollerbach (1984 : 16/10 - 16/14) to exert an influence on the salary and wage structure.

The above list is by no means complete, but it does give an indication to compensation management of the spectrum of forces that contribute to shaping the compensation system of an organisation. Their impact will be reflected in the compensation policies adopted by an organisation.

To reiterate, since this study focuses on the salary and wages component of compensation management, the subsequent discussion on objectives, policy and technical issues will be restricted to those aspects relating only to the base pay element.

5.2.2 COMPENSATION OBJECTIVES.

Objective-formulation is an important second step in giving direction in the design of effective compensation systems after environmental scanning. As stated by Thompson and Stickland (1984 : 24), the setting of objectives "helps prevent organisation drift; it helps promote and instill a results orientation; and it focusses attention on making the right things happen". More specifically, objectives serve two important purposes according to Milkovich and Newman (1984 : 7 - 8). Firstly, they provide direction in shaping the form of the compensation system, and secondly, they serve as standards against which the success of the compensation system is evaluated.

There is no single compensation objective. The choice of objectives is guided by the purpose to be served (Milkovich and Newman 1984 : 7).

One fundamental objective, which has the support of many compensation authors, is the need to attract, retain and motivate manpower (inter alia, Dunn and Rachel 1971 : 102; Mahoney 1981 : 11; Schuler 1981 : 261; Milkovich and Newman 1984 : 7). Both Mahoney and Milkovich and Newman provide illustrations of how the statement of objectives affects the mechanics of the pay system in terms of varying the emphasis.

An array of supplementary objectives have also been identified. Three additional compensation objectives have been suggested by Milkovich and Newman (1984 : 7). They are : to facilitate organisation performance; to control labour costs; and to comply with legal requirements. Patten (1977 - reported in Glueck 1979 : 282) elaborates on the fundamental objective of attraction, retention and motivation by suggesting seven criteria for effectiveness. A compensation system should strive for adequacy, equitability, balance, cost effectiveness, security, incentive providing, and acceptability to the employee.

Thus without a clear statement of compensation objectives, the compensation planning process will lack direction and purpose. But compensation objectives must not be seen in isolation. This point is argued by many authors who emphasise the theme of integration with corporate objectives and strategies as discussed in chapter 4. To elaborate, Walker (1980 : 245) sees compensation planning "as part of overall human resource planning within the context of strategic planning", while Milkovich and Newman (1984 : 11) believe compensation systems "need to be designed to reinforce the strategies adopted by the organisation". The call for reinforcement and integration is made by Ellig (1982:2) too, who maintains that "not only should the compensation objectives and strategies facilitate the attainment of organisational objectives, but also penalise their degree of failure".

Davis (1984:56/5) believes that the effectiveness of compensation systems depends upon both good compensation administrative practices and a compensation philosophy consistent with overall corporate philosophy. Failure to provide this corporate support has, in Davis' view, resulted in the wreckage of numerous compensation programmes. He adds further, that "objectives not in tune with approved policy are wasted effort". He reflects the view of other authors mentioned above when he argues that "the salary program is a management tool, and, as such, must be designed to reflect overall corporate philosophy and the policies which embody that philosophy". Sibson (1974:4-6) emphasises the integration aspect too by indicating the effect on organisational performance of three different compensation objectives. At the lowest level, an objective of merely "avoiding trouble" by having an effective and efficient administration system "does not really add anything to the enterprise". Secondly, a system designed to "contribute to the goals of the organisation ... adds a strategic element of success to the enterprise" and can be viewed as a positive contribution to organisation effectiveness. Finally, a compensation system aimed at "contributing to organisational development" is likely to have the greatest impact on organisational effectiveness.

Unfortunately, according to Ellig (1982 : 2), this integration philosophy "is a philosophy agreed to in principle but largely ignored in practice". This view is supported by Greene and Roberts (1983 : 79) who express the concern that "compensation practitioners are overly preoccupied with technical issues, and that this narrow perspective has caused them to overlook, or underemphasise, the strategic and motivational implications of the way compensation programs are designed and administered." Their belief is that "practitioners who operate with a broad, strategic view will become more involved in policy making and implementation within the organisation; they will more significantly affect the organisation's costs and profitability; and they will become more critical to the success of that organisation".

Objectives specify the end result sought. Strategies indicate the method of achieving these goals. The following section will identify the policy options available to achieve specific compensation objectives.

5.2.3 COMPENSATION POLICIES.

There are essentially two policy decision areas in compensation management. Based on the compensation objectives set and the nature and strength of the various strategic influences, compensation planners must formulate policy guidelines in the areas of :

- *pay level*, and
- *pay structure.*

The importance of these two decision areas is underscored by Glueck (1979 : 283) who sees the responsibility for these decisions as resting with senior management in both line and staff functions.

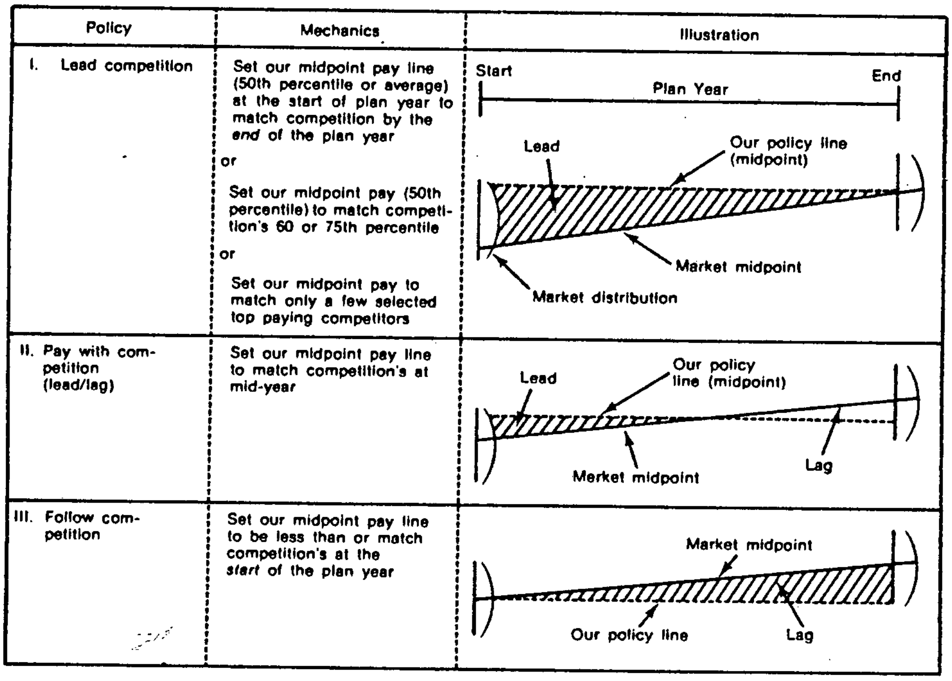
(i) PAY LEVEL DECISIONS.

Setting the pay level is by no means a 'technical task'. "It is a major strategic choice top management must make" (ibid : 296). There are essentially three classes of pay level policies: to lead, to meet, or to follow competition. "The choice of strategy in part reflects the motivation and attitude set of the manager" (ibid : 297), but is guided largely by the need to ensure external equity (Milkovich and Newman 1984 : 192). Figure 5.1 illustrates graphically each of these pay level policies.

Both Glueck (1979 : 297-298) and Milkovich and Newman (1984 : 195, 216-217) discuss the factors considered most relevant to pay level decision. Their combined list includes almost all the strategic factors mentioned in section 5.2.1 above.

Present evidence suggests that the most common policy is to match rates paid by competitors with a more recent study showing many organisations favouring a lead or at least a match policy (ibid : 217).

FIGURE 5.1 : Alternative Pay Level Policies.



Source : Milkovich, G.T. and Newnam, J.M. (1984) p.252.

In addition to the factors affecting the pay level decision, compensation planners should also be aware of the consequences of alternative policies. Milkovich and Newman (1984 : 217) present a model, shown in Figure 5.2, of the likely impact on a set of compensation objectives. The 'lead' policy appears to contribute most to the stated objectives, and a 'lag' policy the least. Two further consequences mentioned, which involve a trade-off, are the affects on operating expenses and the quality of the work force (ibid : 193). The degree of competitiveness of the pay level, too, results in specific consequences which should be noted (ibid : 209).

To conclude, the setting and changing the pay level is a key decision in compensation management that can profoundly affect the performance of the organisation. The technical issues of constructing a pay policy line will be discussed in section 5.3.

FIGURE 5.2 : Probable Relationships between Pay Level Policies and Objectives.

	Compensation Objectives				
Policy	*Ability to Attract*	*Ability to Retain*	*Contain Labor Costs*	*Reduce Pay Dissatisfaction*	*Increase Productivity*
Pay above market (lead)	+	+	?	+	?
Pay with market (match)	=	=	=	=	?
Pay below market (lag)	−	?	+	−	?

Source : Milkovich, G.T. and Newman, J.M. (1984) p.217.

(ii) PAY STRUCTURE DECISIONS.

A primary consideration in the setting of the pay level is 'external equity'. In pay structure decisions, however, the emphasis is on 'internal equity' (Glueck 1979 : 299). The task of strategic management is to provide guidelines concerning the general relationships among levels of pay in a way which equates jobs of equal worth, and similary, differentiates between jobs of unequal worth (Henderson 1979 : 264). Management may prescribe these criteria either arbitrarily, through the process of collective bargaining, or the organisation can adopt a formal job evaluation process. The latter approach appears to be the most widely used and accepted manner of striving for internal equity according to Glueck (1979 : 299).

As with pay level decisions, three issues should be considered in setting guidelines. They are (with further discussion provided in the references):

- the contribution of the pay structure to objective achievement (Milkovich and Newman 1984 : 25);

- the factors influencing internal equity and consequently pay structure decisions (Livernash 1957, Jaques 1961, Mahoney 1979 - ibid : 34); and

- the potential consequences of a non-internally equitable pay structure (Glueck 1979 : 299, Milkovich and Newman 1984 : 27).

The belief is that internally equitable pay structures will promote the objectives of attraction retention and motivation. Mahoney (1979 : 202), however, disputes this apparent influence on motivation. The factors influencing internal equity are essentially similar to those affecting pay levels with the emphasis placed by Milkovich and Newman (1984 : 27) on the internal labour force and their attitudes and perceptions.

Given the pay structure guidelines,there is still an array of more specific issues which must be resolved before implementation of a compensation system is possible. These technical design issues will be discussed in the following section.

5.3 TECHNICAL DESIGN CONSIDERATIONS.

It is clear at this stage that the design of a compensation system at the technical level is heavily dependent on the formulation of compensation objectives and policy guidelines. From these guidelines, "managers must consider the issues and make acceptable and workable determinations" concerning a host of specific aspects (Henderson 1979: 264). Henderson mentions at least ten specific aspects revolving around pay level and pay structure mechanics and deal essentially with determining specific employee rates.

This section will only review the various alternatives with the final choice of design features being decided by the circumstances surrounding a particular compensation system.

5.3.1 ESTABLISHING A PAY POLICY LINE.

Both Henderson (1979 : 266-268) and Milkovich and Newman (1984 : 242 - 252) present clear guidelines on the mechanics of constructing a pay policy line. It is essentially a three-phase approach.

Firstly, survey data is used to identify the market rates for various key jobs that cover the entire pay spectrum from lowest to highest rates of pay. The importance of salary surveys as a valuable data source in South African companies was also established in the study by Tromp and Wegner (1985 : 21). The use of one of three methods, ranging from 'eyeballing' to statistical estimation, is then employed to site the market pay line.

Next, the updating of the survey data is considered to counter the time lapse effect from data origination to data utilisation.

Finally, the setting of the employer's pay level line can proceed in accordance with the policy guidelines mentioned above. This translates essentially into a pay line with a midpoint either above, at, or below the market midpoint for each job grade as defined by the pay level policy. Figure 5.1 also illustrates the mechanics associated with each pay level policy decision. This diagram again emphasises the importance of relating the technical considerations to the strategic issues and so promote total integration of the compensation program through all levels of management.

The determination of the pay policy line now provides the basis for establishing the relationship between the grades, and the range of the pay grades which are the following issues to be discussed.

5.3.2 PAY STRUCTURE MECHANICS.

There are essentially four stages involved in guiding the compensation planner in achieving internal equity through pay structure design (Glueck 1979 : 299-305). They are:

- the determination of the relative worth of the jobs;
- the grouping of jobs into classes or grades;
- the design of pay ranges within each class; and
- individual pay determination.

Two sources in particular, namely Henderson (1979 : 272-300) and Burgess (1984 : chapters 4-11) present in-depth discussions on the technical aspects of each of these four stages. Glueck (1979), Schuler (1981) and Milkovich and Newman (1984), inter alia, also cover these aspects in varying degrees of detail. The following discussion will only outline important aspects of each issue.

(i) DETERMINATION OF JOB WORTH.

The objective of this initial phase of the salary structuring process is to produce a ranking of the relative worth of jobs within an organisation. While this may be achieved either through arbitrary management decisions, or collective bargaining, a more systematic and less subjective approach is to use *job evaluation* (Hackett 1979 : 171-172). A combination of collective bargaining input and job evaluation is considered to be the most acceptable method of determining relative job worths (Glueck 1979 : 299).

The process to achieve internal equity consists of four essential steps (Henderson 1979 : 196; Schuler 1981 : 267; Milkovich and Newman 1984 : 114). Briefly, the process begins with a job analysis, followed by a definition of the 'compensable factors'. This, in turn, determines largely the choice of job evaluation system. Finally, the execution of the process of job evaluation takes place prior to its linkage with the compensation system.

As indicated above, various systems of job evaluation exist. They can be classified into two broad categories: non-quantitative methods and quantifiable methods. The former methods include ranking, and job classification; while the point rating method, the factor comparison method and the Hay Guide Chart-Profile method are more quantifiable.

These methods are adequately described by, amongst others, Sibson (1974 : chapter 4), Henderson (1979 : chapters 7 and 8), Glueck (1979 : 299-302), Hackett (1979 : 172-180), Schuler (1981 : 267-271), Milkovich and Newman (1984 : chapter 4), and Burgess (1984 : chapters 5-9).

Concerning their usefulness, the point system, followed by the factor comparison method appear to be the two most commonly used methods of formal job evaluation (Schuler 1981 : 271; Milkovich and Newman 1984 : 145; Burgess 1984 : 93).

Since most organisations favour the point method, it is necessary to consider the next step, namely the determination of job classes.

(ii) DETERMINATION OF JOB CLASSES.

Each of the job evaluation methods referred to above facilitate to a greater or lesser degree the categorisation of jobs. Categories of jobs automatically follow from the use of the ranking and classification methods (Schuler 1981 : 272), but additional analysis and grouping is necessary for the other methods of job evaluation in the establishment of job classes.

Before examining the methodology, the comments of Wolf (1984:20/2) concerning the need for grades versus individual job ranges should be noted. On the one hand, grading loses some of the precision of the quantitative job evaluation methods, but is administratively simpler and covers for margins of error in the numerical rating process. But on the other hand, complaints of perceived inequities can result where for example, two identifiably different jobs are remunerated equally, or two jobs of almost identical job worth are treated differently for pay purposes because they lie on either side of an arbitrarily placed grade boundary.

Given that the setting of grades is desirable, questions arise as to the number of grades to set. Those advocating fewer job grades argue that a proliferation of classes is difficult to explain or defend. Too few grades however, tend to blurr the distinction between the relative worth of jobs to the organisation. Those advocating a greater number of jobs use the arguement that employees favour frequent upgrading, but risk, by so doing, complicating the adminstrative process (Milkovich and Newman 1984 : 102).

However, the choice of the number of grades is dictated largely by convention and experience, rather than by research. As a benchmark, Belcher (1974 : 151-152) suggests that between 15 and 17 is appropriate. A survey amongst South African organisations tends to confirm this. Organisations tend to use between 16 and 20 grades with a tendency to use fewer rather than more grades (Tromp and Wegner 1985 : 26).

On the practical level, the process of establishing grades can be performed by recourse to a scatterplot of the point value of jobs to predetermined remuneration rates with the setting of boundary points dictated by organisational values and history (Schuler 1981 : 272).

(iii) DETERMINATION OF PAY RANGES.

The horizontal dimensions of a pay structure are determined by the setting of job grades. The vertical dimension relates to the range of salary to be paid to each job grade.

This range may in fact be a single rate, termed a flat or standard rate, or alternatively consist of a spread of values with identifiable minimum, midpoint and maximum rates of pay for each grade (Henderson 1979 : 285-287). While single rates do exist and arise mainly from union-management negotiations, it is more common to find rate variations for a given grade (Glueck 1979 : 304; Milkovich and Newman 1984 : 254).

Ranges allow an employer to recognise individual differences whether they be experience or performance based. "From an internal equity perspective, the range established should approximate the range of performance or experience differences that an employer wishes to recognise." Similarly, "from an external perspective, the range indicates the market value the employer attaches to the job" (Fogel 1965 - reported in Milkovich and Newman 1984 : 254). Henderson (1979 : 287) expands on this "recognition of individual differences through pay ranges" concept by presenting a three phase rationale for setting ranges. The range of salaries below the midpoint relates to encumbents meeting probationary requirements, while salaries above the midpoint indicate employees having exhibited acceptable job performance.

The practicalities of actually setting the grade minima and maxima are not well defined. A practice reported by Henderson (1979 : 287) and Milkovich and Newman (1984 : 256) is to use the 25th and 75th percentiles of market survey data linked to the organisation's job evaluation system and moderated by various internal considerations of the type noted in section 5.2.1. Another reported practice is to increase the range progressively through the pay structure (Glueck 1979 : 304; Henderson 1979 : 286; and Wolf - reported in Rock 1984 : 20/4; Burgess 1984 : 193) . These variable ranges, it is argued, are designed to reflect the greater individual discretion of work. The survey by Tromp and Wegner (1985 : 27) established that the fixed percentage method across all grades is more common in South African organisations.

A direct consequence of range setting is the likely existence of an *overlap* between adjacent grades. The size of the overlap is determined directly from the size of the pay range and the differences in midpoints between adjacent grades.

The significance of the overlap is discussed by Milkovich and Newman (1984 : 257) and Burgess (1984 : 194). It is argued there is a close link between employee motivation and the extent of the overlap.

While research has not yet defined an exact relationship, there appears to be some agreement amongst researchers concerning the magnitude of an acceptable overlap. Burgess (1984 : 195) cites Patton, Littlefield and Self (1964 : 270), Dunn and Rachel (1971 : 225) and Belcher (1974 : 285) as concurring that overlaps ranging from 50 percent to 60 percent are acceptable. Henderson (1979 : 291) considers an overlap of approximately 70 percent as not being unusual between adjoining grades.

A further guideline, suggested by some experts, is to avoid overlap beyond three adjacent levels (ibid : 292). The survey by Tromp and Wegner (1985 : 28-29) found that almost all surveyed organisations have pay structures involving overlaps constructed on a sliding scale basis across successive job grades.

(iv) INDIVIDUAL PAY DETERMINATION.

For each grade, the pay range merely specifies the minimum and maximum pay levels applicable to jobs within that grade. The remaining task of the compensation planner in the design processis the assignment of individual employees to a specific pay level within the pay range *and* to specify the method of personal progression through the salary grade.

Milkovich and Newman (1984 : 268) introduce the term *employee equity* to refer to the pay relationship between *individuals* within the same job and organisation to guide the positioning of individuals within the salary grade. The guidelines used for positioning individuals is either performance or seniority or a combination of both (Sibson 1974 : chapter 6; Henderson 1979 : 288; Schuler 1981 : 275; Burgess 1984 : 202; Milkovich and Newman 1984 : 268). Performance appears to be the most preferred criteria. But, as seen from the discussion in chapter 4, there is still much doubt on the relationship between pay and performance.

Given an assignment of an individual to a particular salary level within a job grade, based on whatever criteria are considered appropriate, the only unresolved issue is the personal progression through the salary grade. Again, performance and/or seniority are the primary progression criteria. Hackett (1979 : 184) examines the rationale for the adoption of either a fixed or variable incremental method which has implications on employee work-related attitudes and performance, while Henderson (1978 : 287) and Burgess (1984 : 203) present guidelines, based on merit, for establishing an individual's pay progression.

(v) VARIATIONS ON THE PAY STRUCTURE.

The fundamentals of a pay structure have been outlined above. What needs to be emphasised are the alternative configurations within each parameter and the consequent multiplicity of resulting combinations of pay structures. As Milkovich and Newman (1984 : vii) point out, "there are multiple correct answers which are more or less viable depending on an analysis of the uniqueness of both the organisation and the environment ..... and organisations and environments are constantly changing".

The alternatives in the policy decision areas have already been identified in section 5.2.3. This discussion will focus on the possible variations in the parameter values at the technical level.

Beginning with the shape of the *pay curve* itself, it is possible to use a curvilinear function instead of a linear function to describe the relationship between pay and grades. Burgess (1984 : 194) notes that the use of a rising percentage differential function between midpoints of pay grades is recognised by many companies.

Concerning the *overlap*, this can reasonably range from zero to about 70 percent across adjacent grades. This value can be preset either at a constant or incremental percentage across all grades. Alternatively, the overlap may be a function of the pay ranges and grade midpoints, where upon the presetting of the overlap level is inappropriate.

There are many other wage structures an organisation can establish. These can be achieved by varying the overlap; through the selection of different grade widths; and the variation of pay ranges. "All are designed to help make the organisation's internal salary structure consistent and equitable and to offer some incentive for higher performance" (Schuler 1981 : 272).

Thus, from a mechanical perspective, a myriad of pay structure configurations are possible. However, not all are suitable for any given organisation, but the subset of viable configurations still present a large array of alternatives to evaluate. Each configuration represents conceptually different compensation objectives and policies with consequential motivational implications on the work behaviour of the internal labour force.

5.4 SUMMARY AND CONCLUSION.

A recurring theme throughout this chapter has been the reference, sometimes only tentatively, to the relationship between compensation planning decisions - both of a strategic and technical nature - and the motivational level of the existing, and even potential, employee. This link is best summarised by Mahoney (1982 : 230) who refers to compensation planning and administration as "an application of motivational theory". The exact relationship is not clear, as section 4.3.4 indicates, but the literature implies that an appreciation of the various theories and concepts of compensation theories can greatly assist compensation planners in designing a system with significant motivational impact on the internal labour force, given the environmental and organisational climate of the period.

Apart from the underlying theme of tying the compensation package as closely as possible to motivational influences, *four* further issues emerge from the preceeding review.

Firstly, compensation planning is an *integrated process* requiring involvement from strategic management through to operating management, involving even employees and unions where appropriate. Sections 5.2.2 and 5.2.3 emphasise the importance of senior management involvement in formulating compensation objectives and policies consistent with the objectives and philosophy of the other areas of the organisation. These policies translate into practical procedures for implementation as discussed in section 5.3.

Secondly, the compensation system is but one of a number of organisational systems which collectively contribute to overall organisational effectiveness. Thus a *systems view* must be adopted in compensation planning. As indicated in section 4.3.4, compensation is but one of a number of factors that are considered to influence employee motivation and hence organisation performance and output. The adoption of a *systems* view in the design of a compensation system is advocated by the literature to ensure that the collective impact on the employee work-related attitudes and behaviour has a synergistic effect.

Thirdly, the multiplicity of strategic and technical planning options - as highlighted in sections 5.2 and 5.3 - underscore the need for a decision support tool to facilitate the evaluation of alternative structures in a rational, objective and timely manner. This array of alternatives is emphasised by Henderson (1979 : 282) who indicates that "there are no firm rules for setting quantitative guidelines for developing a pay structure - *only acceptable indicators*". This implies too, that there is no universal optimal solution - only solutions that *satisfice* rather than *optimise* should be sought (Kleijnen 1980 : 44). A decision support tool to serve this need could serve too as a focal point for compensation planning and so promote the desirable criterion of communication across the different levels of management involved in the planning process.

Finally, compensation systems *maintenance* is an important element in the process of achieving the stated objectives. This requires periodic reviews. Both Whittington (1984 : 19/7) and Tromp and Wegner (1985 : 21) indicate that this review process be undertaken at least annually. But depending upon changing circumstances, this may occur more frequently. Further, a decision support tool could facilitate the necessary regular maintenance of a compensation system which, as Henderson (1979 : 300) describes "is often monotonous and, in many ways, drudgery .... (but) without maintenance, the best-designed and best-built compensation structure will deteriorate and fail in its primary mission - the development of an organisational atmosphere that stimulates employee motivation, resulting in superior performance".

The above four issues, amongst others, point to the need for a form of decision support tool which can play a major role in the efficient and effective design and maintenance of a compensation system. The importance of using a Decision Support tool in a strategic planning role to assist with policy formulation has also been emphasised.

The next chapter integrates the concepts of Decision Support Systems as discussed in chapter 3 with the compensation planning process as reviewed in chapters 4 and 5 in the form of a specific DSS model in compensation planning.

REFERENCES.

1. Belcher, D.W. 1974. Compensation Administration. USA. Prentice Hall.

2. Burgess, L.R. 1984. Wage & Salary Administration - Pay and Benefits. USA. Charles E Merrill.

3. Carter, M.F., Shapiro, K.P. 1984. Benefits as Part of Total Remuneration. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill. Chapter 44.

4. Davis, J.H. 1984. Keeping the Compensation Program Up to Date. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill. Chapter 56.

5. Dunn, J.D., Rachel, F.M. 1971. Wage and Salary Administration: Total Compensation Systems. USA. McGraw-Hill.

6. Ellig, B.R. 1982. Executive Compensation : A Total Pay Perspective. USA. McGraw-Hill.

7. Glueck, W.F. 1979. Foundations of Personnel. USA. Business Publications Inc.

8. Glueck, W.F. 1976. Business Policy : Strategy Formation and Management Action. Second Edition. Tokya. McGraw-Hill Kogakusha Ltd.

9. Greene, R.J., Roberts, R.G. May 1983. Strategic Integration of Compensation and Benefits. Personnel Administrator : 79 - 82.

10. Hackett, P. 1979 Success in Management : Personnel. U.K. John Murray.

11. Henderson, R.I. 1979. Compensation Management - Rewarding Performance. Third Edition USA. Reston.

12. Hollerbach, R.E. 1984. Determining Wage and Salary Policy. Handbook of Wage and Salary Administration. Rock, M.L. (Editor) : USA. McGraw-Hill. Chapter 16.

13. Kleijnen, J.P.C. 1980. Computers and Profits. Phillipines. Addison-Wesley.

14. Lawler III, E.E. 1978. New Approaches to Pay : Innovations that Work. Perspectives on Personnel /Human Resource Management. Heneman III H.G., Schwab, D.P. (Editors). USA. Irwin : 226 - 234.

15. Lawler III, E.E. 1981. Pay and Organisation Effectiveness. USA. Addison-Wesley.

16. Mahoney, T.A. 1979. Compensation and Reward Perspectives. Homewood Illinois. Richard D Irwin.

17. Mahoney, T.A. 1982. Compensation for Work. Personnel Management. Rowland, K., Ferris, G. (Editors). USA. Allyn & Bacon. Chapter 9 : 227 - 262.

18. Milkovich, G.T., Newman, J.M. 1984. Compensation. Texas. Business Publications Inc.

19. Opsahl, R.L., Dunnette, M.D. 1966. The Role of Financial Compensation in Industrial Motivation. Motivation and Management. Vroom, V.H., Deci, E.L. (Editors). U.K. Penguin Education. 127 - 159.

20. Schuler, R.S. 1981. Personnel and Human Resource Management. USA. West Publishing Company.

21. Sibson, R.E. 1974. Compensation. USA. AMACOM.

22. Steiner, G.A., Miner, J.B. 1986. Management Strategy and Policy. Third Edition. New York. MacMillan.

23. Thierauf, R.J. 1982. Decision Support Systems for Effective Planning and Control : A Case Study Approach. New Jersey. Prentice-Hall.

24. Thompson, Jr. A.A., Stickland III, A.J. 1984. Strategic Management : Concepts and Cases. Third Edition. Texas. Business Publications Inc.

25. Tromp, D., Wegner, T. February 1985. The Computer's Role in Personnel Management with specific reference to Compensation Planning. Occasional Paper 9. Stellenbosch University Business School.

26. Whittington, G.P. Establishing the Exempt and Management Pay Structure. 1984. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill. Chapter 19.

27. Wolf, M.G. 1984. Solving Technical Problems in Establishing the Pay Structure. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill. Chapter 20.

28. Walker, J.W. 1980. Human Resource Planning. USA. McGraw-Hill.

CHAPTER 6

THE COMPENSATION PLANNING MODEL

6.1	Introduction	153
6.2	The COMPLAN Model Objectives	154
6.3	The COMPLAN Design Features	155
6.4	The COMPLAN Model Structure	158
	6.4.1 Salary Database Creation and Editing	161
	6.4.2 The Current Salary Structure Review	170
	6.4.3 Scenario Identification	170
	6.4.4 Scenario Parameter Values Setting	176
	6.4.5 Scenario Evaluation	181
	6.4.6 Interface with Spreadsheets	184
	6.4.7 Additional Features	186
6.5	Summary and Conclusion	188
	References	190

6.1 INTRODUCTION.

This chapter represents a synthesis of the concepts of Compensation Planning and of Decision Support Systems in the form of a microcomputer-based decision model. The DSS Development Life Cycle phases of *design*, *system construction* and *system testing* are illustrated through the specification, design and development of a prototype DSS in compensation planning. The model, referred to as COMPLAN (COMpensation PLANning), aims to assist compensation planners in developing a coordinated and integrated approach to this important area of human resource management. The focus of the model is on the design and development of the basic salary structure. It does not incorporate the area of employee benefits management.

It should be noted that COMPLAN is not an optimisation model. It merely evaluates alternative scenarios as identified by the compensation plannner(s) and establishes the likely consequences of a proposed course of action. The final decision as to which course of action to pursue resides exclusively with the planner(s). The Model is designed to enhance the information base and provide a comprehensive, integrated view of the system under study.

A compensation planning model can be classified within the framework of Decision Support Systems. The conclusion that has emanated from the reviews presented in the preceeding four chapters and made explicit in chapter 5.4 has been that there exists the need for an integrated structure to provide a systems view, and the need for the evaluation of a multiplicity of possible scenarios. Both these requirements appear consistent with the definitions for non-structured decisions to which DSS are applicable. Brookes, Grouse, Jeffery and Lawrence (1982:434) for example, describe semi-structured decisions as "those for which broad guidelines, rules, or precedents exist, but where complexity, uncertainty, or risk is significant", while Carlson (1983:16) sees them as being the "result of novelty, time constraints, lack of knowledge, large search space, (and the) need for nonquantifiable data etc."

This chapter will initially define the design criteria for the COMPLAN Decision Support System. Thereafter the model's structure will be described.

6.2 THE COMPLAN MODEL OBJECTIVES.

As identified in chapter 5, the objectives of a compensation planning system with respect to base salary planning, are the development of a structure that is both internally and externally equitable *and* is affordable to the organisation. These systems objectives serve as a guide to formulating operational objectives for systems modelling.

The Model aims to provide a *useful* and *usable* tool to compensation planners to perform their corporate responsibility more effectively.

Specifically this translates into providing a DSS tool that:

- presents an *integrated* view of the total salary structure,
- provides *flexibility* in the selection of a compensation scenario, and
- permits *rapid evaluation* of the consequences of the proposed compensation scenario.

These model objectives can now be translated into design criteria to ensure their attainment.

6.3 THE COMPLAN DESIGN FEATURES.

The DSS design principles, strategies and techniques reviewed in chapter 3, provide the framework for the design of the COMPLAN model. Three important design principles, in particular, that form an integral part of the COMPLAN design process, are highlighted.

Firstly, an important consideration in the structure of a DSS design is the need for *congruence* between the system's logic and the model's logic. In this instance, knowledge of the compensation planning decision process is required. This relates to Stabell's (1983 : 228) call for a decision orientated approach which emphasises *usefulness* to DSS design. This implies that the goal of the DSS design should be "expressed in terms of how decisions should be made".

In the context of compensation planning, the decision making process involves reviewing the current structure, followed by amendments initiated either by market conditions or negotiated internal arrangements or both. An examination of the consequences of any amendments would lead to the acceptance of the revised structure or to further amendments to satisfy both employer and employee requirements.

Secondly, compensation planners tend to conceptualise a particular compensation structure and then seek the parameters that describe that structure. These familiar *representations* as described by Carlson (1983 : 18-21) provide a frame of reference for designing the DSS.

In compensation planning, the representations sought are :

- cost analyses by grade of a specific structure,
- graphic representation of the structure,
- employee distributions by grade with compa-ratios, and
- corresponding graphic displays of the distributions.

Thirdly, the *interface design*, as seen from chapter 3, is a critical issue in determining a System's *usability*. The interface "strongly determines whether or not users will view the DSS as friendly and easy to use" (Keen and Gambino 1983 : 140). A commonly used vehicle in interface design is the menu approach. Bennet (1983 : 54) argues that a "user finds menu-driven access to function easier when learning the system or when returning after some time away from a once-familiar system. A menu driven approach can remind a user quickly of the route through a procedure".

For the COMPLAN system, a menu-driven approach is adopted for ease of use. The COMPLAN system is intended for use when salary reviews take place. This occurs mainly annually or when union negotiations demand (Tromp and Wegner 1985 : 20).

Included in the interface design are facilities for :

- file creation/editing of salary structure parameters and the salary database,
- error checking,
- backward stepping, and
- interface with spreadsheets.

These design criteria are translated into a model structure which is presented in the following section.

6.4 THE COMPLAN MODEL STRUCTURE.

The model has undergone numerous revisions since its inception. The structure of the current version of the COMPLAN model reflects the repeated application of the three design criteria from section 6.3.

- In consultation with compensation planning specialists attached to the Graduate School of Business, University of Stellenbosch, and practitioners, the *management decision process* was enunciated and refined. This logic is reflected in the flowchart of Figure 6.1 and translated into the *Main Menu* of the COMPLAN Model as shown in Figure 6.2.

- Furthermore, the *representations* sought by compensation planners were identified from the same sources and translate into cost analysis tables; graphic representations of salary structures; and tables with related graphs of employee distributions.

- Each decision point within the model structure is presented as a *menu* from which a selection is made. Single key commands, prompts and error checking facilities promote rapid and easy progression through the COMPLAN structure.

FIGURE 6.1 : Flowchart of the Compensation Planning Model.

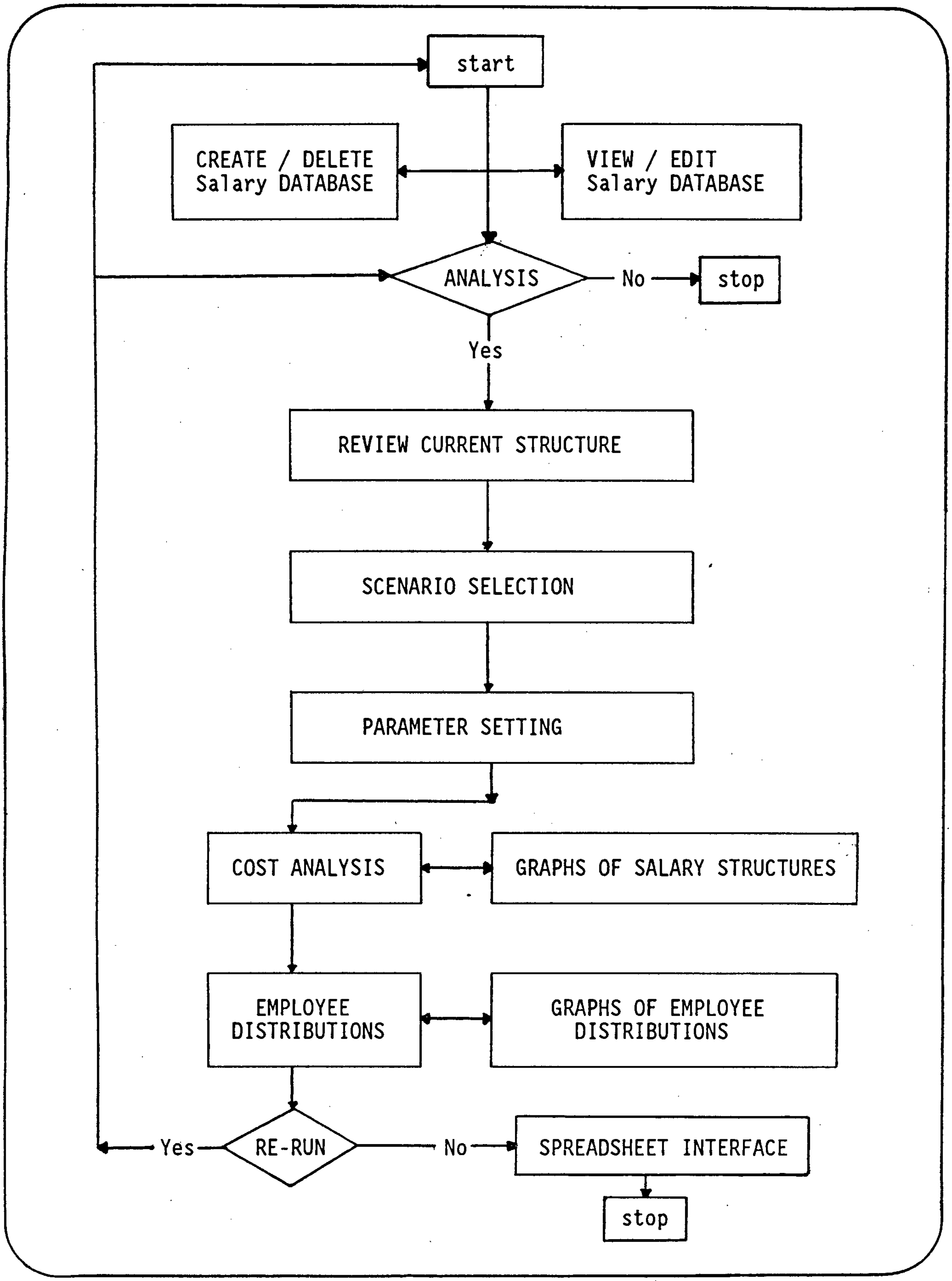


FIGURE 6.2 : Main Menu of the COMPLAN Model.

```
C O M P L A N  :  MAIN  MENU
============================

1.  CREATE / DELETE Database

2.  EDIT Database

3.  ANALYSIS

4.  EXIT to DOS


ENTER  1 , 2 , 3  or  4

<F1>  Backpage Facility          <Shift> <PrtSc>  Print Screen
```

Conceptually, the Model structure consists of SIX phases:

- salary database creation and editing,
- a review of the current salary structure,
- selection of a potential compensation scenario,
- setting of scenario parameter options,
- scenario evaluation, and
- spreadsheet interfacing.

6.4.1 SALARY DATABASE CREATION AND EDITING.

The primary data requirement is the current salary database. The COMPLAN model manipulates this data source in accordance with a specified scenario for which a variety of parameter values are required to quantify it. Thus the complete data required consists of both the current salary database and various parameter values. The nature of the salary database is discussed in this section, while that of the parameter settings is considered in section 6.4.4.

Two sets of salary data are required to reflect the current structure: namely,

- individual employee salaries, and

- the current salary scales.

The *individual employee salaries* provide data for cost analyses and for determining salary distributions within a given job grade. Changes may be made to the current employee salary database - obtained from the payroll system - prior to processing. These changes may take the form of removing employees that have left; adding new recruits; or adjusting an existing employee's salary and/or grade data to reflect promotion, transfer etc.

The *current salary scales*, on the other hand, describe the current pay line and each grade limits. For the purposes of reviewing both the current structure and providing a basis for comparison with the proposed structure, the current salary scales are required.

The option also exists to create and/or delete a particular salary database within the COMPLAN file directory.

These options of creating, deleting and editing the current salary databases are exercised at the beginning of the modelling process and are initiated through the selection of options one and two of the COMPLAN Main Menu (refer to Figure 6.2). Upon entering the *Database Edit Menu* - as shown in Figure 6.3 - each data set within the salary database may be viewed / edited. An illustration of the sub-menus for editing *employee salary records* is given in Figure 6.4 (for *Addition*), Figure 6.5 (for *Deletion*), and Figure 6.6 (for *Changes*). Similary, Figure 6.7 (for *Addition*), Figure 6.8 (for *Deletion*), and Figure 6.9 (for *Changes*) illustrate the sub-menus for the editing of the *salary scales*.

FIGURE 6.3 : Salary Database Edit Menus.

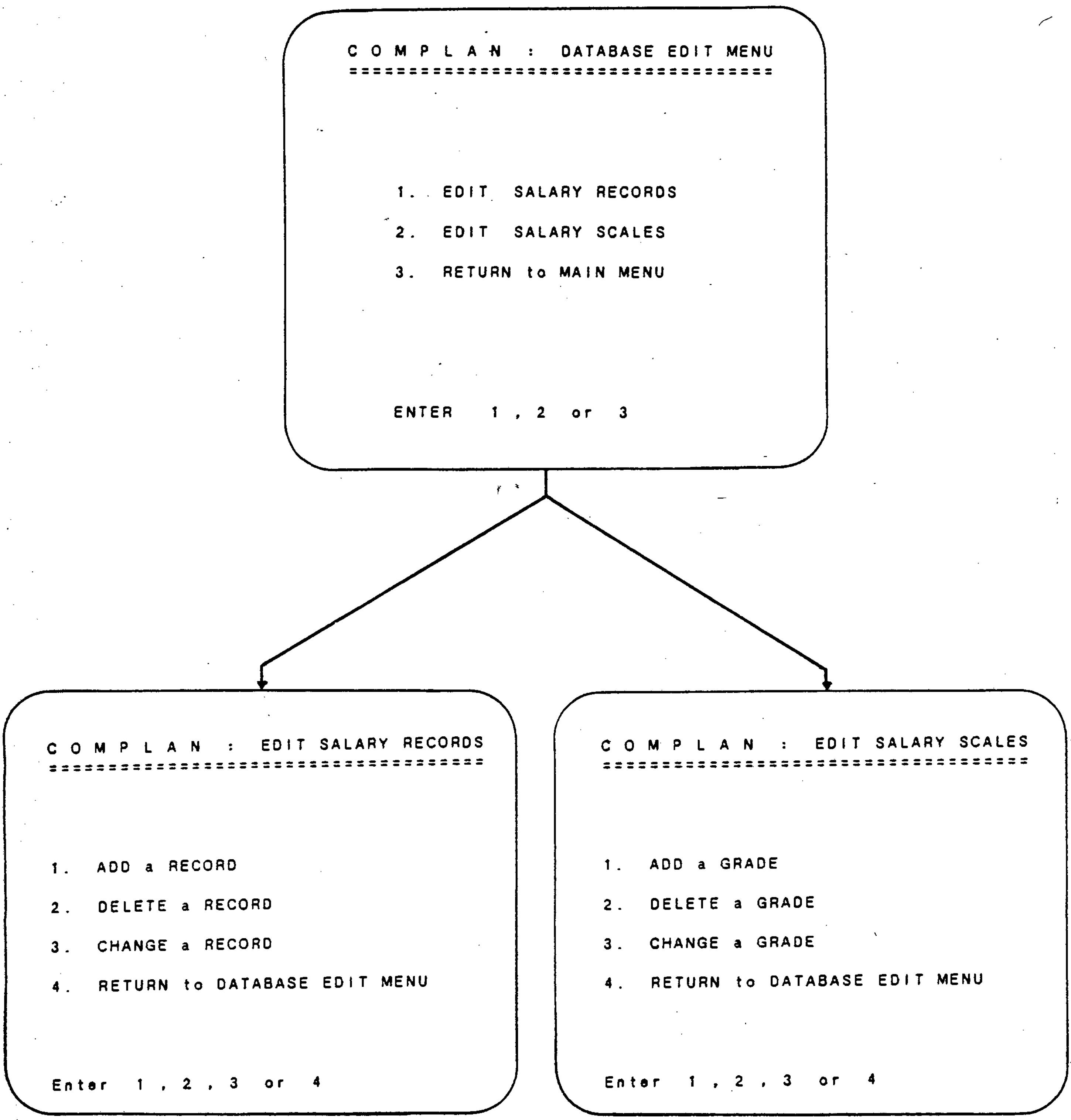


FIGURE 6.4 : Illustration of the Addition of a Salary Record

C O M P L A N : EDIT SALARY RECORDS
====================================

1. ADD a RECORD

2. DELETE a RECORD

3. CHANGE a RECORD

4. RETURN to DATABASE EDIT MENU

Enter 1 , 2 , 3 or 4

C O M P L A N : ADD SALARY RECORD
==================================

Employee CODE	555
Employee Job GRADE	3
Employee SALARY	16945

ENTER Another RECORD ? <Y> Yes <N> No

FIGURE 6.5 : Illustration of the Deletion of a Salary Record

```
C O M P L A N   :   EDIT SALARY RECORDS
=======================================

1.   ADD a RECORD

2.   DELETE a RECORD

3.   CHANGE a RECORD

4.   RETURN to DATABASE EDIT MENU


Enter  1 , 2 , 3  or  4
```

```
C O M P L A N   :   DELETE SALARY RECORD
========================================

EMPLOYEE  CODE :  555

EMPLOYEE  CODE  555  IS  DELETED


DELETE Another RECORD ?   <Y> Yes   <N> No
```

FIGURE 6.6 : Illustration of the Changing of a Salary Record

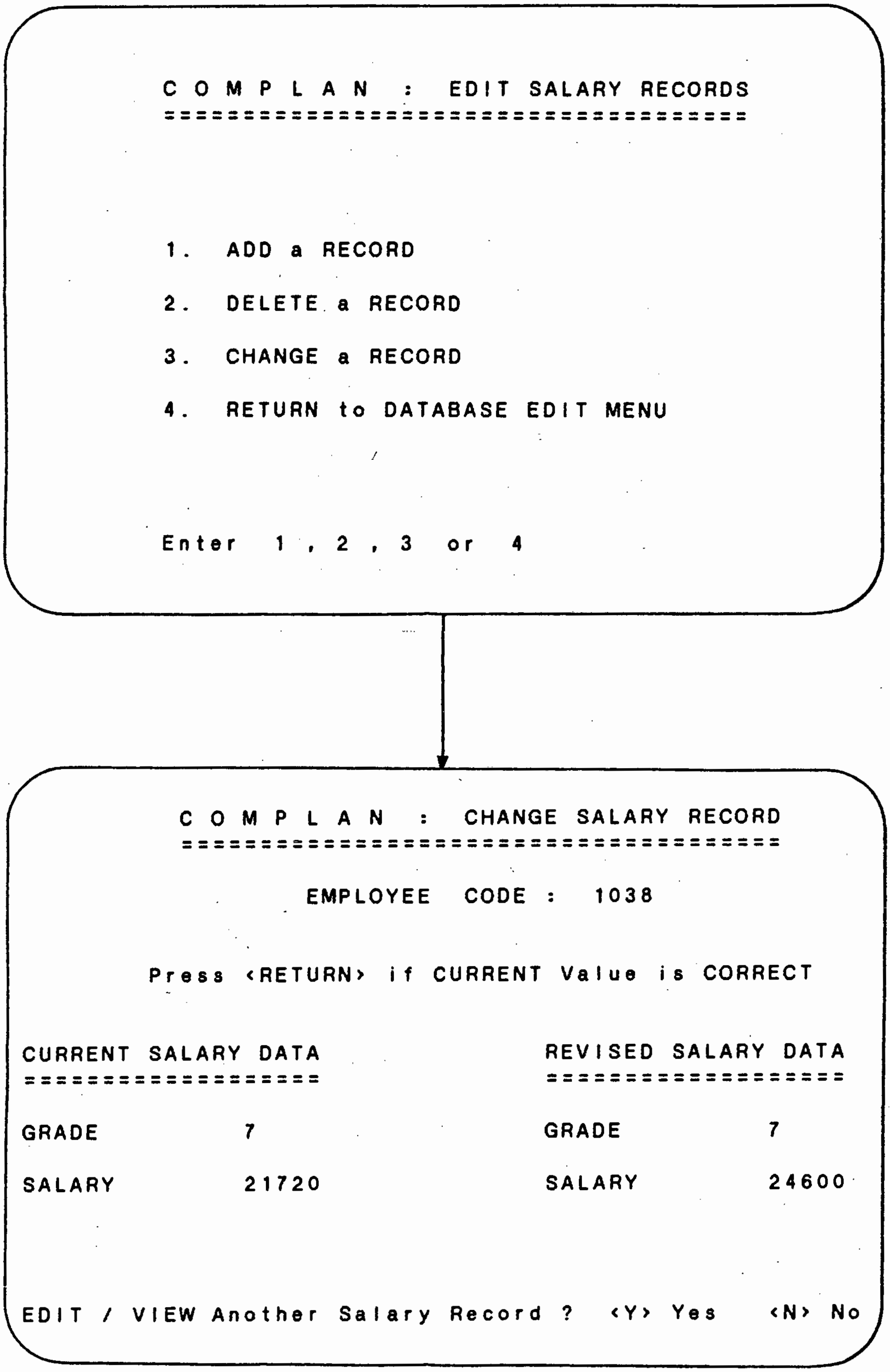


FIGURE 6.7 : Illustration of the Addition of a Salary Scale.

```
C O M P L A N  :  EDIT SALARY SCALES
======================================

1.  ADD a GRADE

2.  DELETE a GRADE

3.  CHANGE a GRADE

4.  RETURN to DATABASE EDIT MENU


Enter  1 , 2 , 3  or  4
```

```
C O M P L A N  :  ADD A GRADE
==============================

Enter NEW Grade


1.  At BOTTOM of Scale ?

2.  BETWEEN Two Current GRADES ?

3.  At TOP of Scale ?

4.  RETURN to SALARY SCALES Menu

Enter  1 , 2 , 3  or  4

NOTE :  CURRENT EMPLOYEE GRADES WILL ALSO BE ADJUSTED
```

FIGURE 6.8 : Illustration of the Deletion of a Salary Scale.

```
C O M P L A N   :   EDIT SALARY SCALES
======================================

1.  ADD a GRADE

2.  DELETE a GRADE

3.  CHANGE a GRADE

4.  RETURN to DATABASE EDIT MENU


Enter  1 , 2 , 3  or  4
```

```
C O M P L A N   :   DELETE A GRADE
==================================

     DELETE GRADE #   2

TREATMENT OF EMPLOYEES IN GRADE #  2

1.  REMOVE from Salary File

2.  RE-LOCATE  in GRADE #  3

3.  RE-LOCATE  in GRADE #  1


  Enter  1 , 2  or  3
```

FIGURE 6.9 : Illustration of the Changing of a Salary Scale.

```
C O M P L A N  :  EDIT SALARY SCALES
====================================

1.  ADD a GRADE

2.  DELETE a GRADE

3.  CHANGE a GRADE

4.  RETURN to DATABASE EDIT MENU


Enter  1 , 2 , 3  or  4
```

```
C O M P L A N  :  CHANGE GRADE LIMITS
=====================================

GRADE  #   2

PRESS <RETURN> if VALUE is CORRECT

CURRENT SCALES                     REVISED SCALES
==============                     ==============

LOWER        9000                  LOWER        9500

MIDPOINT     11000                 MIDPOINT     11000

UPPER        13000                 UPPER        13500


EDIT / VIEW Another SCALE ?   <Y> Yes   <N> No
```

6.4.2 THE CURRENT SALARY STRUCTURE REVIEW.

At the outset of the *analysis* phase of the Model (option three of the COMPLAN Main Menu), a compensation planner can request a review of the current salary structure. Current salary scales, cost data and employee distributions across grades are given for each job grade in tabular format (refer to Figure 6.10). In addition, simple comparisons between current pay levels and market-related pay levels can be made through the inclusion of salary survey data. Finally, the option exists to examine the current salary structure graphically as illustrated in Figures 6.11.

This exercise provides the basis for :

- identifying both the elements of the salary structure that require modification, and
- assisting in the estimation of the parameter values that will generate the desired structure as determined by the pay system objectives.

6.4.3 SCENARIO IDENTIFICATION.

On the assumption that the current salary structure should be adjusted to accommodate changed circumstances, the model
presents the user, at the second stage of the *analysis* phase, with a menu of parameter options from which an

FIGURE 6.10 : Review of Current Salary Structure.

C O M P L A N : CURRENT SALARY DATA

Grade	Staff	Min	Mid	Max	Spread	O/lap	Average	Market	Diff
1	6	8600	10300	12000	16	88	10240	14485	4245
2	14	9000	11000	13000	18	0	9702	16356	6654
3	8	13000	15500	18000	16	80	16455	18469	2014
4	26	14000	17000	20000	17	83	17073	20854	3781
5	16	15000	18500	22000	18	71	18697	23547	4850
6	11	17000	21000	25000	19	50	20803	26589	5786
7	8	21000	23500	26000	10	60	23355	30023	6668
8	8	23000	26500	30000	13	86	25980	33901	7921
9	6	24000	30000	36000	20	33	30460	38279	7819
10	6	32000	37000	42000	13	40	38200	43223	5023
11	4	38000	43000	48000	11	80	44340	46000	1660
12	4	40000	47500	55000	15	67	46500	52000	5500
13	3	45000	52500	60000	14	0	55560	56123	563

VIEW GRAPH of CURRENT STRUCTURE <Y> Yes <N> No

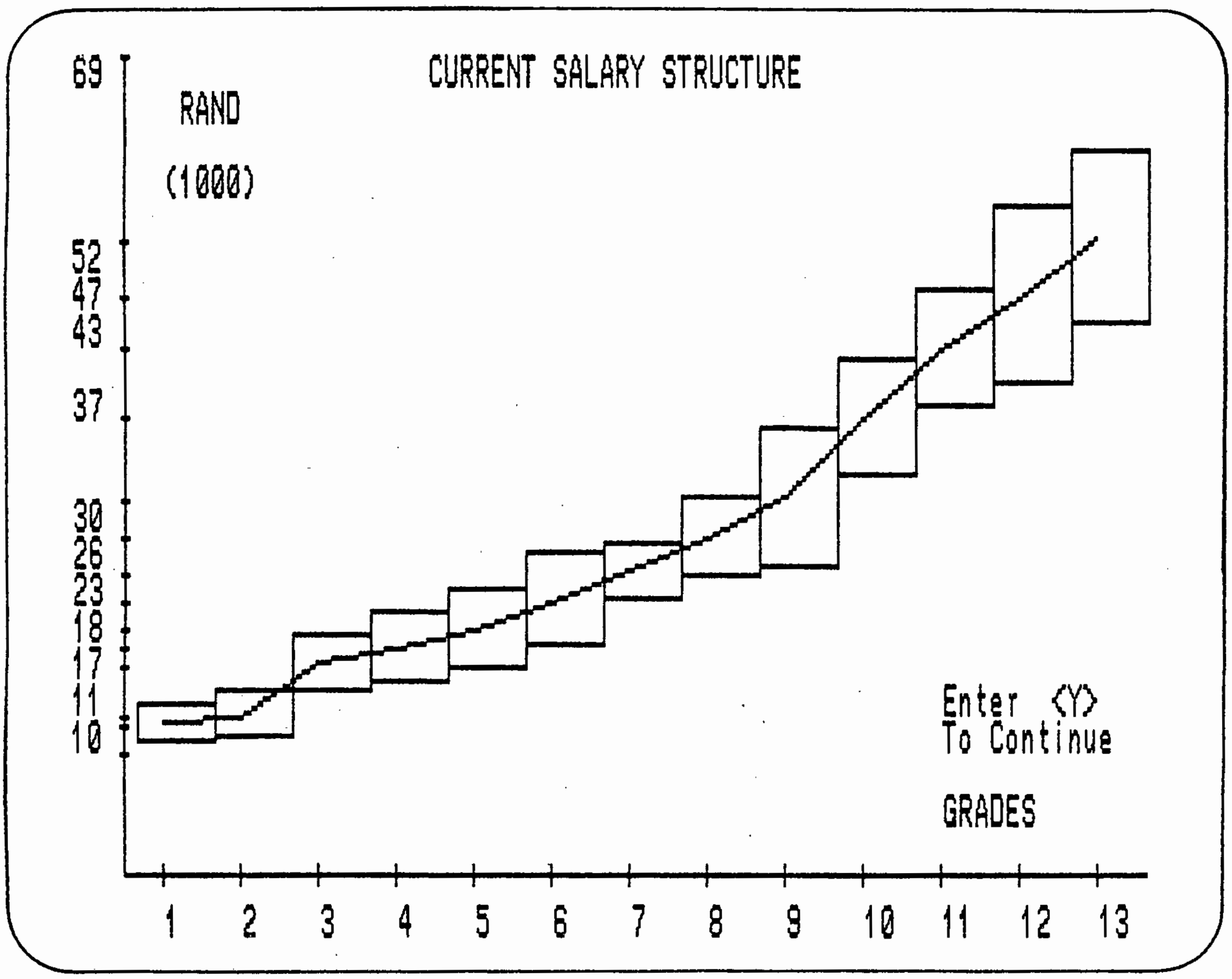
appropriate compensation scenario can be selected. The *Scenario Selection Menu* is shown in Figure 6.12. The parameter selections relate to the three important elements of a salary structure, namely

- the pay level,

- the pay structure, and

- individual employee distributions per grade.

FIGURE 6.11 : Graphical Display of Current Salary Structure.



The scenario selected from the various elements reflect the changes to be made to the current salary structure. Technically, a total of 144 combinations or scenarios are possible with the COMPLAN model. However, not all are appropriate. Each of the sub-options within the five option categories is discussed briefly.

FIGURE 6.12 : The Scenario Selection Menu.

```
            C O M P L A N  :  SCENARIO  SELECTION  MENU
            ========================================

   A. DATA SOURCE OPTIONS                  D. SPREAD OPTIONS

   1. Market Values                        8.  Fixed Rate plus Increment
   2. Current Midpoints                    9.  Variable Rate per Grade
   3. Preset Minimums                      10. Current Spread

   B. MIDPOINT OPTIONS                     E. INDIVIDUAL EMPLOYEE OPTIONS

   4. Fixed Rate plus Increment            11. Current Spread
   5. Variable Rate per Grade              12. GREEN Circle + Option 11
                                           13. Variable Rate per Grade
   C. CURVE FITTING                        14. GREEN Circle + Option 13

   6. Yes
   7. No

   <Space> HIGHLIGHT        <Return> SELECT        <Tab> RESET
```

The "DATA SOURCE OPTIONS" determine the nature of the scenario to be evaluated. The adjustments may be linked to market data or they may simply be internal adjustments.

- By selecting *market values*, the user wishes to relate the revised salary structure to market conditions.

- The use of *current midpoints* implies ad hoc adjustments to the pay policy line is to be made, without reference to the market.

- Finally, if *preset minimums* is selected, changes are to be made to the current salary structure on the basis of pegging certain grade minima as may be agreed to through negotiation with unions.

The "MIDPOINT OPTIONS" refer to an adjustment factor which is applied to either market data to compensate for the time lag in data collection, or to current salary data to adjust for inflation. Two forms of adjustment are available:

- The first, *fixed rate plus increment* sub-option allows an across-the-board adjustment of salary midpoint values with a constant percentage increment to be selected.

- Alternatively, the choice of *variable rate per grade* enables individual grade midpoints to be singled out for prespecified adjustments.

"CURVE FITTING" contributes towards an internally equitable structure. Acceptance of the *yes* sub-option will result in a smoothed revised salary structure that also incorporates the organisation's pay policy of either leading, lagging, or matching market rates. The Model applies the Ordinary Least Squares curve fitting technique to logarithmic salary data to compute the smoothed structure. Alternatively, the revised salary structure can be constructed around an unadjusted pay line through the selection of the *no* sub-option.

The above three sets of option categories relate to deriving the *pay policy* line.

Unless an organisation is paying a single rate per grade, there is a need to identify parameter values that specify the spread of salaries about a grade midpoint. The "SPREAD OPTIONS" offer this facility.

The "SPREAD OPTIONS" can be implemented in three ways.

- Firstly, a constant percentage spread across all grades with an incremental factor can be used by selecting the *fixed rate plus increment* sub-option.

- Secondly, the *variable rate per grade* sub-option allows separate spreads to be determined for each individual grade.

- Thirdly, the organisation may wish to retain the spreads currently used on its salary structure. In this instance, the *current spread* sub-option can be selected.

Finally, the "INDIVIDUAL EMPLOYEE OPTIONS" offer the flexibility of positioning individual employees within each grade's salary scale. This is important from, amongst others, a costing point of view.

The sub-options are the following:

- The current distribution of employees with each salary scale may be retained.
- The current distribution sub-option together with the inclusion of all *green circle* employees within the grade scale limits at the minimum is the second alternative.
- Separate distributions of employees can be specified for individual grades using the *variable rate per grade* sub-option. The value specified for a given grade is used to adjust each employee's current salary within that grade.
- The final sub-option allows for separate grade adjustments as defined by the *variable rate per grade* sub-option, but with the inclusion of *green circle* employees at the scale minima.

6.4.4 SCENARIO PARAMETER VALUES SETTING.

Once a particular scenario has been selected for evaluation, appropriate parameter values to quantify it need to be set. The choice of parameter values reside with the compensation planner. The choice of values are guided both by experience and reference to the values of current or previous salary structures. The numerical values selected are intended to reflect the proposed changes to the salary structure. A summary of the sub-options chosen to reflect a particular scenario is shown in Figure 6.13.

FIGURE 6.13 : Summary of Parameter Options Selected.

```
            COMPLAN  :  PARAMETER VALUES
            ============================

       You Have SELECTED the Following OPTIONS :


  1. DATA SOURCE Option       :  Market Survey Data

  2. MIDPOINT Option          :  Base plus Increment

  3. CURVE FITTING Option     :  Semi Log Curve to Midpoints

  4. GRADE SPREAD Option      :  Base plus Increment

  5. EMPLOYEE SPREAD Option   :  Current Relative Spread

  6. PROCEED with ANALYSIS


       ENTER  1 , 2 , 3 , 4 , 5  or  6
```

Any of the numerical settings from a previous run of the Model for the identified parameters may be viewed / edited by selecting the appropriate option from the PARAMETER VALUES menu. Alternatively, if no numerical settings exist for the particular parameter, new values may be set at this stage. Figures 6.14, 6.15, 6.16, 6.17, and 6.18 illustrate specific parameter value settings for the sub-options shown in Figure 6.13.

In the context of the COMPLAN model logic, the setting of the parameter values, for a given scenario, follows the selection of that scenario.

FIGURE 6.14 : Parameter Option Setting - Data Source Option.

C O M P L A N : DATA SOURCE OPTION
==================================

: MARKET SURVEY DATA

Grade	Market Medians	Grade	Market Medians
1	14485	7	30023
2	16356	8	33901
3	18469	9	38279
4	20854	10	43223
5	23547	11	46000
6	26589	12	52000
		13	56123

ALTER Any GRADE Value ? <Y> Yes <N> No

FIGURE 6.15 : Parameter Option Setting - Midpoint Option.

```
C O M P L A N   :  MIDPOINT OPTION
==================================

: BASE RATE PLUS INCREMENT


1. Initial Adjustment Rate     4   %

2. Incremental Rate            3   %

3. RETURN to MENU



   Enter  1 , 2  or  3
```

FIGURE 6.16 : Parameter Option Setting - Curve Fitting Option

```
C O M P L A N   :  CURVE FITTING OPTION
=======================================

: FIT SEMI-LOG CURVE

1. Adjustment Rate              10   % p a

2. Lead Time to Breakeven       6    months

3. RETURN to MENU




   Enter  1 , 2  or  3
```

FIGURE 6.17 : Parameter Option Setting - Grade Spread Option.

```
C O M P L A N  :  GRADE SPREAD OPTION
======================================

: BASE RATE PLUS INCREMENT


1. Initial Adjustment Rate    8   %

2. Incremental Rate           5   %

3. RETURN to MENU


   Enter 1 , 2 or 3
```

FIGURE 6.18 : Parameter Option Setting- Employee Spread Option

```
C O M P L A N  :  EMPLOYEE SPREAD OPTION
=========================================


1. Adjust to CURRENT RELATIVE Positions  YES

2. Move GREEN CIRCLE Employees to Minima

3. Specify NEW Adjustments per Grade

4. Same as (3), but include (2)

5. RETURN to PARAMETER OPTIONS MENU

Enter Code To Alter Choice
```

6.4.5 SCENARIO EVALUATION.

Once parameter value editing is completed, the salary database and parameter settings combine to produce a revised salary structure which reflects the consequences of the proposed scenario.

The nature of the output generated from the processing is threefold :

- a revised salary structure,
- a comparative cost analysis, and
- comparative employee distributions.

On the basis of the proposed scenario, revised salary scales are generated. Together with the proposed employee adjustments distributions, cost estimates are prepared. The *Cost Analysis* table - illustrated in Figure 6.19 - presents a comparative analysis of costs between the current and the revised structures, both on a grade-by-grade basis and for the organisation as a whole. Percentage cost differences reflect the net cost change between the two structures.

The option exists to view graphically the revised salary structure as illustrated in Figure 6.20. In addition, the option to view the current and revised structures superimposed upon each other also exists as illustrated in Figure 6.21.

FIGURE 6.19 : Comparative Cost Analysis Schedule.

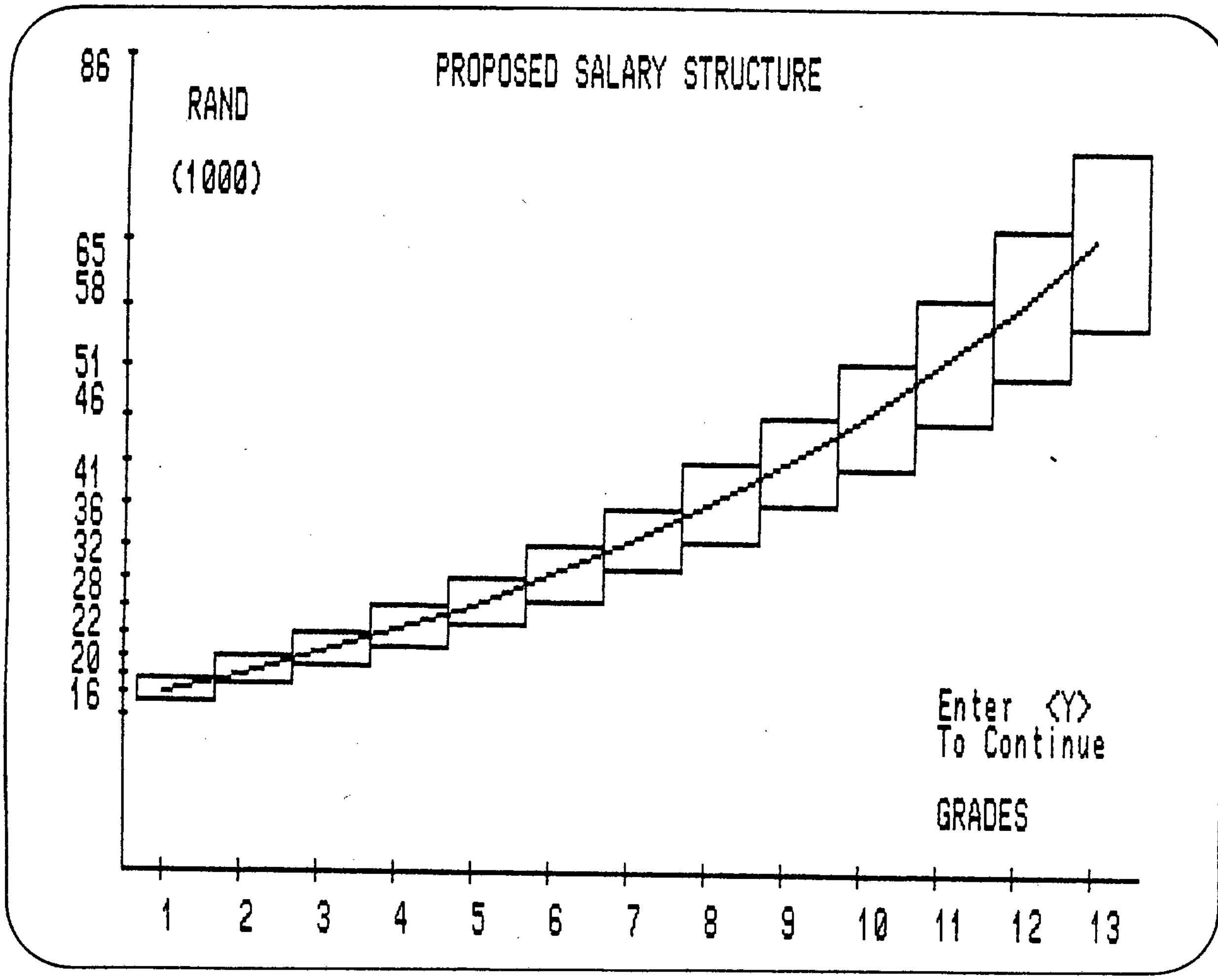
C O M P L A N : COST ANALYSIS BY GRADE

GRADE #	STAFF #	PROP SCALES Lower	Mid	Upper	O/LAP %	AVE SALARY Curr	Prop	COST Curr	Prop	% DIFF
1	6	14866	16159	17451	32	10240	16064	61440	96385	57 %
2	14	16631	18157	19682	35	9702	16015	135840	224216	65 %
3	8	18601	20401	22200	39	16455	21657	131640	173260	32 %
4	26	20799	22922	25044	42	17073	23021	443914	598539	35 %
5	16	23250	25755	28259	45	18697	26029	299160	416470	39 %
6	11	25983	28938	31892	48	20803	28667	228840	315336	38 %
7	8	29028	32514	35999	51	23355	32313	186840	258503	38 %
8	8	32420	36533	40645	54	25980	35816	207840	286525	38 %
9	6	36195	41047	45898	57	30460	41676	182760	250055	37 %
10	6	40396	46120	51843	59	38200	47615	229200	285691	25 %
11	4	45067	51820	58572	62	44340	53434	177360	213737	21 %
12	4	50258	58225	66191	64	46500	56999	186000	227995	23 %
13	3	56022	65421	74819	0	55560	69234	166680	207701	25 %
	120							2637514	3554476	35 %

Enter <Y> to CONTINUE

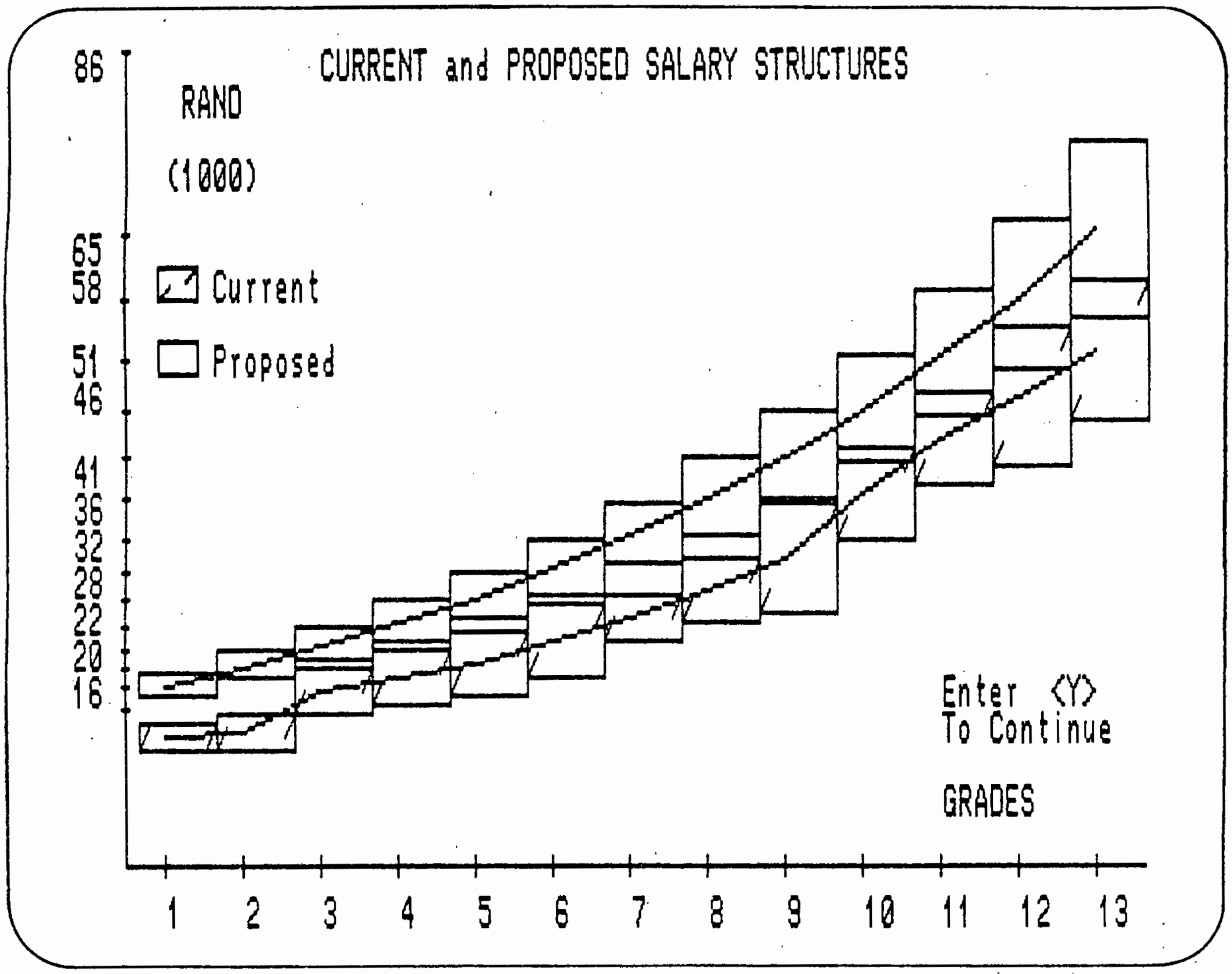
Different grades may require a different distribution of employees within each scale's limits. To observe the percentage spread of employees within each grade, a comparative analysis of employees within grades is conducted and presented in tabular form as shown in Figure 6.22. In addition to the inter-quartile breakdown, a compa-ratio is computed for each grade. This is shown for both the current and the revised grades.

FIGURE 6.20 : Graphical Display of Proposed Salary Structure.



To facilitate rapid assimilation of the employee distributions, comparative bar charts of any grade or for the organisation as a whole can be requested. Illustrations are given for each alternative in Figures 6.23 and 6.24.

FIGURE 6.21 : Graph of Current and Proposed Salary Structures



6.4.6 INTERFACE WITH SPREADSHEETS.

The data analysis capability of the modelling approach is extended through the ability of the COMPLAN model to interface with spreadsheet facilities such as LOTUS 1-2-3. The saving of the *cost analysis-* and *employee distribution* -schedules and the availability of the employee salary database enables all this data to be transferred into the LOTUS 1-2-3 spreadsheet whereupon the full analytical capabilities of spreadsheets can be applied. The graphical capabilities of LOTUS 1-2-3 can further enhance the readability and comprehension of any particular analysis.

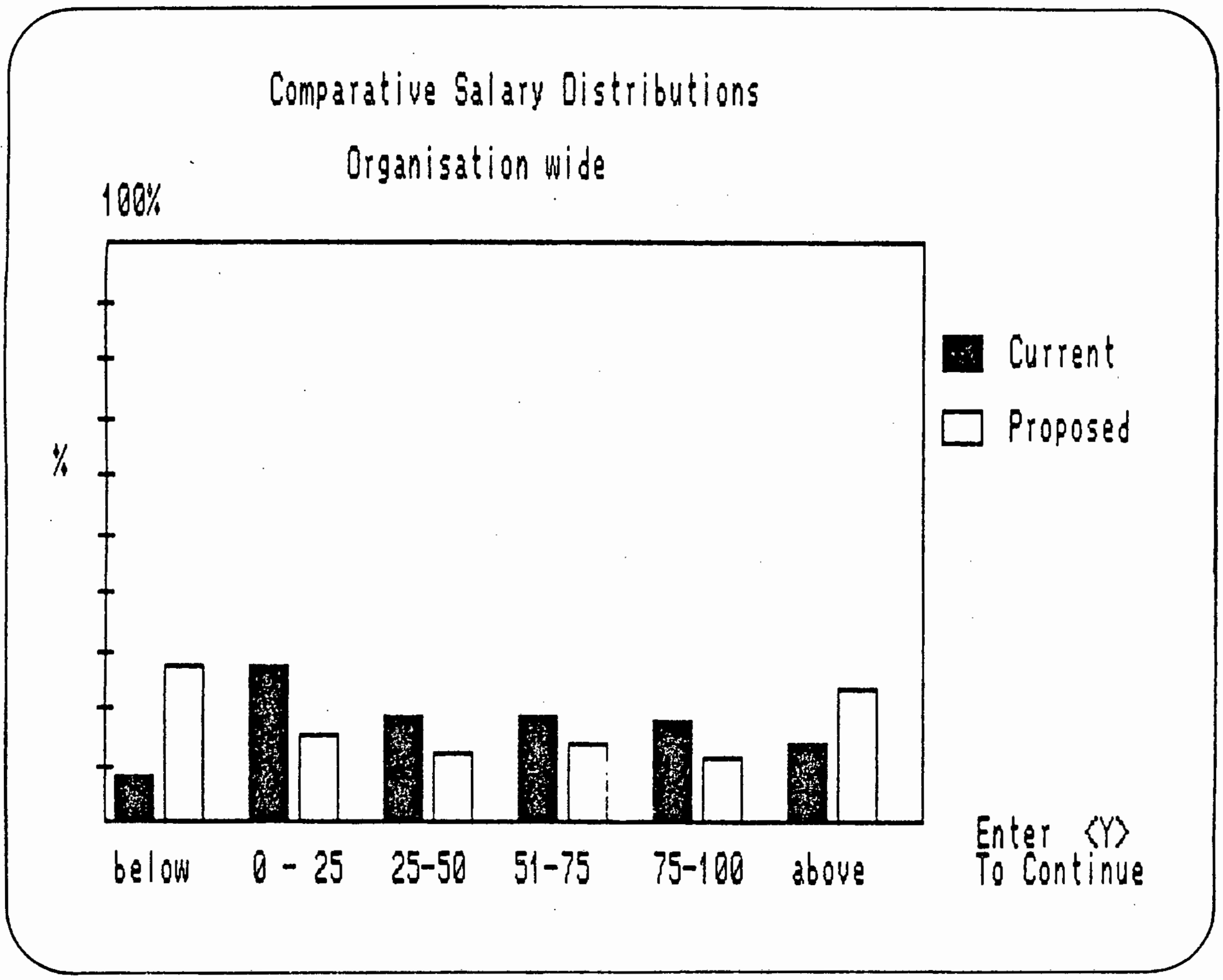
FIGURE 6.22 : Schedule of Spread of Employees Across Grades.

C O M P L A N : EMPLOYEE DISTRIBUTION ACROSS GRADES

Grade	Below		0 - 25%		26 - 50%		51 - 75%		76 - 100%		Above		Compa-Ratios	
	Curr	Prop	Curr	Prop	Curr	Prop	Curr	Prop	Curr	Prop	Curr	Prop	Curr	Prop
1	17	33	17	17	17	0	17	0	17	17	17	33	.99	.99
2	36	64	29	7	7	0	7	0	14	7	7	21	.88	.88
3	0	38	38	13	25	13	0	0	0	0	38	38	1.06	1.06
4	12	38	31	4	0	0	23	19	23	4	12	35	1	1
5	0	25	25	6	19	13	31	19	19	19	6	19	1.01	1.01
6	0	18	18	18	55	36	9	9	9	0	9	18	.99	.99
7	0	0	38	38	13	13	38	38	13	13	0	0	.99	.99
8	0	0	38	50	38	25	0	0	13	13	13	13	.98	.98
9	0	17	17	17	33	17	17	17	17	0	17	33	1.01	1.01
10	0	0	17	17	33	33	17	17	17	17	17	17	1.03	1.03
11	0	0	25	25	0	0	25	25	25	50	25	0	1.03	1.03
12	25	25	25	25	0	0	25	25	0	0	25	25	.97	.97
13	0	0	0	0	33	33	0	0	67	67	0	0	1.05	1.05
	====	====	====	====	====	====	====	====	====	====	====	====		
TOTAL	10	32	32	18	22	14	21	16	20	13	15	27		

Enter <Y> to Continue

FIGURE 6.23 : Histogram of Employee Spreads for Organisation

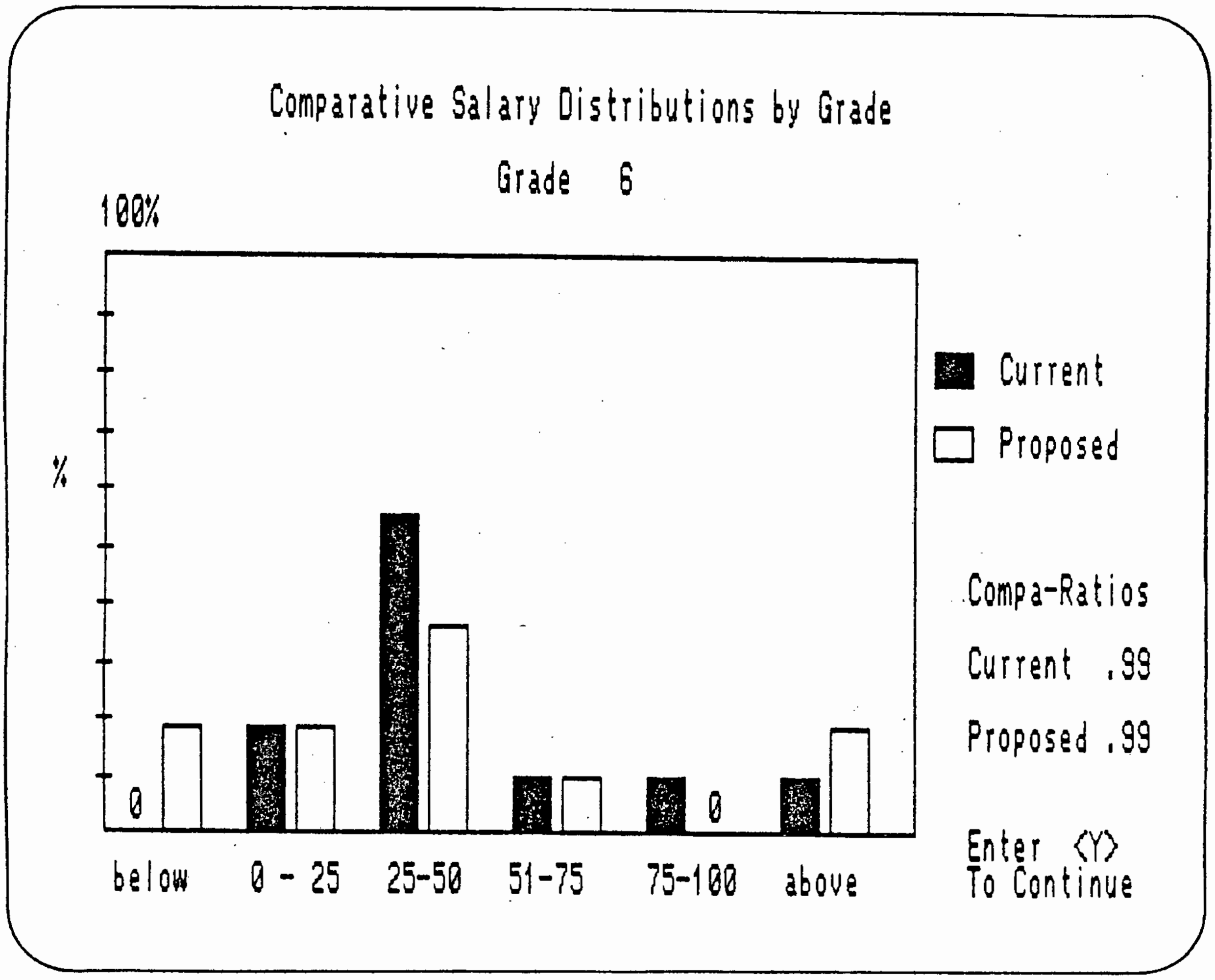


6.4.7 ADDITIONAL FEATURES.

(i) REPEAT TRIALS.

An examination of the output generated may prompt further investigation. The nature of the further study can range from minor adjustments of current parameter settings to complete reappraisals of the proposed scenario.

FIGURE 6.24 : Histogram of Employee Spreads by Grade.



To facilitate this reassessment process, the model recycles the user to the *Scenario Selection Menu* (Figure 6.12). Through this looping mechanism, the user can evaluate numerous proposed scenarios in a relatively short period of time. The storage of the previous parameter settings and the editing facilities available combine to considerably reduce the lead time between consecutive trials of the model in terms of input data preparations.

(ii) BACK-PAGING FACILITY.

During the editing cycle or the processing cycle, a user may detect either an input error or a scenario choice deficiency requiring termination of the normal model cycle and a reversion to an earlier stage of the model. The need for the facility to backstep to an earlier stage and recommence the analysis after editing was identified in an early 'testing' of the COMPLAN model. It has subsequently been inserted.

6.5 SUMMARY AND CONCLUSION.

The COMPLAN Decision Support System was not developed to meet a specific organisation's compensation planning needs. Rather, it is a generalised model developed in response to a broadly identified need - as established in chapter two. Certain adaptions may therefore be necessary to accommomodate a specific organisation's or industry's compensation planning needs. It should be noted that the model is independent of the job evaluation system employed within an organisation. Further, all or only a selection of job grades may be included in any analysis.

Controlled 'laboratory-like' testing of the Model using test data will continue to ensure that it is 'bug-free'. In addition, a recent version of the COMPLAN model has been installed in a large retail organisation with several thousand employees for further 'in the field' testing. However, a more formal testing of the COMPLAN model has been undertaken to establish if user-defined needs are being met through the design specifications. The method and results are reported in chapters 7 and 8.

A demonstration version of the COMPLAN DSS is provided with this dissertation (see attachment). The specifications of the system and user instructions are given in Appendix 2.

Further revision of the model may well be in the direction of incorporating the area of employee benefit management to provide a total compensation planning decision support tool. The complexities of employee benefit management could possibly be accommodated in the merging of the disciplines of DSS and Expert Systems. While further revision is inevitable as its development is part of an adaptive design process, it is envisaged that its incorporation into the decision making process of compensation planners will contribute significantly to the achievement of the pay system objectives as specified by the organisation.

REFERENCES

1. Bennett, J.L. 1983. Analysis and Design of the User Interface for Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 3.

2. Brookes, C.H.P., Grouse, P.J., Jeffery, D.R., Lawrence, M.J. 1982. Information Systems Design. Sydney. Prentice-Hall of Australia.

3. Carlson, E.D. 1983. An Approach for Designing Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 2.

4. Keen, P.G.W., Gambino, T.J. 1983. Building a Decision Support System: The Mythical Man-Month Revisited. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 7.

5. Smith, I. 1984. The Management of Remuneration - Paying for Effectiveness. U.K. Gower.

6. Stabell, C.B. 1983. A Decision-orientated Approach to Building DSS. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 10.

7. Tromp, D., Wegner, T. 1985. The Computer's Role in Personnel Management with Specific Reference to Compensation Planning. Occasional Paper 9. University of Stellenbosch Business School.

8. Whittington, G.P. 1984. Establishing the Exempt and Management Pay Structure. Handbook of Wage and Salary Administration. Rock, M.L. (Editor) Second Edition. USA. McGraw-Hill. Chapter 19.

CHAPTER 7

TOWARDS AN EVALUATION METHODOLOGY FOR DECISION SUPPORT SYSTEMS - LITERATURE STUDY AND METHODOLOGY.

7.1	Introduction	192
7.2	Evaluation Research	192
7.3	Formative Evaluation in DSS	194
7.4	Summative Evaluation in DSS	195
	7.4.1 Literature Study	197
	- Background Survey	197
	- Approaches to Cost-Benefit Evaluation	200
	7.4.2 A Value Analysis Approach	205
	- Objectives	206
	- A Methodological Framework	207
	Phase 1 : Benefit Identification	211
	Phase 2 : Benefit Grouping	211
	Phase 3 : The Quantification of DSS Benefits Without Cost Considerations	212
	Phase 4 : Inferences Using Benefit Utilities	213
	Phase 5 : The Quantification of DSS Benefits With Cost Considerations	214
	Phase 6 : An Alternative Approach to Benefit Utility Generation	215
7.5	Summary and Conclusion	218
	References	219

7.1 INTRODUCTION.

In the iterative design phase of the DSS Development Life Cycle as advocated by Meador, Guyote and Keen (1984 : 125), demonstration and *evaluation* are two of the latter processes. Exposure to, and feedback from the end-user community are essential ingredients of a DSS development process. Chapters 7 and 8 investigate and report on issues pertaining to the evaluation of DSS effectiveness with specific reference to the compensation planning DSS. In particular, chapter 7 examines the literature on evaluation research as applied to Information Technology and proposes an evaluation methodology to overcome some of the observed shortcomings. The proposed evaluation methodology is then illustrated with empirical data using the compensation planning DSS as the prototype system under review. These results are presented in chapter 8.

7.2 EVALUATION RESEARCH.

Evaluation research has been and continues to be an important issue in a number of disciplines. For example, the Environmental, Social and Political Science disciplines in particular have devoted considerable energies to evaluation research aimed at establishing the effectiveness of various environmental, social and political programs (inter alia Weiss 1972; Struening and Guttentag 1975; Patton 1978; Morell 1979; Patton 1980; Gramlich 1981). Evaluation research conducted in these disciplines is particularly appropriate to DSS in focusing attention on the evaluation effort. Scriven (1967 - reported in Weiss 1972 : 17; Patton 1980 : 68 - 71; and Gramlich 1981 : 6) identified two types of uses of evaluations which have become a standard classification of evaluation studies. They are :

- *formative* evaluations, and

- *summative* evaluations.

The former is concerned with collecting information that can be used primarily for ongoing program development and improvement, while the latter focuses on making an overall judgement about the effectiveness of a program in terms of whether or not the program should be continued or terminated (Weiss 1972 : 6; Patton 1980 : 71; Gramlich 1981 : 7). In the context of DSS, the formative evaluation situation may be equated to examining primarily the *usability* criterion as defined by Bennett (1983 : 49 - 51) and to a lesser extent the *usefulness* criterion as described by Keen and Gambino (1983 : 143) and Hurst, Ness, Gambino and Johnson (1983 : 127). The summative evaluation situation on the other hand, is almost exclusively concerned with the *usefulness* criterion. Both these evaluation situations will be examined in the DSS evaluation research.

7.3 FORMATIVE EVALUATION IN DSS.

A formative evaluation program often includes a *process* evaluation strategy. Process evaluations are aimed at elucidating and understanding the internal dynamics of program operations and are particularly useful for revealing areas in which programs can be improved as well as highlighting those strengths of the program which should be preserved (Patton 1980 : 60-61). Many process evaluations focus on how the program is perceived by participants. Keen and Gambino (1983 : 157) too, mention that no formal measures of the quality of interface features exist and therefore that user comments are reasonably adequate as indicators.

In the case of the prototype compensation planning DSS then, a survey amongst potential users drawn from compensation planners was undertaken. The survey sought to provide feedback on the appropriateness of the various Model features and guidance as to the future development direction of the COMPLAN Model. A structured questionnaire was administered to 15 respondents who participated in a hands-on workshop on the COMPLAN model. The results which deal with each criterion, namely *usability* and *usefulness* are presented in chapter 8.

However, formative evaluations do not establish the users' propensity to adopt the proposed system. For this, a summative evaluation as described by amongst others Weiss (1972 : 16 - 17), Patton (1980 : 71), and Gramlich (1981 : 7) is required. In this instance, a more formal cost-benefit evaluation approach needs to be considered. This is the purpose of the remainder of this chapter.

7.4 SUMMATIVE EVALUATION IN DSS.

Decision Support benefits are important ingredients in the justification decision of a Decision Support System (DSS). They are most often intangible and therefore expressed in descriptive terms. Historically they have been viewed as nonquantifiable. This view has resulted in these benefit statements being overlooked or shortchanged in traditional justification approaches which seek to quantify all factors. Gramlich (1981 : 7) acknowledges that, in the context of social and political programs, it is often impossible to answer the question asked in summative evaluations, namely 'whether the value of all benefits exceeds that of all costs' because, he argues, "values cannot be placed on all the benfits of a program" (ibid : 7).

Recent studies however, have noted this omission and have attempted to address the *contribution* imbalance by integrating these benefits into cost-orientated approaches. More recently, the focus on value as a primary selection criterion has been advocated. However, research appears lacking on the quantification of DSS benefits within the framework of value analysis and the formulation of appropriate decision rules within this context.

This section of the research considers a number of issues relating to the quantification of identified DSS benefits within a value analysis context.

Firstly, an approach is suggested for generating quantitative measures for an identified set of intangible DSS benefits. The decompositional approach advocated uses evaluative judgements to infer numeric measures of relative importance to the DSS benefits.

Secondly, using the analytic capabilities associated with quantitative measures, rational decision rules can be formulated. A decision rule based on value rather than cost is advocated to assist in the justification decision of a proposed Decision Support System.

Thirdly, the potential impact of the cost of acquiring / developing a proposed DSS on the decision rule is considered. The same decompositional approach using evaluative judgements conditioned by cost implications is applied to generate revised numeric measures.

Fourthly, an alternative approach to derive the numeric measures of the perceived relative importance of DSS benefits is considered. This approach is compositional as opposed to the decompositional method advocated above. A prediction model is developed to examine the degree of association between these two approaches.

7.4.1 LITERATURE STUDY.

This literature study will comprise two parts. Firstly, the circumstances and difficulties associated with the field of benefit evaluation as it pertains to management Decision Support Systems are outlined. Secondly, studies that have addressed the cost-benefit evaluation problem are considered.

(i) BACKGROUND SURVEY.

The influence of the new information technologies, particularly since the advent of the microcomputer, is increasingly being felt in the higher echelons of the management hierachy (Benjamin 1982 : 18-19). The growing emphasis on Decision Support Systems is changing the nature of decision making at the corporate level.

However, this upward penetration of the new information technologies raises issues which hitherto did not exist. One of the most significant of these issues involve the evaluation of the effectiveness of these information technologies upon the decision making processes. The traditional cost-benefit approach has been discounted due primarily to the difficulty in defining, quantifying and measuring the intangible benefits derived from computer-based Decision Support Systems. "Benefits are especially hard to assess, since they depend largely on the decision maker's perception" (Hurst, Ness, Gambino and Johnson 1983 : 127). Consequently most, if not all, DSS have been developed without a thorough evaluation of the contribution that the System will make to the management decision process. Because of the inherent subjectivity in assessing the effectiveness of any new information technology, particularly as it applies to top management decision making, this subject has been glibly treated in the literature. A review of the Social Sciences Citation Index indicates that the emphasis with respect to DSS has been in the areas of application and design criteria (SSCI: Pemutation Subject Index, Source Index 1984).

Various papers discuss the need for such an evaluation procedure, but few offer any meaningful approaches to meet this problem. Bennet (1983 : 13) refers to Keen and Scott-Morton (1978 : chapter 8) as an indication of some research in this field, but acknowledges that the area of evaluation of DSS has been largely overlooked by researchers. This view is supported by amongst others Radford (1978 : 216), Hamilton and Chervany (1981 : 55) and Keen (1981 : 1). Radford predicted that progress in this area was likely to be slow and concludes that "managers responsible for the decision about whether or not to expend significant resources in this area will probably be left for some time without a completely quantified and well-defined method of estimating the benefits that are likely to accrue".

An argument advanced to discount the need for a comprehensive evaluation procedure is the relatively cheap cost of hardware, especially since the advent of the microcomputer. Vaid-Raizada (1983 : 31) and Harrison, Magel and Kluczny (1983 : 10), however, argue that the costs of software development and maintenance arising from systems growth and evolution are far more significant than hardware costs, thus making any investment in new information technologies worthy of prior evaluation. Boczany (1983 : 19) too, discounts arguments that the benefits must be taken on faith alone and calls for a more rigorous justification procedure consistent with that used in the evaluation of any other investment proposal.

In a survey by Ball and Harris (1982 : 30), the issue of "gauging MIS effectiveness" ranked second only to the issue of "MIS long range planning and integration" out of a total of eighteen issues which MIS management felt ought to be addressed. More recently, Dickson, Leitheiser, Wetherbe and Nechis (1984 : 137) noted from a survey that "measurement and improvement in IS effectiveness" received high priority out of nineteen issues considered relevant for the 1980's to help focus research and educational effort. Meador, Guyote and Keen (1984 : 121), too, established from an end user survey that "perceptions of overall cost-effectiveness predominate" in assessing DSS effectiveness. Further, they established that evaluation was still one of the least effectively performed tasks in developing a DSS (ibid 1984 : 127). These findings are consistent with Keen's (1986 : 35) assessment of outstanding DSS issues to be addressed in the next decade. He cites the measurement of effectiveness of DSS as one of only six issues still be researched.

The urgent need to screen new information technologies adopted by corporate management to support the decision making process is highlighted by both Alavi (1982 : 1-9) and Curley (1984 : 37). Curley reports that the danger with uncontrolled acquistion of new information technologies is an escalation of the 'information overload' situation which line management fear "may make them the best informed, unprofitable company in the market." Alavi notes that the need is even greater now to subject each new proposal to a rigorous evaluation process to ensure that only the ones that will make a significant impact on decision making, particularly at the strategic level, are adopted. DeSanctis (1986 : 25) refers specifically to Human Resource Information Systems when noting that the lack of a consistent approach to evaluating a proposed information system is hindering the development of such systems.

(ii) APPROACHES TO COST-BENEFIT EVALUATION.

The nature of Information Systems has changed in recent years from servicing mainly operational level decisions to decision support at the strategic level. Consequently, the traditional tool of cost-benefit analysis which sought to reduce all variables in the evaluation process to monetary terms is no longer valid. Further, approaches which ignore the intangible benefits are equally invalid (Oxenfeldt 1979 : 51; Melone and Wharton 1984 : 31). The need exists for new evaluation approaches to accommodate the changed nature of Information Systems. The diversity of approaches advocated in the literature reflect this search for new criteria and guidelines.

The scope of the review covers evaluation studies conducted in such areas as computer selection, MIS project selection, DSS applications, and office automation studies. Common problems of evaluation exist in all these areas. All incorporate intangible elements to a greater or lesser extent. A composite view can be obtained by examining the evaluation approaches in all these areas.

Classifications of evaluation approaches have been presented by among others Keen (1981 : 10), Smith (1983 : 22) and Melone and Wharton (1984 : 30). While terminology may differ, their groupings are similar. The classification presented by Melone and Wharton will be used. Briefly, evaluation models can be broadly classified into Political Gambit models, Economic models, and Scoring models. The first type of models has no set evaluation criteria and is subject to political pressure groups dictating the project selection procedure. Economic models focus exclusively on quantifiable cost variables and attach no importance to the intangible benefits which, in the case of DSS, are significant. The third model type, namely the scoring models, is based on the premise that information obtained through economic analysis needs to be integrated with the intuitive judgements of management and with the qualitative factors which have an effect upon a project's successful implementation and use. Most published research into System's evaluation are versions of the scoring approach (Kleijnen 1980 : 36,44).

The dimension that has been introduced in the newer approaches to accommodate the changed nature of Information Systems is the concept of "subjective evaluations" as applied to the intangible benefits. Munro and Davis (1977 : 55-67) and Neumann and Segev (1979 : 272) were amongst the earlier researchers to examine user perceptions of information characteristics for systems improvement, but did not propose any formal scoring model. However, versions of the scoring model approach that do reflect this trend have been suggested by amongst others, Litecky (1981), Ghandforoush (1982), Boczany (1983), and Vaid-Raizada (1983). While the concept of linking quantitative and qualitative factors underscores each of these approaches, they differ with respect to :

- procedures to capture subjective evaluations data;
- the manner in which quantitative and qualitative data are combined; and
- the nature of application of each approach.

Subjective data gathered from end users and systems designers comprise either rankings or the assignment of subjective probabilities to the intangible benefits. The linking of costs and benefits is achieved either through the discounting of economic costs by some subjectively derived discounting factor (Boczany 1983; Vaid-Raizada 1983); or by reducing benefits to expected monetary terms (Litecky 1981); or by assigning weights as measures of the relative importance between the two major elements (Ghandforoush 1982). An approach is used either in the evaluation of a single investment proposal (Litecky 1981, Boczany 1983), or in a comparative evaluation situation (Ghandforoush 1982, Vaid-Raizada 1983).

In relation to DSS, each of the above approaches has certain limitations.

Firstly, the assignment of monetary values to intangible benefits is questionable. Litecky's concept of "excess tangible costs" assumes this ability on the part of management to assign monetary values to the intangible benefits. Similarly, the "productivity improvement factor" in Boczany's modified economic model requires an assigned monetary value. It can be argued that the perception of monetary values for intangible benefits has high variability across individual users and for some benefits must be completely arbitrary. This is likely to introduce considerable instability and inconsistency into the results of the selection methodologies.

Secondly, a specific DSS application is a single investment proposal. Comparative evaluation approaches such as proposed by Ghandforoush and Vaid-Raizada are not applicable in the evaluation of a specific Decision Support System. A positive feature in both their approaches is the use of subjective rankings of the qualitative factors as a means of quantifying these intangibles. However, the indices produced are only meaningful in the context of a comparative evaluation situation.

Thirdly, all the above approaches examine costs and benefits separately initially and only combine these elements in the final stages. Given that user perceptions are fundamental to these approaches in terms of ranking the qualitative factors, and noting Harrison's (1981 : 202) comment that "the greater the contact with the facts and the more information available, the more likely it is that a perception will be sharp and defined", it would appear reasonable that all data on costs and benefits be integrated and made available for consideration at the beginning of any evaluation approach.

Fourthly, if the argument forwarded by Keen (1981 : 1-14) that the justification for a DSS should be based on value rather than cost, then many of the above approaches could be faulted. With the exception of the "Rigorous Evaluation Model" proposed by Ghandforoush which computes a "relative importance index" to be used in a comparative evaluation situation, the remaining approaches reduce all factors to a net cost term - thus focusing on cost rather than value. An important premise of the Value Analysis approach as advocated by Keen is that the perceived benefits of a DSS are significant determinants in justifying a Specific DSS. As Keen (ibid : 3) states, "this requires a focus on value and a recognition that qualitative benefits are of central relevance". Further, "value is the issue, and any exploitation of the DSS approach rests on a systematic strategy for identifying benefits, however qualitative" (1981:14). Melone and Wharton (1984 : 29) relate *value* to the non-quantitative factors of the decision choice and indicate that management must determine and establish a consistent set of criteria for project evaluation. Hurst et al (1983 : 127) note that "it is the lack of perceived value of a DSS which generally keeps it from being built, not its cost". If the potential user(s) do not perceive the proposed DSS to have value, even if it produces all the 'right' answers, the system should not be developed or acquired. Keen (1981:11) too believes that "the benefit of a DSS is the incentive for going ahead". Thus perceived benefits which are a measure of value need to be more rigorously analysed and used in a decision approach on how to allocate corporate resources effectively.

7.4.2 A VALUE ANALYSIS APPROACH.

This research study proposes a quantitative approach which meets a number of criteria with respect to the summative evaluation of a specific DSS. The criteria are:

- emphasis on value rather than cost;
- applicability to a single investment proposal; and
- the quantification of subjective evaluations for, initially, the intangible benefits only, and subsequently, for the combination of costs and benefits.

(i) OBJECTIVES.

The proposed quantification approach, which will be examined using two alternative methodologies, is intended to give substance to the Value Analysis framework, in particular stage II, as proposed by Keen (1981 : 13). Since Value Analysis is intended to apply at each stage of the Adaptive Design process as outlined by Keen and Gambino (1983 : 153), a more rigorous interpretation of the perceived benefits of a DSS which are a measure of value of the system should greatly facilitate the decision on whether or not to proceed with the next stage of development.

An analogy may be drawn with the marketing of a social product. Kelley and Lazer (1973 : 64) note that the marketer of a social product "somehow processes the major benefits and compares them to the major costs, and the strength of their motivation to act is directly related to the magnitude of the excess benefit". It is the objective of this proposed DSS summative evaluation approach to offer guidelines for the measurement of the excess benefit. This in turn is likely to influence the potential DSS user's "motivation to act".

The discussion will proceed within the context of a specific DSS application in the area of compensation planning. The need for a micro-computer based interactive graphics modelling capability in compensation planning was identified from a survey amongst human resource managers in South Africa and presented in chapter 2 (Tromp, Wegner 1985: 33).

(ii) A METHODOLOGICAL FRAMEWORK.

User perceptions are the primary data source of evaluation studies incorporating mainly intangible benefits. The scoring approaches considered tend to combine rank order responses with monetary values to arrive at bottom-line figures for decision making. Such approaches tend, in the writers view, to introduce a degree of arbitrariness into the end results upon which the final decisions rest. This study aims to minimise the degree of subjective intervention and extract the maximum amount of useful information from the 'statistically weak' rank order data captured from users.

The proposed approach is based on the *utility analysis* concept. Both Kleijnen (1980 : chapter 4) and Ahituv and Neumann (1986 : 64-71) review utility analysis and consider its application to the assessment of the value of an information system. Kleijnen (1980 : 33) notes that the scoring method is but a special case of utility theory. He concludes that "although multiattribute utility theory remains quite theoretical, time spent on this topic is worthwhile because utility theory provides a sound foundation for the more practical approaches followed in computer selection and information system evaluation" (ibid: 44).

The conjoint measurement approach is employed to translate user perceptions into utility measures.

Conjoint analysis is concerned with the measurement of psychological judgements and has been used to examine respondent perceptions in primarily marketing related applications on product attributes (Holbrook 1981 : 13-14). A DSS can be viewed as a product possessing multiple attributes. In the DSS context, the intangible benefits and cost are the attributes. Collectively they influence the user's perception of the *value* of the proposed system.

It is a decompositional approach which uses evaluative judgements on factorially designed configurations of attribute combinations to infer the utilities (part-worths) of the underlying product features. In this study the *product* is a specific DSS - namely a compensation planning system - with the related potential intangible benefits being associated with the *product features*.

Judgements concerning the assignment of weights to individual attributes regarding their relative importance are usually ambiguous (Johnson 1974 : 121). Users are however better able to express overall judgements in the form of ranked order responses. Further, the concept of *trade-off* of product attributes - which is inherent in the conjoint approach - facilitates the identification of the relative importance attached to the various attributes.

The conjoint technique assumes that the DSS user has a value (utility) for each combination of attributes (benefits), but finds it difficult to articulate how they are combining them to form overall judgements. It is however assumed that users are willing to rank combinations of the intangible benefits. From these rankings, the conjoint technique deduces, using a linear utility function, their underlying utilities for the individual benefits. Jackson (1983 : chapter 3) provides a useful insight into technical aspects of the technique.

The purpose of the technique is therefore to decompose the more easily formulated overall judgements of the users concerning the value of a given DSS into relative importance scores for the individual benefits. These derived interval-scaled scores for the individual benefits may then be used in further analysis to establish the perceived value of the proposed specific DSS.

The primary advantages associated with this approach are:

- users need only express overall judgements on the perceived importance of the intangible benefits and costs, and
- economically designed data bases of user perceptions can be achieved using fractional factorial displays.

This study will not review the literature on the developments and applications of the conjoint method. Numerous studies, particularly in the Marketing field are reported in journals such as The Journal of Marketing Research, Journal of Consumer Research and European Journal of Marketing amongst others.

DSS may be viewed in the marketing context as a new product under consideration. Since conjoint analysis is widely applied in New Product Evaluation studies (Cattin and Wattink 1982 : 45), its application to the evaluation of DSS would appear appropriate. Furthermore, while initial studies of the conjoint approach involved only consumer preferences, research by Green and DeSarbo (1978 : 58 - 65) show that *perceptions* data can be adequately accommodated through conjoint analysis.

The proposed methodology will proceed as follows :

- identifying and grouping appropriate DSS benefits,
- quantifying the intangible benefits, without cost considerations, through the application of conjoint analysis,
- using the numeric measures of relative importance to propose a decision rule for establishing *value*,
- quantifying the intangible benefits, with cost considerations, through the application of conjoint measurement, and
- comparison of a direct, self-explicated approach to utility generation as against the conjoint approach.

A description of the methodology employed in each of the above phases follows.

PHASE 1 : BENEFIT IDENTIFICATION.

Since DSS benefits vary according to Keen (Keen 1981:6), it is necessary to identify a list of benefits which are perceived to relate to the compensation planning function. Two approaches were examined.

Initially, a literature review was undertaken to identify a list of potential DSS benefits. Seven sources were consulted in the literature.

Secondly, and independent of the literature study, a Delphi approach, as described by Linstone and Turoff (1975 : 4, 540), was applied using a group of 36 delegates on an MBA (Manpower) programme offered by the Stellenbosch Graduate School. This group was selected as they are all employed as specialists in manpower in various organisations. In addition, they have all studied Advanced Compensation as part of their MBA programme. Over four consecutive sessions, the delegates refined lists of potential benefits for a compensation planning DSS.

PHASE 2 : BENEFIT GROUPING.

The application of conjoint measurement requires the grouping of product features into homogeneous sets. This section presents an approach to achieve these natural groupings of DSS benefits.

A *product feature* is an identifiable attribute which impacts upon a user's perception. From the compiled list of individual DSS benefits, it is not always clear where the primary area of impact on the organisation lies. Keen and Wagner (1979:122) for example, group the benefits of IFPS under two headings referred to as "people-oriented" and "feature-oriented". For the proposed Compensation Planning DSS, benefit groupings were identified using the delegates involved with the Delphi exercise. These benefit groupings are now used in the application of the conjoint measurement approach to gather subjective evaluation data.

PHASE 3 : THE QUANTIFICATION OF DSS BENEFITS WITHOUT COST CONSIDERATIONS.

To apply conjoint analysis, the benefits were grouped according to the areas of impact as established above. In addition, each benefit grouping was supplemented with a *Null benefit* which stated that no benefits are associated with a particular area of impact. These null benefits are included to provide a basis for examining the magnitude of the excess benefit - an approach to be discussed later.

The data capture process requires respondents to rank combinations of benefits drawn from each grouping. To simplify the data capture, a fractional factorial design has been used. A group of 15 delegates with compensation planning experience and who attended a workshop on a pilot version of the compensation planning DSS, comprised the sample for data capture.

The decomposition of the benefit combination rankings was performed using the MDSX-UNICON package to produce interval-scaled measures (utilities or part-worths) for each respondent on each separate benefit.

PHASE 4 : INFERENCES USING BENEFIT UTILITIES.

The decision facing managers in justifying the continued development of a specific DSS is whether the proposed system has value i.e. whether the benefits are perceived as significant by the potential end users.

The approach proposed involves establishing the statistical significance of benefits regarded by the decision maker(s) as the critical set to establish *value* for the proposed DSS under consideration.

This approach identifies the critical level for a benefit utility or combination of benefit utilities against which the corresponding derived utility values are compared. The decision rule would be to proceed with the DSS development as long as the utility value exceeds the critical level.

PHASE 5 : THE QUANTIFICATION OF DSS BENEFITS WITH COST CONSIDERATIONS.

The above approach does not include any *cost* information which may influence potential user's perception of the value of any proposed DSS. *Cost* information was excluded from the above study for two reasons:

- the initial development of a DSS takes place within the context of a R&D project which is below the capital investment level - thus cost considerations are minimised;

- available software for DSS development, particularly on microcomputer based systems, is relatively inexpensive and unlikely to be a significant factor in proceeding with the development of a specific DSS.

Keen and Wagner (1979:120) refer to the low developmental costs of early versions of Decision Support Systems. However, cost may be a significant factor, in which case the perception of value may be conditioned by the cost involved.

To examine the potential impact of *cost*, a further set of benefit utilities has been generated for each respondent. The ranked data captured from respondents for this phase of the study is intended to reflect the impact of *cost*. Respondents were requested to rank the previously defined fractional factorial benefit combinations with the knowledge "that there are significant costs involved in developing and implementing a Specific Decision Support System".

To examine the impact of cost, the following analyses were conducted:

- Correlations between the utility values for the *no cost* and *cost* scenarios are compared statistically;

- the relative importance of benefit groups is compared statistically between the *no cost* and *cost* scenarios;

- the hypothesis tests conducted on the individual and combined utilities to establish *value* for the proposed DSS are repeated on the derived utilities based on cost considerations.

PHASE 6 : AN ALTERNATIVE APPROACH TO BENEFIT UTILITY GENERATION.

Conjoint-derived benefit utilities are obtained through the decomposition of rankings for benefit combination. To establish if similar results of individual benefit utilities can be computed from a more direct measure, a self-explicated utility generation approach is examined. A literature search conducted by Holbrook (1981 : 13 - 14) showed that each of the two approaches has been developed and advanced in isolation to the other, but that each is concerned with essentially the same objective of uncovering perceptions toward product attributes through evaluative judgements. Neslin (1981 : 80) established that "previous research has demonstrated that in practical applications, statistical and self-stated importances often do not agree". The purpose of Neslin's research was to compare the predictive validity of statistical and self-stated procedures for linking features to perceptions. His findings (ibid : 85) "support the use of statistical rather than self-stated methods for linking features to perceptions". However, he declares that the use of self-stated procedures are desirable as "they are simple to analyse and are completely idiosyncratic" (ibid : 86). He believes that the development of better self-stated procedures are a necessity.

This research examines a self-stated procedure used by Goldberg, Green and Wind (1984 : S111-S138) and examines its usefulness as a measure of benefit utilities compared to the conjoint-derived utilities.

The self-explicated method is a compositional approach requiring weights and ratings to be assigned to individual benefits in order to arrive at a utility measure. Using the same benefit groupings as for the conjoint approach, respondents are required to assign weights to each benefit group which reflect the relative importance attached to each group. Thereafter, each benefit is considered in turn and a rating based on a lickert scale is assigned. This rating measures the respondent's strength of perception of the value of the specific DSS benefit.

The model to construct a respondent's self-explicated utility is similar to that given by Goldberg, Green and Wind(1984 : S115) : namely

$$U(i,j) = W(i) * u(i,j)$$

where U(i,j) is the self-explicated utility for benefit j in benefit group i ;

W(i) is the weight assigned to each benefit group i ;

u(i,j) is the assigned Lickert scale rating for benefit j in benefit group i.

To compile the self-explicated utility for a benefit, a respondent is requested to :

- assign a weighting factor, W(i), which reflects the relative importance attached to each of the three benefit groups; and

- rate each individual benefit on an 'importance' scale.

The results of benefit utilities obtained through the self-explicated model are correlated with those derived through conjoint measurement. To consider the predictive ability of conjoint-derived utilities from those derived through the direct approach, ordinary least squares analysis are conducted. Refinements to the predictive model are considered through the grouping of respondents into relatively homogeneous groups using cluster analysis.

7.5 SUMMARY AND CONCLUSION.

This section of the study focuses on the measurement of the effectiveness of a specific DSS. Two types of evaluation approaches were considered. The first, formative evaluation, seeks to identify the appropriateness of model features and provide guidance on further systems development.

The second evaluation form, namely that of summative evaluation, examines the *value* to the potential users of the proposed DSS. The methodology developed for this purpose involves the quantification of the intangible benefits associated with the specific DSS. Conjoint analysis is used to translate users' subjective perceptions towards the intangible benefits associated with DSS into measures which reflect their relative importance. This approach is applied initially to identified intangible benefits alone and thereafter to a set of attributes which include the attribute *cost*. The significance of the *cost* attribute can then be identified.

An alternative approach to utility generation is considered as a final step in this section of the research. A self-explicated model is considered and a comparative analysis of benefit utilities derived from each of the two approaches is conducted.

REFERENCES

1. Ahituv, N., Neumann, S. 1986. Principles of Information Systems for Management. Second Edition. Iowa. W Brown.

2. Alavi, M. December 1982. An Assessment of the Concept of Decision Support Systems as viewed by Senior-Level Executives. MIS Quarterly. Vol. 6(4) : 1 - 9.

3. Ball, L., Harris, R. March 1982. SMIS Members : A Membership Analysis. MIS Quarterly. Vol. 6(1) : 30.

4. Benjamin, R.I. June 1982. Information Technology in the 1990's : A Long Range Planning Scenario. MIS Quarterly. Vol. 6(2) : 18 - 19.

5. Bennett, J.L. (Editor). 1983. Building Decision Support Systems. Massachusetts. Addison-Wesley.

6. BMDP Statistical Software. 1983 Edition. University of California.

7. Boczany, W.J. July 1983. Justifying Office Automation. Journal of Systems Management. Vol. 34(7) : 15 - 19.

8. Cattin, P., Wittink, D.R. Summer 1982. Commercial Use of Conjoint Analysis. Journal of Marketing. Vol. 46(3) : 44 - 53.

9. Curley, K.F. July / August 1984. Are There Any Real Benefits from Office Automation? Business Horizons. Vol. 27(4) : 37 - 42.

10. DeSanctis, G. March 1986. Human Resource Information Systems : A Current Assessment. MIS Quarterly. Vol.10(1) : 15 - 27.

11. Dickson, G.W., Leitheiser, R.L., Wetherbe, J.C., Nechis, M. September 1984. Key Information Systems Issues for the 1980's. MIS Quarterly. Vol. 8(3) : 135 - 160.

12. Ghandforoush, P. June 1982. Model for Mini Computer Selection. Journal of Systems Management. Vol. 33(6) : 11 - 13.

13. Goldberg, S.M., Green, P.E., Wind, Y. 1984. Conjoint Analysis of Price Premiums for Hotel Amenities. Journal of Business. Vol. 57(1) : S111 - S138.

14. Green, P.E., DeSarbo, W.S. June 1978. Additive Decomposition of Perceptions Data via Conjoint Analysis. Journal of Consumer Research. Vol. 5 : 58 - 65.

15. Guttentag, M., Streuning, E.L. (Editors) 1975. Handbook of Evaluation Research. Volume 1. California. Sage.

16. Gramlich, E.M., 1981. Benefit-Cost Analysis of Government Programs. New Jersey. Prentice-Hall.

17. Hamilton, S., Chervany, N.L. September 1981. Evaluating Information Systems Effectiveness - Part 1 : Comparing Evaluation Approaches. MIS Quarterly. Vol. 15(3): 55 - 69.

18. Harrison, E.F. 1981. The Managerial Decision Making Process. Second Edition. USA. Houghton Mifflin.

19. Harrison, W., Magel, K., Kluczny, R. July 1983. Research in Software Maintenance. Journal of Systems Management Vol. 34(7) : 10 - 14.

20. Holbrook, M.B. February 1981. Integrating Compositional and Decompositional Analyses to Represent the Intervening Role of Perceptions in Evaluative Judgements. Journal of Marketing Research. Vol XVIII : 13 - 28.

21. Hürst, E.G. (Jr), Ness, D.N., Gambino, T.J., Johnson, T.H. 1983. Growing DSS : A Flexible, Evolutionary Approach. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 6.

22. Jackson, B.B. 1983. Multivariate Data Analysis : An Introduction. Illinois. R D Irwin.

23. Johnson, R.M. May 1974. Trade-Off Analysis of Consumer Values. Journal of Marketing Research. Vol. XI : 121 - 127.

24. Keen, P.G.W., Gambino, T.J. 1983. Building a Decision Support System : The Mythical Man-Month Revisted. Building Decision Support Systems. Bennett, J.L. (Editor). USA. Addison-Wesley. Chapter 7.

25. Keen, P.G.W. March 1981. Value Analysis - Justifying Decision Support Systems. MIS Quarterly. Vol. 5(1) : 1 - 14.

26. Keen, P.G.W., Wagner, G.R. November 1979. DSS - An Executive Mind Support System. MIS Quarterly. Vol. 3(4) : 117 - 122.

27. Keen, P.W.G., Scott Morton, M.S. 1978. Decision Support Systems : An Organisational Perspective. USA. Addison-Wesley.

28. Keen, P.W.G. June 1986. Decision Support Systems : The Next Decade. IFIP WG 8.3 Working Conference on Decision Support Systems : A Decade in Perspective. (Paper) Noordwijkerhout, The Netherlands.

29. Kelley, E.J., Lazer, W. 1973. Social Marketing - Perspectives and Viewpoints. USA. R.D. Irwin.

30. Kleijnen, J.P.C. 1980. Computers and Profits : Quantifying Financial Benefits of Information. Philippines. Addison-Wesley.

31. Litecky, C.R. February 1981. Intangibles in Cost/Benefit Analysis. Journal of Systems Management. Vol. 32(2) : 15 - 17.

32. Linstone, H.A., Turoff, M. (Editors) 1975. The Delphi Method : Techniques and Applications. USA. Addison-Wesley.

33. Meador, C.W., Guyote, M.J., Keen, P.G.W. June 1984. Setting Priorites for DSS Development. MIS Quarterly. Vol. 8(2) : 117 - 129.

34. McCosh, A.M., Scott Morton, M.S. 1978. Management Decision Support Systems. London. MacMillan.

35. MDSX Statistical Software. 1984.

36. Morell, J.A. 1979. Program Evaluation in Social Research New York. Pergamon.

37. Melone, P., Wharton, T.J. February 1984. Strategies for MIS Project Selection. Journal of Systems Management. Vol. 35(2) : 26 - 33.

38. Munro, M.C., Davis, G.B. 1977. Determining Management Information Needs : A Comparison of Methods. MIS Quarterly. Vol. 1 : 55 - 67.

39. Neslin, S.A. February 1981. Linking Product Features to Perceptions - Self-Stated Versus Statistically Revealed Importance Weights. Journal of Marketing Research. Vol XVIII : 80 - 86.

40. Neumann, S., Segev, E. 1979. A Case Study of User Evaluation of Information Characteristics for System Improvement. Information and Management. Vol. 2 : 271 - 278.

41. Oxenfeldt, A.R. 1979. Cost-Benefit Analysis for Executive Decision Making. AMACOM. American Management Association.

42. Patton, M.Q. 1978. Utilisation-Focused Evaluation. California. Sage.

43. Patton, M.Q. 1980. Qualitative Evaluation Methods. California. Sage.

44. Radford, K.J. 1978. Information Systems for Strategic Decisions. Virginia. Reston.

45. Smith, R.D. September 1983. Measuring the Intangible Benefits of Computer-based Information Systems. Journal of Systems Management. Vol. 34(9) : 22 - 27.

46. Social Sciences Citation Index. 1984.

47. Tromp, D., Wegner, T. February 1985. The Computer's Role in Personnel Management with Specific Reference to Compensation Planning. Occasional Paper 9. University of Stellenbosch Business School.

48. Vaid-Raizada, V.K. November 1983. Incorporation of Intangibles in Computer Selection Decisions. Journal of Systems Management. Vol. 34(11) : 30 - 36.

49. Weiss, C.H. 1972. Evaluation Research - Methods of Assessing Program Effectiveness. New Jersey. Prentice-Hall.

CHAPTER 8

FORMATIVE AND SUMMATIVE EVALUATION APPROACHES - RESEARCH FINDINGS

8.1 Introduction	224
8.2 Analysis	224
8.2.1 Formative Evaluation : A User Survey of Model Features	225
8.2.2 A Summative Evaluation Approach Using Conjoint Analysis	229
Phase 1 : Benefit Identification	229
Phase 2 : Benefit Grouping	233
Phase 3 : The Quantification of DSS Benefits Without Cost Considerations	235
Phase 4 : Inferences Using Benefit Utilities	242
Phase 5 : The Quantification of DSS Benefits With Cost Considerations	248
Phase 6 : An Alternative Approach for Deriving Benefit Utilities Using Self-Explicated Ratings	252
8.3 Summary	257
References	260

8.1 INTRODUCTION.

This chapter presents empirical evidence of the various studies relating to both the formative and summative evaluation processes. The objectives and methodologies are described in chapter 7. Data for the analyses have been provided by :

- a MBA (Manpower) group of 36 delegates from the Stellenbosch Graduate School of Business for the *Benefit Identfication* study of the summative evaluation approach;

- a separate MBA (Manpower) group of 24 delegates from the Stellenbosch Graduate School of Business for the *Benefit Grouping* study of the summative evaluation approach; and

- a group of 15 compensation planners who attended a workshop on the specific compensation planning DSS (i.e. COMPLAN) at the University of Cape Town for the formative evaluation survey and the *Evaluation of Benefits* study of the summative evaluation approach.

8.2 ANALYSIS.

The results of the user survey of the COMPLAN Model features ,which comprises the formative evaluation process, are presented first. Thereafter, the results pertaining to the various studies related to the summative evaluation approach are given.

8.2.1 FORMATIVE EVALUATION : A USER SURVEY OF MODEL FEATURES.

The results of a self-administered questionnaire completed by the fifteen compensation planners who attended a workshop on a prototype of the COMPLAN DSS are analysed according to the *usability* and *usefulness* criteria. Refer to Appendix 3 for the questionnaire.

(i) USABILITY CRITERION.

Usability refers essentially to the ease-of-use of the specific DSS where the interface design is of considerable importance. In this survey, the interface design was examined through issues such as clarity of menus and prompts, ease of data capture and editing, and consistency of screen formats.

On each of these aspects, between 85 percent and 95 percent of respondents rated the Model as "good/excellent". In addition, users were requested to formulate an overall impression of the Model's user-friendliness. All but one respondent rated it highly on user-friendliness.

The features liked about the model included the ability to model the total compensation system, the ability to include speculative data, the flexibility to build numerous alternative scenarios, the ease of use and understanding of the system, and immediate access to all relevant information pertaining to a compensation review process.

The concept of "usability walk-through" (Carlson 1983 : 74) was employed to establish ease of use and shortcomings in the design interface. While no features of input/output were disliked about the model, the participants did highlight one area of improvement relating to usability. The issue involved the ability to "page back" to earlier screens. As indicated above, this feature is presently being incorporated into the system. This added flexibility enables users, once they identify a problem in the outputs, to return to the appropriate input screens immediately without having to complete the full scenario evaluation cycle first.

(ii) USEFULNESS CRITERION.

Usefulness refers primarily to to the DSS output in terms of its relevance to the decision making process. User perceptions of the overall usefulness of the information generated by the COMPLAN DSS were very positive. All but two respondents rated this aspect "good/excellent".

More specifically, the *amount* of information provided compared to currently available information, the *relevance* of the information to compensation planning, and the *completeness* thereof were examined. Again, 85 percent to 95 percent of all respondents considered the information generated to be *more* than is currently available; of *considerable* relevance; and complete to the point of providing all the essential information plus, in the case of 40 percent of respondents, new additional information being made available that was previously not readily available. No information was viewed as redundant. Further, while over two-thirds of all respondents believed no additional information was required, there was a request from a minority for a facility to analyse budgeted versus actual costs per job grade. Such an analysis can however be accommodated in a spreadsheet facility which can interface with the COMPLAN DSS.

The use of graphics to display tabular output was rated "good/excellent" by all but one respondent. They are perceived as 'completely necessary - to promote rapid identification of the problem and facilitate finding solutions'. Again, while most respondents (nearly 70 percent) did not feel the need for additional graphs, a minority group requested scatterplots of individuals within each job grade. In response, it can be noted that all of the requests for additional graphs can be accommodated through the spreadsheet facility.

The model was also rated according to the *flexibility* to cope with a variety of actual situations. In this respect, the model was rated "good" by all but two respondents. The model *logic* was also examined in terms of how well it is perceived to follow the natural decision making process in compensation planning. Again, with the exception of two respondents, the model logic was rated "good/excellent" by all respondents.

An important aspect of the design process of a DSS is to promote user learning and stimulate changes in user thinking (Keen and Gambino 1983 : 153). In the survey, respondents were asked to rate the extent to which they believed that their *thinking* and *understanding* of the compensation planning process would alter over time through the use of a DSS such as the COMPLAN model. The distribution on a 5-point scale was heavily skewed toward the "considerable" rating with both the mode and median values located at the fourth rating.

In terms of potential users of such a system in an organisation, at least three-quarters of all respondents saw the information produced to be of use both as working documents within the Personnel department, and for submission to the Board in support of policy statements.

In conclusion, the formative evaluation as conducted through a survey amongst potential users and analysed through simple frequency counts, indicates a general satisfaction with the Model format and structure. However, these findings do not establish the users' propensity to adopt the proposed system. For this, a summative evaluation approach is required. The results of the summative evaluation approach advocated in chapter 7 are presented in the remainder of this chapter.

8.2.2 A SUMMATIVE EVALUATION APPROACH USING CONJOINT ANALYSIS.

As described in chapter 7, the proposed methodology for the summative evaluation approach comprises SIX phases. They are : benefit identification; benefit groupings; benefit utility generation without cost considerations; inferential analysis using phase four benefit utilities; the regeneration of benefit utilites with cost considerations and corresponding inferential analysis; and finally, the investigation of an alternative utility generating process using self-explicated ratings. Each of these processes are illustrated with data obtained from three independent groups as outlined at the beginning of this chapter.

PHASE 1 : BENEFIT IDENTIFICATION.

Potential benefits relating to the specific DSS in compensation planning were identified using two approaches.

Initially, a literature review was undertaken. Seven sources were identified in the literature. Two of the sources, namely Wagner (1981 : 85) and Alavi (1982 : 4) list benefits established through surveys. Figure 8.1 gives a summary of the benefits listed across the various sources which are, in addition to the above two, Radford (1978 : 215), Keen (1981:7), Parker (1982 : 118), Thierauf (1982 : 137) and Smith (1983 :24 - 25). The frequency count reflects the number of sources who refer to the specific benefit.

Secondly, and independent of the literature study, a Delphi approach was employed on a group of 36 delegates on a MBA (Manpower) programme offered by the Stellenbosh Graduate School. Over four consecutive sessions, delegates refined lists of potential benefits for the prototype compensation planning DSS. The list of potential DSS benefits which is given in Figure 8.2 represents the consensus of the groups.

The literature study extracted benefits which do not relate to any specific DSS. The empirical Delphi study on the other hand, was conducted with reference to a specific DSS application - namely a prototype compensation planning system. While the wording of the benefits as identified by the delphi groups has been modified to indicate the similarity with the literature study benefits, the same meaning is conveyed as that presented by the groups.

As seen from Figures 8.1 and 8.2 then, the benefits identified through the literature are considered to be equally valid for a specific proposed DSS application in the area of compensation planning. It should be pointed out that the studies were conducted entirely independently.

FIGURE 8.1 : Literature Survey of Perceived DSS Benefits

(Number of Sources Consulted = 7)

Code*	Benefit	Source	Frequency
1	Clerical time / labour saving / smoother administration	Wagner, Keen, Thierauf, Smith, Parker	5
2	Improve utilisation of management time	Alavi, Keen, Wagner, Thierauf	4
3	Improved Decision making capability (better decs; cope with increased complexity in decisions)	Thierauf, Parker, Alavi, Keen, Wagner, Smith	6
4	Promotes a clearer understanding / apprec of the problem (learning value, mgnt. skills leaverage, increased decision confidence)	Alavi, Wagner, Keen, Radford, Parker	5
5	Better utilisation of data (improved timeliness , accuracy, access and availability of data)	Alavi, Keen, Wagner, Thierauf, Parker, Radford, Smith	7
6	Improve Planning & Control	Parker, Keen, Thierauf	3
7	Permits an evaluation of a wider range of alternatives / deeper exploration of alternatives	Alavi, Smith, Keen, Wagner, Parker, Thierauf	6
8	Promotes communication between management levels	Radford, Smith, Keen	3

* : The numeric code is used to identify the benefit in subsequent analysis.

FIGURE 8.2 : Benefits Identified from Empirical Study using the Delphi Approach. (N = 6 groups)

Benefit	Frequency
Clerical time / labour saving / smoother administration	6
Better utilisation of data (improved timeliness, accuracy, access and availability of data)	5
Permits an evaluation of a wider range of alternatives / deeper exploration of alternatives	3
Promotes communication between management levels	4
Improved Decision making capability (better decisions,cope with increased complexity in decisions)	5
Improve Planning and Control	5
Improve utilisation of management time	2
Promotes a clearer understanding / appreciation of the problem (learning value, management skills, leaverage, increased decision confidence)	3

The application of conjoint measurement requires the grouping of product features into homogeneous sets. The next section presents the results of a grouping exercise conducted on the list of potential DSS benefits identified above.

PHASE 2 : BENEFIT GROUPINGS.

The Delphi delegates were requested to indicate on their final submissions, areas of likely impact for each of the individual benefits. From their input, three impact areas are hypothesised. Each benefit is likely to either :

- relate mainly to the *operational* level, or
- be mainly *managerially* orientated, or
- be directed mainly at the *personal* level.

To validate these groupings of *product attributes* for the specific compensation planning DSS, an independent group of 24 MBA (Manpower) delegates was requested to assign the identified benefits (from Figure 8.2) to each of the three hypothesised areas of impact. Appendix 4 gives the questionnaire used. A cluster analysis using the BMDP2M package was applied to the ratings which reflected the closeness of association of each potential benefit with each of the hypothesised attributes (viz. areas of impact). The resulting dendrogram from the BMDP2M package is given in Figure 8.3.

As seen from the analysis, three separate groupings of benefits appear to exist. Clerical benefits (1) and better utilisation of data (5) form one natural group - cluster A. Improved use of management time (2), together with improved planning and control (6) and better communication

FIGURE 8.3 : Dendrogram of Benefits from BMDP2M.

```
                           Benefit Code*

             1   5   8   6   2   4   7   3
Amalg. Dist.

  .000       I   I   I   +---+   I   I   I
  .000       I   I   I     I     I   +---+
  .038       I   I   +-----+     I     I
  .064       +---+      I        I     I
  .133         +--------+        I     I
  .163              I            +-----+
  .267              +---------------+
```

* : The Benefit descriptions referring to the codes are given in Figure 8.2.

between managers (8) represent a second clear grouping - cluster B. The third grouping referred to as cluster C, comprises improved decision making (3), better understanding of the problem (4) and a wider exploration of alternatives (7).

From the nature of the benefits within each group, it is possible to reasonably associate an area of impact with each cluster. Figure 8.4 indicates this association. Cluster A can be termed the *Operationally* orientated benefits, cluster B the *Managerially* orientated benefits, and cluster C the *Personally* orientated benefit group.

These benefit groupings are now used in the application of the conjoint measurement approach to gather subjective evaluation data.

FIGURE 8.4: Benefit List and Designated Cluster from BMDP2M.

Code	Benefit	Cluster
1	Potential clerical time and labour savings	A
2	Improves utilisation of management time	B
3	Improves management decision making capabilities	C
4	Promotes clearer appreciation / understanding of the problem	C
5	Promotes better utilisation of data	A
6	Improves planning and control	B
7	Permits deeper and wider exploration of alternatives	C
8	Improves communication between managers	B

PHASE 3 : THE QUANTIFICATION OF DSS BENEFITS WITHOUT COST CONSIDERATIONS

The factors and factor levels required for the application of conjoint analysis are represented by the benefit groupings and individual benefits respectively. An additional factor level identified as a *Null benefit* which states that no benefits are associated with a particular area of impact, is included for each benefit grouping. These Null benefits are included to provide a basis for examining the magnitude of the excess benefit. The groupings of benefits together with the Null benefit per group is given in Figure 8.5.

FIGURE 8.5: Benefit Groupings for Conjoint Analysis

Group A -	Operational Benefits
A_1	Clerical time and labour savings
A_2	Better utilisation of data
A_3	No Operational benefits (Null)
Group B -	Managerial / Organisational Benefits
B_1	Improves communication between managers
B_2	Improves planning and control
B_3	Improves utilisation of management time
B_4	No Managerial/ Organisational benefits (Null)
Group C -	Personal Benefits
C_1	Deeper and wider exploration of alternatives
C_2	Improves decision making capability
C_3	Clearer appreciation/understanding of problem
C_4	No personal benefits (Null)

The data capture process requires respondents to rank combinations of benefits drawn from each grouping. A full factorial approach would involve the ranking of 48 (3x4x4) benefit combinations. However, to simplify the data capture, a fractional factorial design consisting of only 12 combinations to be ranked can be used. Figure 8.6 provides the fractional design scheme appropriate for this study.

FIGURE 8.6 : Fractional Factorial Design for a 3x4x4 Model

	Factor A	Factor B	Factor C
Levels	0 1 2	0 1 2 3	0 1 2 3

Sequence	Fractional Design.			Benefit Combination*
1	0	0	0	A_1 B_1 C_1
2	1	0	1	A_2 B_1 C_2
3	2	0	2	A_3 B_1 C_3
4	0	1	1	A_1 B_2 C_2
5	1	1	2	A_2 B_2 C_3
6	2	1	3	A_3 B_2 C_4
7	0	2	2	A_1 B_3 C_3
8	1	2	3	A_2 B_3 C_4
9	2	2	0	A_3 B_3 C_1
10	0	3	3	A_1 B_4 C_4
11	1	3	0	A_2 B_4 C_1
12	2	3	1	A_3 B_4 C_2

NOTE : * Refer to Figure 8.5 for the Benefit Descriptions.

A group of 15 delegates with compensation planning experience and who were exposed, through a workshop on a prototype of the compensation planning Decision Support modelling system, were requested to rank the twelve benefit combinations from *most important* to *least important* with respect to the justification of the specific compensation planning DSS. The questionnaire used is given in Appendix 5.

The decomposition of the benefit combination rankings was performed using the MDSX-UNICON package to produce interval-scaled measures (utilities or part-worths) for each separate benefit defined in Figure 8.5. Figure 8.7 illustrates the utility values for each benefit as generated for one respondent, namely respondent four. Similar benefit utility values were generated for each of the 15 respondents separately.

The stress level indicates the *goodness of fit* of the derived utilities against the user-supplied rankings. A level less than 0.05 is regarded as a good measure of fit.

Since the utility values are interval-scaled, metric intepretations on these values are valid. Both the strength of perceptions and marginal changes in perceptions can be inferred from the absolute and relative magnitudes of different individual benefits as well of combinations of benefits. The following five observations can be made.

Firstly, the strength of perception associated with each benefit can be gauged from the absolute magnitude of the respective utilities. From Figure 8.7, it can be seen that Benefit C_2 is perceived to be most important in justifying a specific DSS for respondent four, while Benefit B_4 is viewed as least important.

FIGURE 8.7 : Utility Values for Respondent 4 from Conjoint Analysis.

Benefit Code by group	Benefit Utility Value *
A_1	1.073
A_2	1.368
A_3 (Null)	0.174
B_1	0.516
B_2	0.811
B_3	1.105
B_4 (Null)	-0.088
C_1	0.995
C_2	2.151
C_3	0.406
C_4 (Null)	0.112
Stress Level	0.00000051

* : The scale unit is arbitrary ; the important point is that all the separate interval scales are measured in terms of a *common* unit (Green, Tull 1978: 484).

Secondly, the relative change in utility values measures the perceived tradeoff made between specific benefits. For example, the marginal change in perception between Benefits C_2 and A_2 of 0.783 (2.151 - 1.368) exceeds that between A_2 and B_3 of 0.263 (1.368 - 1.105) by a factor of about 3. This implies that perceived differences between the former pair of benefits is much greater than between the latter pair of benefits.

Thirdly, the relative importance of the each area of impact under which the various benefits were categorised can be estimated (refer to Figure 8.8). For respondent 4, the *Personal* area of impact is considered the most important with a relative weighting of 46 percent. The other two areas, namely *Operational* and *Managerial*, are perceived as equally important as each have a relative weighting of 27 percent.

FIGURE 8.8: Relative Importance of Benefits Groups for Respondent Four.

	Operational	Managerial	Personal
Utility Range	1.194	1.193	2.039
Percentage Weight	27%	27%	46%

The average across all respondents showed a similar pattern to that for respondent 4, namely the attachment of greater importance to *personal* benefits than to organisation-related benefits. An hypothesis test of equality on the group means concluded that the *personal* group mean is significantly different from the other two group means. Figure 8.9 gives the mean and standard deviation for each benefit category across all respondents.

FIGURE 8.9: Statistics for Relative Importance Measures for each Benefit Group across all Respondents.

	Operational	Managerial	Personal
Mean %	32	29	39
Std. Dev.	9.86	9.95	8.20

Fourthly, the absolute and relative importance of subsets of benefits can be measured from the summation of the corresponding utilities. To compile the *best benefit combination* across the areas of impact, the highest utility from each benefit grouping would be selected and summed. Comparisons between different combinations can show the relative importances attached to various subsets of benefits.

Fifthly, importance measures can be derived for benefit combinations that were not in the original stimuli set ranked by the respondent. Thus the full factorial set of 48 combinations of benefits can be evaluated from the utilities generated from the fractional factorial design.

Thus the translation of the ordinal-scaled data captured from each respondent can be used, through conjoint analysis, to extract more meaningful information which uncovers further details about the respondent's perception of the value of a specific DSS as expressed through the benefits.

PHASE 4 : INFERENCES USING BENEFIT UTILITIES.

The decision facing managers in justifying the continued development of a specific DSS is whether the proposed system has value i.e. whether the benefits are perceived as significant by the potential end users.

The approach proposed involves establishing the statistical significance of benefits regarded by the decision maker(s) as the critical set to establish *value* for the proposed DSS under consideration.

This approach identifies the critical level for a benefit utility or combination of benefit utilities against which the corresponding derived utility values are compared. The decision rule would be to proceed with the DSS development as long as the utility value exceeds the critical level.

To illustrate this approach, three examples are given.

Example 1:

For this illustration, it is assumed that *value* for the proposed Compensation Planning DSS is defined in terms of the *most important* benefit combination across all respondents. For this benefit combination, it is hypothesised that the associated utility value is significantly greater than the Null benefit combination of $\{A_3,B_4,C_4\}$. From an analysis of the utility values across all respondents, it is established that the benefit combination which is perceived to be the most important by the majority of respondents (60%) is the set $\{A_2,B_3,C_2\}$.

Since the two sets of utilities for each respondent are dependent, a matched pairs test is considered appropriate. Both parametric and nonparametric tests are used to test the hypothesis.

Statistically, the hypothesis to test for this illustration is :

$$H_0 : \mu \text{ (most important - null combination)} <= 0$$

$$H_1 : \mu \text{ (most important - null combination)} > 0$$

The data for the analysis is given in Figure 8.10.

FIGURE 8.10 : Utility Sets for *Most Important* and *Null* Benefit Combinations.

Respondent	Utility Values		
	Most Important	*Null*	Difference
1	3.539	-0.384	3.923
2	3.961 *	0.362	3.559
3	4.322 *	1.302	3.020
4	4.624 *	0.198	4.426
5	1.743	0.700	1.043
6	4.291 *	0.414	3.877
7	3.859 *	0.236	3.623
8	2.672	0.186	2.486
9	4.313 *	-0.042	4.355
10	1.598	0.276	1.322
11	3.619	1.082	2.537
12	2.915	0.508	2.407
13	4.398 *	0.437	3.961
14	3.753 *	0.554	3.199
15	3.546	-0.263	3.809

* Denotes respondents who ranked the *most important* benefit combination within the top three out of 48 possible rankings.

Parametric t-test.

A matched pairs test using the t-statistic on the *difference* measure indicates a rejection of the null hypothesis. The conclusion that the decision makers could reach therefore is that the specific DSS has value as perceived by the potential users and as expressed through the utility values assigned to the identified DSS benefits. Figure 8.11 gives the statistical results of the matched pairs test.

FIGURE 8.11: Matched Pairs Test of Benefit set $\{A_2,B_3,C_2\}$.

Sample Mean (difference)	3.1680
Sample Std. Dev. (diff)	0.9951
Sample Size	15
t-calculated	12.3374
t (.005) (14)	2.9770

Nonparametric tests.

Both the Wilcoxon matched-pairs signed-ranks test and the Walsh test were applied to the *difference* utility data. In both instances the null hypothesis is rejected. Figure 8.12 summarises the appropriate statistical results.

FIGURE 8.12 : Nonparamteric Test Results for Example One.

Wilcoxon Matched pairs Signed ranks Test	Walsh Test
$T_{calculated} = 0$	$d_{calculated} = 2.333$
$T_{critical} = 16$	$d_{critical} = 0.0$
$n = 15$	$n = 15$
Reject H_0	Reject H_0
$p < 0.005$	$p < 0.005$

Source of Nonparametric Tests : Siegel S : Nonparametric Statistics for the Behavioral Sciences. 1956.

The threshold benefit level in this illustration is the critical value of the appropriate test statistic. In effect, for any individual benefit or benefit combination from the 15 respondents' utility values, the threshold level would remain constant as it is a function of a specied level of significance and the sample size.

Example 2:

Assume the definition of *value* for the proposed Compensation Planning DSS is given by the perceived *least important* combination of benefits excluding the null benefits. From an analysis of the three 'least important' combined benefit utilities, excluding the null benefits, it would appear that benefit combination { A_1, B_1, C_1 } appears most frequently.

Three matched pairs tests were applied to the following hypothesis :

$$H_0 : \mu \{\text{mean } (A_1,B_1,C_1) - \text{null } (A_3,B_4,C_4)\} <= 0$$
$$H_1 : \mu \{\text{mean } (A_1,B_1,C_1) - \text{null } (A_3,B_4,C_4)\} > 0$$

Each application of the t-test, the Wilcoxon matched pairs signed ranks test, and the Walsh test, results in the rejection of the null hypothesis at the 0.005 level of significance. Thus *value* is again inferred to the proposed DSS based on the *least important* combination. Figure 8.13 shows the test results.

FIGURE 8.13 : Matched Pairs Test Results of Benefit Combination $\{A_1,B_1,C_1\}$

	t-test	Wilcoxon test	Walsh test
Sample Mean	2.6041	$T_{calc} = 1.0$	$d_{calc} = 0.989$
Sample S. D.	1.1223	$T_{crit} = 16.0$	$d_{crit} = 0.000$
Sample Size	15	15	15
t-calculated	8.9870	$p < 0.005$	$p < 0.005$
t (.005)(14)	2.9770		
	Reject H_0	Reject H_0	Reject H_0

Example 3:

If *value* is defined by a single DSS benefit, then the hypothesis test involves significance testing of the specific DSS benefit utilities against the null benefit from the associated benefit grouping.

To illustrate, if benefit $\{A_2\}$ is regarded as the benefit against which the value of the Specific DSS is measured, then a matched pairs test of the following hypothesis is required :

H_0 : μ { mean (A_2) - null of benefit group A } <= 0

H_1 : μ { mean (A_2) - null of benefit group A } > 0

For the three matched pairs tests applied, the results indicate that, at the 0.005 level of significance, the null hypothesis is rejected with the resulting conclusion that value is perceived to be significant in the proposed DSS. Figure 8.14 gives the results of the single benefit $\{A_2\}$ hypothesis test.

FIGURE 8.14 : Matched Pairs tests for Benefit $\{ A_2 \}$

	t-test	Wilcoxon test	Walsh test
Mean	1.0833	$T_{calc} = 0.0$	$d_{calc} = 0.756$
Std. Dev.	0.4219	$T_{crit} = 16.0$	$d_{crit} = 0.000$
Sample Size	15	15	15
t_{calc}	9.9452	$p < 0.005$	$p < 0.005$
t (.005)(14)	2.9770		
	Reject H_0	Reject H_0	Reject H_0

PHASE 5 : THE QUANTIFICATION OF DSS BENEFITS WITH COST CONSIDERATIONS.

The above analysis does not include any *cost* information which may influence potential user's perception of the value of any proposed DSS.

To examine the potential impact of *cost*, a further set of benefit utilities has been generated for each respondent. The ranked data captured from respondents for this phase of the study is intended to reflect the impact of *cost*. Respondents were requested to rank the previously defined fractional factorial benefit combinations with the knowledge "that there are significant costs involved in developing and implementing a Specific Decision Support System". Refer to appendix 6 for the questionnaire used.

An initial observation made by comparing the ranked benefits combinations obtained when *cost is not significant* and when *cost is significant*, indicates that 10 out of the 15 respondents did not change their rankings.

(i) CORRELATIONS OF BENEFIT UTILITIES.

The extent to which the perceived importance of the benefits changed as a result of introducing cost explicitly into the ranking process can be seen by examining the correlations between the utilities for the two scenarios. Figure 8.15 summarises the correlations for

- each of the 5 respondents who changed their rankings,
- the group of 5 respondents combined, and
- for all the respondents taken together.

FIGURE 8.15: Correlations between Utilities for the *No Cost* and *Cost* scenarios

Respondent	Correlation
1	0.3873
8	0.4040
9	0.8239 *
12	0.9247 *
13	0.7945 *
Group of 5	0.6565 *
All 15	0.8803 *

Note: * significant at $p < 0.05$

Only two of the five respondents changed perceptions significantly, while the remaining three respondents made only minor adjustments. Collectively, there is no statistically significant change in perceptions toward individual benefits.

(ii) RELATIVE IMPORTANCE MEASURES.

Concerning the relative importance of benefit groups, an hypothesis test between each corresponding pair of group means yielded no statistically significant difference in the relative importance to groups under the two cost scenarios. Figure 8.16 shows the relevant statistical results. In each case, the null hypothesis stated no difference in mean relative importance between the two scenarios for each benefit group.

FIGURE 8.16 : Matched Pairs Test for Difference in Benefit Group Means between the Two Cost Scenarios

	Benefit Group		
	Operational	Managerial	Personal
(a) Average Measure of Relative Importance (%)			
No Cost	32	29	39
Cost	28	31	41
(b) Calculated and Critical Values for t-test			
t_{calc}	1.080	-.580	-.565
t_{crit}	+-1.761	+-1.761	+-1.761
Conclusion	Accept	Accept	Accept

(iii) INFERENCES USING BENEFIT UTILITIES.

Next, the statistical significance of individual and combined benefit utilities are examined to establish the likely impact of cost considerations on the Benefit Threshold analysis. The same sets of benefit utilities as were used earlier to signify *value* for a proposed DSS were tested against the corresponding null benefit set. In each of the three illustrations - as shown by the results in Figure 8.17 - the null hypothesis of no significant difference to the null set is rejected.

FIGURE 8.17: Matched Pairs Test of Benefit Sets Against Null

	$\{A_2,B_3,C_2\}$	$\{A_1,B_1,C_1\}$	$\{A_2\}$
Sample Mean (difference)	3.0917	2.4206	0.8970
Sample Std. Dev. (diff)	1.0316	1.0950	0.3798
Sample Size	15	15	15
t_{calc}	11.6070*	8.5615*	8.9640*
t (.005) (14)	2.9770	2.9770	2.9770
Conclusion	Reject	Reject	Reject

Note : * indicates statistical significance at $p < 0.005$

PHASE 6 : AN ALTERNATIVE APPROACH FOR DERIVING BENEFIT UTILITIES USING SELF-EXPLICATED RATINGS.

To compile the self-explicated utility for a benefit, a respondent is requested to :

- assign a weighting factor which reflects the relative importance attached to each of the three benefit groups; and

- rate each individual benefit on an 'importance' scale.

Refer to Appendix 7 for the two questionnaires used.

The resultant utility values can be interpreted and used in the same manner as those generated through the conjoint approach. To establish the extent to which there is correspondence between the utilities generated from the two approaches, correlations are computed. Figure 8.18 shows the correlation for each respondent and the appropriate level of significance.

FIGURE 8.18 : Correlations between Conjoint and Self-Explicated Benefit Utilities for Individual Respondents.*

Respondent	Correlation	t_{calc}
1	.7217	6.080
2	.7956	7.659
3	.7458	6.527
4	.7666	6.962
5	.2735	1.658
6	.6453	4.925
7	.9301	14.760
8	.6453	4.925
9	.6520	5.015
10	.7055	5.804
11	.6679	5.232
12	.6673	5.224
13	.8718	10.378
14	.8518	9.483
15	.7187	6.027
	$t_{(.0005)(34)}$ =	3.610

* : The benefit utility values used relate to those benefit combinations which were NOT included in the Fractional Factorial Design of the conjoint data collection.

On an individual-by-individual basis all respondents, with the exception of respondent 5, generated self-explicated benefit utilities that correlate significantly with their conjoint derived counterparts.

When compared on an aggregated basis across all respondents, the correlation, computed in the same manner as in Figure 8.18 is 0.5851 (t_{calc} = 16.736 : n=540) which is statistically significant at $p < 0.0005$. This represents however, only a moderate association between the two approaches. A corresponding predictive model for conjoint-derived utilities from self-stated benefit utilities can be computed using the OLS regression method.

For the aggregated responses, the predictive model is given by :

$$Y_{1,k}(\text{hat}) = 0.3587 + 0.3187\, X_{1,k}$$

where

$Y_{1,k}(\text{hat})$ = predicted conjoint-derived benefit utility 1 for respondent k, and

$X_{1,k}$ = self-explicated utility 1 for respondent k.

Neslin (1981 : 86) suggests that the predictive ability between the two utility generation approaches could possibly be improved through the development and testing of clustering schemes among individual respondents.

For the 15 respondents of this study, a cluster analysis was performed using the ranked values of the benefit combinations to establish if any natural groupings of respondents existed for which the within-group variation of benefit utilities was small. The results of the clustering algorithm using the BMDP2M package are given in the dendrogram of Figure 8.19.

FIGURE 8.19 : Dendrogram of Respondents from BMDP2M

```
Distance                 Respondent

       1  11  4  12  14  7 13   9  15  6  2  10  8  3  5

1.249  I   I  I   I   I  -----  I   I  I  I   I  I  I  I
1.396  I   I  -----   I    I    I   I  I  I   I  I  I  I
1.424  I   I    I     I    +----+   I  I  I   I  I  I  I
1.426  I   I    I     I       +-----+  I  I   I  I  I  I
1.437  I   I    I     I          +-----+  I   I  I  I  I
1.538  I   I    I     +----------+        I   I  I  I  I
1.562  I   I    +----------+              I   I  I  I  I
1.697  --+--               I              I   I  I  I  I
1.977    I                 +--------------+   I  I  I  I
2.140    +------------------------+           I  I  I  I
2.442                +------------------------+  I  I  I
2.571                             +--------------+  I  I
2.980                                     +---------+  I
3.268                                            +-----+
```

Note : The single linkage, chi-squared rules are used to group the respondents on rank order data.

From Figure 8.19, if a cut-off distance of 2.00 is selected, then two distinct groupings of respondents emerge based on similarity of rankings of benefit combinations used for the conjoint analysis. A single grouping of nine respondents (codes 2,4,6,7,9,12,13,14,15) comprise the largest homogeneous cluster, while the second group consists of only two respondents (codes 1 and 11). The remaining four respondents, namely codes 3,5,8 and 10, do not gravitate towards any natural groups.

The correlation and regression analysis between the conjoint and self-stated benefit utilities are repeated for the two identified clusters. From the results, shown in Figure 8.20, it can be seen that

- for the cluster of nine respondents, there is a marginal increase in the predictive ability of the regression model, and

- for the second identified cluster of two respondents (respondents 1 and 11) there is no meaningful increase in predictive ability.

If the cluster of nine respondents is further subdivided to reflect greater homogeneity between respondents within groups, then predictive ability does tend to improve as clusters are more homogeneously defined. However, these improvements are only moderate. These results are evident from the correlations between the two sets of benefit utilities for subgroups identified from the dendrogram in Figure 8.19 and shown in Figure 8.21. In each case, the respondent or group of respondents which joined the cluster last is removed and the predictive ability examined for the reduced subgroup.

FIGURE 8.20 : Correlation and Regression for Clusters

Cluster	Correlation	Regression
All 15 respondents	0.5851 * (n = 540)	y = 0.3587 + 0.3187 x
Cluster One (2,4,6,7,9, 12,13,14,15)	0.6817 * (n = 324)	y = 0.3098 + 0.3387 x
Cluster Two (1,11)	0.6065 * (n = 72)	y = -0.583 + 0.4371 x

Note : * indicates significance at $p < 0.0005$

8.3 SUMMARY.

The evaluation of a prototype DSS in the area of compensation planning has been examined from two perspectives, namely a formative approach and a summative approach. The formative evaluation approach examined Model features. The results of a user survey presented in section 8.2.1 indicated general satisfaction with the prototype DSS in compensation planning.

Concerning the summative evaluation process, this study has proposed and illustrated a methodology which incorporates the intangible benefits into a decision model. The study focussed primarily on:

- quantifying the intangible benefits normally associated with Decision Support Systems; and
- using the derived utilities to establish value for a proposed specific DSS.

FIGURE 8.21 : Correlations for Sub-clusters of Cluster One

Cluster	Correlation	t_{CALC}
Group of 9 (2,4,6,7,9,12,13,14,15)	0.6817	16.718 (n=324)
Group of 8 (4,6,7,9,12,13,14,15)	0.6920	16.212 (n=288)
Group of 6 (6,7,9,13,14,15)	0.7217	15.253 (n=216)
Group of 5 (6,7,9,13,15)	0.7009	13.110 (n=180)
Group of 4 (7,9,13,15)	0.7513	13.564 (n=144)
Group of 3 (7,9,13)	0.7791	12.797 (n=108)
Group of 2 (7,13)	0.8711	14.843 (n=72)

Note : All correlations are significant at $p < 0.0005$

The purpose of the methodology is to incorporate these intangible benefits into the mainstream of decision making concerning DSS evaluation.

The emphasis is on *value* rather than *cost*. A DSS which is perceived to have value by the potential users is more likely to be adopted and implemented than one for which no significant value is perceived. The approach is also applicable to the evaluation of a single investment proposal.

The conjoint measurement approach advocated provides a suitable means of converting subjective judgements about the relative importance of intangible benefits into numeric scores to which further analytic tests can be applied to establish whether a specific DSS is perceived by the potential end-users to have *value*.

It should be noted that the approach proposed does not prescribe the mix of benefits that is perceived as constituting the *value* of a specific DSS. This process resides with the potential end-users. However, once this mix is known, the proposed approach can establish the statistical significance or otherwise thereof. In terms of the decision rule then, guidance can be provided as to whether to proceed/not proceed with the development / acquistion of a proposed specific Decision Support System.

The final phase of the study examined the appropriateness of using self-explicated utilities as opposed to conjoint derived utilities. Since the two approaches do not produce consistently high correlations, further research on suitable methods is needed before the two approaches can be used interchangably.

REFERENCES

1. Alavi, M. December 1982. An Assessment of the Concept of Decision Support Systems as viewed by Senior-Level Executives. MIS Quarterly. Vol. 6(4) : 1 - 9.

2. BMDP Statistical Software. 1983. University of California Press.

3. Green, P.E., Tull, D.S. 1978. Research for Marketing Decisions. Fourth Edition. New Jersey. Prentice-Hall.

4. Keen, P.G.W. March 1981. Value Analysis - Justifying Decision Support Systems. MIS Quarterly. Vol. 5(1) : 1 - 14.

5. MDSX Statistical Software. 1984.

6. Neslin, S.A. February 1981. Linking Product Features to Perceptions - Self-Stated Versus Statistically Revealed Importance Weights. Journal of Marketing Research. Vol. XVIII : 80 - 86.

7. Parker, M.M. 1982. Enterprise information analysis : Cost-benefit analysis and the data-managed system. IBM Systems Journal. Vol. 21(1) : 108 - 121.

8. Radford, K.J. 1978. Information Systems for Strategic Decisions. Virginia. Reston.

9. Siegel, S. 1956. Nonparamteric Statistics for the Behavioral Sciences. Kogakusha. McGraw-Hill.

10. Smith, R.D. September 1983. Measuring the Intangible Benefits of Computer-based Information Systems. Journal of Systems Management. Vol. 34(9) : 22 - 27.

11. Thierauf, R.J. 1982. Decision Support Systems for Effective Planning and Control : A Case Study Approach. New Jersey. Prentice-Hall.

12. Wagner, G.R. April 1981. Decision Support Systems : The Real Substance. INTERFACES. Vol. 11(2) : 77 - 86.

CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

9.1	Introduction	262
9.2	Restatement of Research Objectives and Hypotheses	262
9.3	Conclusions	264
9.4	Recommendations for Further Research	277
9.5	Implications of Research	281
9.6	Summary	283
	References	284

9.1 INTRODUCTION.

This dissertation examined each of the phases of the iterative design process within the DSS Development Life Cycle as proposed by Meador, Guyote and Keen (1984). The study was conducted within the context of a specific application area, namely compensation planning in human resource management. This chapter presents the conclusions drawn from each of the phases, makes recommendations for further research and considers some implications of the study.

9.2 RESTATEMENT OF RESEARCH OBJECTIVES AND HYPOTHESES.

In chapter one, two issues are identified and formulated as research objectives. They are :

Objective One : to demonstrate the application of DSS concepts to the area of compensation planning within the field of human resource management; and

Objective Two : to examine and propose an evaluation methodology appropriate for assessing the effectiveness of a proposed specific DSS application in compensation planning.

The DSS Development Life Cycle as proposed by Meador et al (ibid : 125) provides a framework for investigating the two objectives. Within this framework, five research hypotheses which are sub-objectives of the primary objectives are formulated and stated as follows :

Hypothesis One : There is a significant lack of application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Hypothesis Two : The need exists for the application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Hypothesis Three : A literature review of DSS methodology can establish the appropriateness of this discipline to compensation planning.

Hypothesis Four : A literature review of the field of Compensation Management can promote an effective design specification for a prototype compensation planning DSS.

Hypothesis Five : A prototype non industry-specific microcomputer based DSS which will reflect user-defined needs and incorporate appropriate DSS design and development principles can be designed and developed in the area of compensation management.

Hypothesis Six : The effectiveness of the prototype DSS in compensation planning can be gauged through the quantification and analysis of perceived DSS intangible benefits and costs.

The following section will examine each hypotheses in terms of the evidence provided in the preceeding chapters. The examination will proceed within the framework of the DSS Development Life Cycle (ibid : 125).

9.3 CONCLUSIONS.

The first phase of the DSS Development Life Cycle is defined as *planning*. This involves a user needs assessment and problem diagnosis and is dealt with under hypotheses one and two respectively.

Hypothesis One : There is a significant lack of application of information technology to support strategic human resource decision making in general and compensation planning in particular.

The literature search presented in section 2.2 has identified the human resource field as an underdeveloped area with respect to the use of computers in a decision support role. More specifically, the sub-field of compensation planning has received little attention. This lack of application of newly developed information technology to the human resource field as discerned from the literature is also observable in South African organisations. The empirical survey reported in section 2.3 confirms the literature reviews. Both studies established that the majority of computer applications in the human resource field occur at the administrative and/or operating level, while structured reporting systems are moderately developed and decision support systems are largely nonexistent. This conclusion is found to be equally valid for the area of compensation management. Thus, the combined findings from the literature and the empirical study tend to support research hypothesis one, namely that there is a significant lack of application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Hypothesis Two : The need exists for the application of information technology to support strategic human resource decision making in general and compensation planning in particular.

Despite the low level of computer usage with respect to decision support, as reported in sections 2.2 and 2.3, human resource executives are becoming increasingly aware of the need to harness this new information technology. They are increasingly being called upon to justify their decisions with rational, verifiable evidence. The use of decision support facilities are perceived as valuable aids in assisting with this process. Both the literature review of section 2.2 and the empirical survey results reported in section 2.3 provide evidence of the need that exists amongst human resource personnel for such decision tools. The need within the compensation planning area is for an interactive facility with graphics capabilities to examine alternative compensation structures. Thus the evidence presented suggests that hypothesis two which states that there exists a need for the application of information technology to support strategic human resource decision making in general and compensation planning in particular can be supported.

The *research* phase of the DSS Development Life Cycle, which succeeds *planning*, relates to hypothesis three.

Hypothesis Three : A literature review of DSS methodology can establish the appropriateness of this discipline to compensation planning.

Research, in the context of the DSS Development Life Cycle, involves an examination of the relevant fundamental approaches for addressing user needs. The appropriateness of DSS as opposed to the traditional MIS approach is examined in sections 3.2 and 3.3. From the classification of decision types and information requirements given in section 3.2, it is shown in section 3.3 that traditional MIS which emphasises structured information flows for the purpose of management control serves management's decision making and planning needs only in a limited sense. Decision Support Systems, on the other hand, are characterised as being flexible, adaptable, user-driven, user-orientated, and with a focus on planning rather than control. These DSS characteristics are more conducive to the environment within which compensation planning takes place (as summarised in section 5.4) than those of the traditional MIS. Consequently, it can be concluded in support of hypothesis three, that DSS is an appropriate tool for supporting strategic decision making in compensation planning.

Hypothesis four is associated with the *analysis* phase of the DSS Development Life Cycle. This phase involves a contextual examination of the application area.

Hypothesis Four : A literature review of the field of Compensation Management can promote an effective design specification for a prototype compensation planning DSS.

In chapters 4 and 5, the field of compensation management is reviewed. Section 4.3 establishes the strategic importance of compensation planning to the organisation, the employee and the broader economy. This importance is underscored by the review of compensation theories which provides evidence, both of a theoretical and empirical nature, of the relationship between compensation planning decisions and the motivational level of the employee (section 4.4). It can thus be concluded that, on a strategic level, an appreciation of the various compensation theories can greatly assist compensation planners in designing a system with significant motivational impact on the internal workforce, given the environmental and organisational climate of the period.

To implement a decision-oriented approach to building DSS however, as advocated by Stabell (1983 : Chapter 10), an appropriate decision model for compensation planning is examined. Towards this end, chapter 5 identifies a top-down decision approach appropriate for the compensation planning process. This top-down approach of identifying compensation objectives and formulating policies as discussed in sections 5.2.2 and 5.2.3 respectively, provides a focus for the design of any specific compensation system. The objective statements guide policy formulations on essentially two issues, namely that of *pay level* and *pay structure*.

These two concepts are central to the design of any compensation system. Section 5.3 examines the technical design considerations relevant to each of these two concepts and concludes that on a technical level, policy decisions in the areas of pay level and pay structure can be readily translated into structural parameters and relationships from which a compensation structure can be developed.

Thus, through an understanding by compensation planners of the theoretical concepts of motivation and their integration into the top-down decision making approach to compensation planning, there is evidence from the literature to support hypothesis four that an effective design specification for a prototype compensation planning DSS can be developed.

Next in the DSS Development Life Cycle are the *design*, *system construction* and *system testing* phases. These phases are covered in hypothesis five.

Hypothesis Five : A prototype non industry-specific microcomputer based DSS which will reflect user-defined needs and incorporate appropriate DSS design and development principles can be designed and developed in the area of compensation management.

Concerning the *design* phase, sections 3.4 and 3.5 review the DSS design and development concepts that have evolved over the past decade. Based on this review, the design criteria that the COMPLAN model seeks to incorporate are those of flexibility in the choice of a compensation scenario, ease-of-use of the model, rapid response, total systems modelling and close user involvement. Each criterion is dealt with in sections 6.1, 6.2 and 6.3 where they are related specifically to the compensation planning system.

Concerning the COMPLAN model development, the process employed is similar to the *adaptive* development strategy proposed by Keen and Gambino (1983 : 153). Two aspects in particular are relevant, namely the use of the middle-out approach, and close user involvement. The model structure presented in section 6.4 reflects many of the design and development characteristics described in chapter 3.

The theoretical considerations reviewed in chapter 3 are synthesised with the compensation system requirements discussed in chapters 4 and 5 to produce the design specifications as presented in sections 6.2 and 6.3. These in turn are translated into a non industry-specific prototype of a compensation planning DSS (COMPLAN). The model structure is illustrated in section 6.4 which represents the *system construction* phase of the DSS Development Life Cycle.

A further issue stated in hypothesis five concerns the COMPLAN DSS model structure reflecting user-defined needs. This relates to the *system testing* phase and involves establishing whether the system performs in accordance with design specifications and user needs.

Initially, the need for a decision support tool in compensation planning has been defined in chapter 2 and eloborated upon in section 5.4. The nature of this need is translated into the design criteria presented in sections 6.2 and 6.3. To establish whether the model structure as reported in section 6.4, incorporates the user-defined need, the COMPLAN model was subjected to a review by a group of compensation planners. The survey results are reported in sections 7.3 and 8.2.1 and focused on model usability and usefulness. The first criterion seeks feedback on model features while the latter was examined in terms of the relevance and completeness of the information provided by the Model. On both criteria the COMPLAN model satisfied the majority of potential users. It therefore appears that the COMPLAN DSS meets the a priori defined needs of the potential user community as reflected in the design specifications.

To conclude then, it has been possible to apply many of the design and development concepts of DSS to the area of compensation planning. Furthermore, the COMPLAN model structure can be seen to reflect user-defined needs. Collectively then, there is evidence to support hypothesis five that a DSS which meets a specified user need, can be developed in the area of compensation planning.

The final phase of the iterative design process within the DSS Development Life Cycle is that of *evaluation*. The prototype compensation planning DSS developed in this research is used as the vehicle for establishing an evaluation methodology relating to the overall effectiveness of the specific DSS.

Hypothesis Six : The effectiveness of the prototype DSS in compensation planning can be guaged through the quantification and analysis of perceived DSS intangible benefits and costs.

Effectiveness, in the context of the summative evaluation approach as discussed in section 7.4, involves establishing the value of a proposed DSS to justify continued expenditure. This entails uncovering the decision maker's perception towards the proposed system. In particular the decision maker's perception to a multiplicity of intangibles which define the value of the proposed system needs to be identified and systemised. The process of benefit evaluation was considered. The methodology proposed in section 7.4 involves the translation of subjective ratings of effectiveness into objective measures. Three aspects were investigated.

- On the assumption that the strength of perceived benefits of a proposed DSS provide a measure of the overall value of the system to the organisation and hence have an influence on its adoption, this study proposed an evaluation methodology. The process initially quantifies the perceived benefits. Thereafter these objective measures are used in a 'go/no-go' decision rule based upon statistical hypothesis testing.

- The initial evaluation approach ignored the implications of the cost of the proposed DSS. To examine its impact, this variable was incorporated into a similar quantification and evaluation process as performed above.

- As an alternative, and maybe more simplistic means of deriving the quantitative measures of benefit utilities, a self-explicated approach is considered. The two sets of measures are compared, initially on an individual basis, thereafter aggregated across all respondents, and finally using homogeneous sub-groups of respondents as identified through cluster analysis.

The conclusions drawn from each of these sub-sections are the following:

(i) Quantification of Benefits using Conjoint Analysis :

The methodology described in section 7.4.2 and illustrated in sections 8.2.2 and 8.2.3 has been shown to provide a quantitative basis for the decision of whether or not to proceed with the proposed specific DSS.

If the calculated test statistic for any specified benefit set - determined by management as a measure of 'value' - is below the critical (threshold) level, this implies that no significant value is perceived in the proposed DSS by the potential DSS users. Consequently, development should cease, or at the very least, a reappraisal of the proposed DSS should be initiated. If, on the other hand, the calculated test statistic exceeds the critical (threshold) level, the perceived value of the proposed DSS is significant. The consequent course of action is to sanction the continued development of the DSS. In the words of Keen (1981:12), "if the expected values exceed the threshold, no further quantification is required .... if they do not, then there must either be a scaling down of the system and a reduction in cost, or a more detailed exploration of benefits".

The strength of the perceived value attached to the proposed DSS can be gauged from the magnitude of the calculated test statistic. A calculated value close to the threshold level indicates a statistically significant, but weak, perceived value. On the other hand, a test value that greatly exceeds the threshold level implies a statistically significant and strong perceived value.

(ii) Cost Impact on Benefit Utilities :

From the analysis presented in section 8.2.4, there is a clear indication that the impact of *cost* as perceived by the potential DSS users is of no significant consequence. The perceived value of a proposed DSS is not significantly deflated by cost considerations.

(iii) Self-explicated Approach to Benefit Utility Generation :

Previous research has demonstrated that in practical applications, statistical and self-stated importances often do not agree (Neslin 1981 : 80). These conclusions appear not to be entirely substantiated from the results presented in section 8.2.5. The two approaches tend to show a moderate to good correlation on average for individual respondents. On an aggregated basis across all respondents the findings are less encouraging. There does however appear to be a moderate improvement in aggregate prediction of the conjoint-derived values using the self-explicated values when homogeneous clusters of respondents are formed.

To summarise,

- a specific quantitative method, namely conjoint measurement, can be employed to quantify perceptions of DSS benefits,

- the derived quantitative measures of perceived benefits can be utilised to establish a decision rule for determining the overall value of a proposed specific DSS,

- the element of *cost* in a proposed specific DSS does not appear to significantly detract from the perceived value of the proposed system,

- an alternative method of deriving benefit utilities, namely a direct self-explicated approach, produces results which have a moderate to good correlation on average with the conjoint measurement approach for individual respondents,

- a regression model designed to predict the conjoint derived benefit utilities from the self-explicated utilities across all respondents shows a significant, but only moderate correlation between the two sets of utilities, and

- the application of the above predictive model to homogeneous clusters of respondents - identified through the use of cluster analysis - shows a moderate improvement in predictive ability over the model using all respondents.

The conclusions drawn from the various sub-sections tend to support hypothesis six which states that the effectiveness of a specific Decision Support System can be gauged through the quantification and analysis of perceived intangible DSS benefits and costs.

Overall, each of the above hypotheses which are sub-objectives of the two primary objectives have been supported by the research findings. It is therefore possible to state that both primary objectives, namely

Objective One : to demonstrate the application of DSS concepts to the area of compensation planning within the field of human resource management; and

Objective Two : to examine and propose an evaluation methodology appropriate for assessing the effectiveness of a proposed specific DSS application in compensation planning,

have been achieved.

9.4 RECOMMENDATIONS FOR FURTHER RESEARCH.

Resulting out of the research, a number of issues can be identified which could provide the basis for further research in these disciplines.

- The survey conducted was exploratory in terms of establishing the incidence of computer-usage within the human resource field of selected South African organisations. It is therefore recommended that a follow up study to the initial survey be conducted. This study could adopt a 'delphi' approach aimed at identifying specific application areas of DSS in human resource management and to establish potential users attitudes towards the introduction of such systems. In addition, the study could be used to further refine the list of intangible benefits used in the evaluation research phase of this study.

- Concerning the specific DSS application in compensation planning, it is recommended that the model be enhanced through the inclusion of an employee benefit component. As indicated in section 6.5, it is suggested that the area of expert systems be investigated as a potential complementary tool to augment the current DSS application. Already the literature on Decision Support Systems is developing the concept of the Expert Decision Support System which represents a merger of the two disciplines.

There are also a number of issues arising out of the study into evaluation methodology of Decision Support Systems that still need to be addressed. They relate primarily to the quantification process of user perceptions. Four issues in particular are identified. They are :

- The data collection process for conjoint measurement should be further investigated to minimise the respondent time and effort required. The ranking of attribute combinations tends to become cumbersome as the number of factors and factor levels increase. Alternative data collection procedures need to be established.

- Given the constraints imposed on the use of the conjoint measurement approach with respect to the data collection procedures, it is appropriate to consider alternative statistical approaches to utility generation. The Analytical Hierarchy Process (AHP) as developed by Saaty (1980) also seeks to quantify user perceptions of attributes and may provide a convenient alternative to the conjoint approach. A possible AHP formulation for establishing the effectiveness of a proposed specific DSS is presented in Figure 9.1.

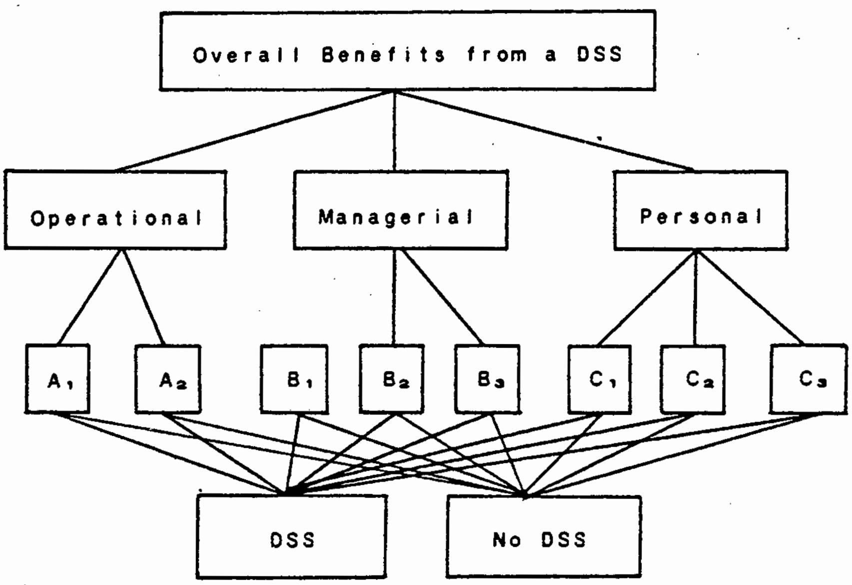
These two hierarchies are merely illustrative to display the form which they could assume (Fatti 1986). By means of pairwise comparisons at all levels within each hierarchy, relative benefits and costs may be obtained for the two options "DSS" and "NO DSS". The data capture procedure could either be performed separately for each of the respondents, and average benefits and costs computed at the end, or alternatively, concensus may be reached amongst the respondents on all pairwise comparisons via, say the Delphi approach. Finally, by computing Benefit/Cost ratios for the two options, it can be established whether the proposed DSS has value.

- Further studies should be conducted on the comparison of utility generation methods. The results obtained from the two methods examined in this study, namely the conjoint approach and the self-explicated approach show moderate consistency. However, refinements and possible hybrid models of existing techniques should be investigated to establish greater consistency of utility results.

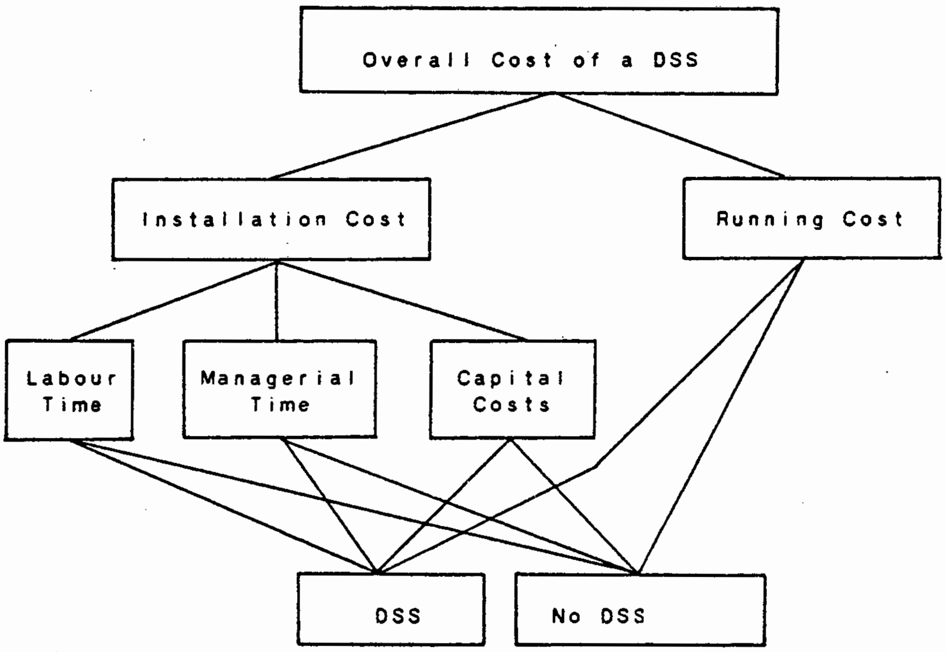
- The issue of the aggregation of individual utilities to form a average utility for a group of individuals who comprise a decision making unit still needs further study. The approach of clustering respondents prior to aggregation as illustrated in section 8.2.5 may provide a solution, but more research is needed to establish the reliability of the approach.

FIGURE 9.1 : Possible Analytical Hierarchy Process Formulation for Establishing DSS Effectiveness.

(a) The Benefits Hierarchy.



(b) The Cost Hierarchy.



9.5 IMPLICATIONS OF RESEARCH.

This research has considered the application of DSS technology to the functional area of human resource management. Arising out of this interface, a number of opportunities present themselves. They relate largely to educational opportunites and a software development opportunity.

Firstly, from the human resource discipline side, it has been established that there is a decided lack of appreciation of the potential value of information technology such as DSS to their functional area. This provides an educational opportunity for professional bodies such as the IPM and academic institutions to include a module on computers and information technology in all formal education and training programmes in the field of human resource management. Such awareness-creation programmes will hopefully contribute to a greater involvement of information technology such as DSS in the decision making processes of human resource specialists. This more professional approach should assist in elevating the discipline, over time, to boardroom status on par with the other functional areas.

Secondly, the emphasis of this particular DSS application is on in-company *planning* in the area of compensation management. The COMPLAN model is intended primarily as a decision support tool to the compensation planner. However, it could equally serve as a training tool as part of a curriculum in manpower management to learn about compensation planning and its implications. Thus it will not only be a planning tool, but a learning instrument as well.

Thirdly, while the more formal DSS summative evaluation methodology proposed in this research should minimise the subjectivity in decision making often associated with investment decisions, the need clearly exists to streamline the capture of data on user perceptions and the translation of such perceptions into measurable utilities. To perform this, it is proposed that an expert DSS be developed. Such a system will have the logical capabilities of an expert system and the modelling capabilities of a DSS. It should be capable of formulating and presenting the benefit combinations to the user; capture the user rankings on these combinations; integrate them with the conjoint technique to generate the utilities; and conduct the inferential analysis. The *go/no go* decision will be the outcome of the expert DSS.

All of the above implications are readily implementable and it is intended to initiate each of them in the near future.

9.6 SUMMARY.

The discipline of Decision Support Systems is continually evolving. While there are still numerous aspects that require further research as indicated in section 9.3, it is envisaged that the research conducted in this dissertation will encourage firstly, further applications of this information technology in the field of human resource management, and secondly, continue the debate on establishing a norm for evaluating proposed specific DSS applications.

REFERENCES

1. Fatti, P. 1986. Discussion at OR Conference. UCT.

2. Keen, P.G.W. March 1981. Value Analysis - Justifying Decision Support Systems. MIS Quarterly. Vol.5(1) : 1 - 14.

3. Meador, C.L., Guyote, M.J., Keen, P.G.W. June 1984. Setting Priorities for DSS Development. MIS Quarterly. Vol. 8(2) : 117 - 129.

4. Neslin, S.A. February 1981. Linking Product Features to Perceptions - Self-Stated Versus Statistically Revealed Importance Weights. Journal of Marketing Research. Volume XVIII : 80 - 86.

5. Saaty, T.L. 1980. The Analytic Hierarchy Process. New York. McGraw-Hill.

BIBLIOGRAPHY

Ahituv, N., Neumann, S. 1986. Principles of Information Systems for Management. Second Edition. Iowa. W Brown.

Alavi, M. December 1982. An Assessment of the Concept of Decision Support Systems as viewed by Senior-Level Executives. MIS Quarterly. Vol. 6(4) : 1 - 9.

Alter, S.L. 1980. Decision Support Systems : Current Practice and Continuing Challenge. Massachusetts. Addison-Wesley.

Anthony, R.N. 1965. Planning and Control Systems : A Framework for Analysis. Cambridge. Mass. Harvard Graduate School of Business.

Ball, L., Harris, R. March 1982. SMIS Members : A Membership Analysis. MIS Quarterly. Vol. 6(1) : 30.

Belcher, D.W. 1974. Compensation Administration. USA. Prentice Hall.

Benjamin, R.I. June 1982. Information Technology in the 1990's : A Long Range Planning Scenario. MIS Quarterly. Vol. 6(2) : 18 - 19.

Bennett, J.L. (Editor). 1983. Building Decision Support Systems. Massachusetts. Addison-Wesley.

Bennett, J.L. 1977. User-oriented Graphics Systems for Decision Support in Unstructured Tasks. User-oriented Design of Interactive Graphics Systems. Treu, S. (Editor) New York. Association for Computing Machinery : 3 - 11.

Bennett, J.L. 1983. Overview. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 1.

Blanning, R.W. October 1983. What is Happening in DSS ? INTERFACES. Vol. 13(5) : 71 - 80.

Blanning, R.W. 1984a. Expert Systems for Management : Possible Application Areas. DSS-84 Transactions. Zmud, R.W. (Editor). North Carolina. Chapel Hill.

Blanning, R.W. 1984b. Knowledge Acquisition and System Validation in Expert Systems for Management. Human Systems Management. Vol. 4 : 280 - 285.

BMDP Statistical Software. 1983. University of California Press.

Boczany, W.J. July 1983. Justifying Office Automation. Journal of Systems Management. Vol. 34(7) : 15 - 19.

Bonczek, R.H., Holsapple, C.W., Whinston, A.B. 1984. Developments in Decision Support Systems. Advances in Computers. Vol. 23 : 141 - 175.

Burgess, L.R. 1984. Wage and Salary Administration - Pay and and Benefits. USA. Charles E Merrill.

Butler Cox Foundation. September 1983. Expert Systems. Report Series No. 37.

Carlson, E.D. 1983. An Approach for Designing Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 2.

Carter, M.F., Shapiro, K.P. 1984. Benefits as Part of Total Remuneration. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). USA. McGraw-Hill. Chapter 44.

Cattin, P., Wittink, D.R. Summer 1982. Commercial Use of Conjoint Analysis. Journal of Marketing. Vol. 46(3) : 44 - 53.

Christy, D.P., Watson, H.J. October 1983. The Application of Simulation : A Survey of Industry Practice. INTERFACES Vol. 13(5) : 47 - 52.

Churchill,Jr. G.A. 1979. Marketing Research - Methodological Foundations. Second Edition. Illinois. The Dryden Press.

Curley, K.F. July / August 1984. Are There Any Real Benefits from Office Automation? Business Horizons. Vol. 27(4) : 37 - 42.

Davis, G.B. 1974. Management Information Systems : Conceptual Foundations, Structure and Development. New York. McGraw-Hill.

Davis, G.B., Olson, M. 1984. Management Information Systems : Conceptual Foundations. Second Edition. New York. McGraw-Hill.

Davis, J.H., Wyatt, L.L., Rosenfeld, J.M. 1984. Supporting Business Strategy with Human Resource Inventory. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). New York. McGraw-Hill. Chapter 59.

Davis, J.H. 1984. Keeping the Compensation Program Up to Date. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). New York. McGraw-Hill. Chapter 56.

DeSanctis, G. March 1986. Human Resource Information Systems : A Current Assessment. MIS Quarterly. Vol. 10(1) : 15 - 27.

Dickson, G.W., Leitheiser, R.L., Wetherbe, J.C., Nechis, M. September 1984. Key Information Systems Issues for the 1980's. MIS Quarterly. Vol. 8(3) : 135 - 160.

Dunn, J.D., Rachel, F.M. 1971. Wage and Salary Administration : Total Compensation Systems. New York. McGraw-Hill.

Duursema, W. November 1984. Should You Computerise the Personnel Function ? Manpower Journal. Vol. 3(7) : 16.

Dyer, J.S., Mulvey, J.M. 1983. Integrating Optimization Models with Information Systems for Decision Support. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 5.

Dyer, L., Schwab, D.P., Fossum, J.A. 1978. Impacts of Pay on Employee Behaviors and Attitudes : an update. Perspectives on Personnel/Human Resource Management. Heneman III, H.G., Schwab, D.P. (Editors). USA. Richard D Irwin. 234 - 241.

Ellig, B.R. 1982. Executive Compensation : A Total Pay Perspective. New York. McGraw-Hill.

Feigenbaum, E.A., McCorduck, P. 1984. The Fifth Generation - Artificial Intelligence and Japan's Computer Challenge to the World. London. Pan Books.

Financial Mail. February 15 1985 : 36-37; 40 - 41.

Fitz-Enz, J. May 1982. Quantifying Personnel. IPM Manpower Journal. Vol. 1(1) : 6 - 14.

Ghandforoush, P. June 1982. Model for Mini Computer Selection. Journal of Systems Management. Vol. 33(6) : 11 - 13.

Ginter, P.M., Rucks, A.C. June 1984. Strategic Models and Simulation : An Emerging Decision-Making Aid. Journal of Systems Management. 12-16.

Glueck, W.F. 1976. Business Policy : Strategy Formation and Management Action. Second Edition. Tokya. McGraw-Hill Kogakusha Ltd.

Glueck, W.F. 1979. Foundations of Personnel. USA. Business Publications Inc.

Goldberg, S.M., Green, P.E., Wind, Y. 1984. Conjoint Analysis of Price Premiums for Hotel Amenities. Journal of Business. Vol. 57(1) : S111 - S138.

Gorry, G.A., Krumland, R.B. 1983. Artificial Intelligence Research and Decision Support Systems. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 9.

Gorry, G.A., Scott Morton, M.S. Fall 1971. A Framework for MIS. Sloan Management Review. Vol. 13(1) : 55 - 70.

Gramlich, E.M., 1981. Benefit-Cost Analysis of Government Programs. New Jersey. Prentice-Hall.

Green, P.E., DeSarbo, W.S. June 1978. Additive Decomposition of Perceptions Data via Conjoint Analysis. Journal of Consumer Research. Vol. 5 : 58 - 65.

Green, P.E., Tull, D.S. 1978. Research for Marketing Decisions. Fourth Edition. New Jersey. Prentice-Hall.

Greene, R.J., Roberts, R.G. May 1983. Strategic Integration of Compensation and Benefits. Personnel Administrator. 79 - 82.

Guttentag, M., Streuning, E.L. (Editors) 1975. Handbook of Evaluation Research. Volume 1. California. Sage.

Hackett, P. 1979. Success in Management and Personnel. London. John Murray Publishers Ltd.

Hamner, W.C. 1974. Reinforcement Theory and Contingency Management in Organisational Settings. Organisational Behavior : A Contingency Approach. Tosi, H., Hamner, W.C. (Editors). USA. St Claire Press.

Hamilton, S., Chervany, N.L. September 1981. Evaluating Information Systems Effectiveness - Part 1 : Comparing Evaluation Approaches. MIS Quarterly. Vol. 15(3): 55 - 69.

Harrison, E.F. 1981. The Managerial Decision Making Process. Second Edition. USA. Houghton Mifflin.

Harrison, W., Magel, K., Kluczny, R. July 1983. Research in Software Maintenance. Journal of Systems Management Vol. 34(7) : 10 - 14.

Henderson, R.I. 1979. Compensation Management - Rewarding Performance. Third Edition. Virginia. Reston.

Henderson, R.I., Chandler, J.T. 1984. Compensation Programs for Public Employees. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). New York. McGraw-Hill : Chapter 54.

Hersey, P., Blanchard, K.H. 1982. Management of Organisational Behavior - Utilising Human Resources. New York. Prentice-Hall.

Hennessey, H,W, Jr. 1979. Computer Applications in Human Resource Information Systems. Human Resource Planning. Vol. 2(4) : 205 - 213.

Hogue, J.T., Watson, H.J. June 1983. Management's Role in the Approval and Administration of Decision Support Systems. MIS Quarterly. Vol. 7(2) : 15 - 26.

Holbrook, M.B. February 1981. Integrating Compositional and Decompositional Analyses to Represent the Intervening Role of Perceptions in Evaluative Judgements. Journal of Marketing Research. Vol XVIII : 13 - 28.

Hollerbach, R.E. 1984. Determining Wage and Salary Policy. Handbook of Wage and Salary Administration. Rock, M.L. (Editor) : USA. McGraw-Hill. Chapter 16.

Huff, S.L., Rivard, S., Grindlay, A., Suttie, I.P. 1984. An Empirical Study of Decision Support Systems. INFORS. Vol. 22(1) : 21 - 39.

Hurst, E.G. Jr., Ness, G.N., Gambino, T.J., Johnson, T.H. 1983. Growing DSS : A Flexible Evolutionary Approach. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 6.

Information Science Incorporated. Circular. Montvale, New Jersey, 15 September 1982.

Ivy, T. 1982. Personnel Computer Systems. London. MacGraw-Hill.

Iwanski, A.A.R. 1985. The Changing Scene in South Africa Today. IPM Journal. Vol. 14 : 10 - 11.

Jackson, B.B. 1983. Multivariate Data Analysis : An Introduction. Illinois. R D Irwin.

Johnson, R.M. May 1974. Trade-Off Analysis of Consumer Values. Journal of Marketing Research. Vol. XI : 121 - 127.

Kantor, J. 1977. Management-Orientated Management Information Systems. Second Edition. New Jersey. Prentice-Hall.

Keen, P.G.W. June 1986. Decision Support Systems : The Next Decade. IFIP WG 8.3 Working Conference on Decision Support Systems : A Decade in Perspective. Noordwijkhout, The Netherlands.

Keen, P.G.W., Gambino, T.J. 1983. Building a Decision Support System : The Mythical Man-Month Revisted. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 7.

Keen, P.G.W., Scott-Morton, M.S. 1978. Decision Support Systems: An Organisational Perspective. Massachusetts. Addison-Wesley.

Keen, P.G.W., March 1981. Value Analysis : Justifying Decision Support Systems. MIS Quarterly. Vol. 5(1) : 1 - 15.

Keen, P.G.W., Wagner, G.R. November 1979. DSS - An Executive Mind Support System. MIS Quarterly. Vol. 3(4) : 117 - 122.

Kelley, E.J., Lazer, W. 1973. Social Marketing - Perspectives and Viewpoints. USA. R.D. Irwin.

Klatt, L.A., Murdick, R.G., Schuster, F.E. 1985. Human Resource Management. USA. Charles E Merrill.

Kleijnen, J.P.C. 1980. Computers and Profits : Quantifying Financial Benefits of Information. Philippines. Addison-Wesley.

Lawler III, E.E. 1978. New Approaches to Pay : Innovations that Work. Perspectives on Personnel/Human Resource Management. Heneman III, H.G., Schwab, D.P. (Editors). USA. Richard D Irwin. 226 - 234.

Lawler III, E.E. 1981. Pay and Organisation Effectiveness. Massachusetts. Addison-Wesley.

Litecky, C.R. February 1981. Intangibles in Cost/Benefit Analysis. Journal of Systems Management. Vol. 32(2) : 15 - 17.

Linstone, H.A., Turoff, M. (Editors) 1975. The Delphi Method : Techniques and Applications. Massachusetts. Addison-Wesley.

Mahoney, T.A. 1979. Compensation and Reward Perspectives Homewood Illinois. Richard D Irwin.

Mahoney, T.A. 1982. Compensation for Work. Personnel Management. Rowland, K., Ferris, G. (Editors). USA. Allyn and Bacon. Chapter 9 : 227 - 262.

Manning, K. March 1983. The Rise and Fall of Personnel. Management Today : 74 - 77.

Martin, J. 1985. Fourth Generation Languages Volume 1 : Principles. New Jersey. Prentice-Hall.

Mathys, N., LaVan, H. 1982. A Survey of the Human Resource Information Systems (HRIS) of Major Companies. Human Resource Planning. Vol. 5(2) : 83-90.

McCosh, A.M., Rahman, M., Earl, M.J. 1981. Developing Managerial Information Systems. Hong Kong. MacMillan.

McCosh, A.M., Scott Morton, M.S. 1978. Management Decision Support Systems. London. MacMillan.

MDSX Statistical Software. 1984.

Meador, C.L., Guyote, M.J., Keen, P.G.W. June 1984. Setting Priorities for DSS Development. MIS Quarterly. Vol. 8(2) : 117 - 129.

Melone, P., Wharton, T.J. February 1984. Strategies for MIS Project Selection. Journal of Systems Management. Vol. 35(2) : 26 - 33.

Meyer, H.H. Winter 1975. The Pay-for-Performance Dilema. Organisational Dynamics. : 71 - 78.

Milkovich, G.T., Newman, J.M. 1984. Compensation. Texas. Business Publications Inc.

Mitchell, T.R. 1978. People in Organisations : Understanding their Behavior. New York. McGraw-Hill.

Moore, J.H., Chang, M.G. 1983. Meta-Design Considerations in Building DSS. Building Decision Support Systems. Bennett, J.L. (Editor). Massachusetts. Addison-Wesley. Chapter 8.

Morell, J.A. 1979. Program Evaluation in Social Research New York. Pergamon.

Munro, M.C., Davis, G.B. 1977. Determining Management Information Needs : A Comparison of Methods. MIS Quarterly. Vol. 1 : 55 - 67.

Nash, A.N., Carroll Jr, S.J. 1975. The Management of Compensation. USA. Brooks and Cole Publishers.

Naylor, T.H. 1979. Corporate Planning Models. Massachusetts. Addison-Wesley.

Naylor, T.H. 1982. Decision Support Systems or Whatever Happened to MIS. INTERFACES. Vol. 12(4) : 92 - 94.

Naylor, T.H. January - February 1982. Effective Use of Strategic Planning, Forecasting, and Modeling in the Executive Suite. Managerial Planning.

Negoita, C.V. 1984. Management Applications of Expert Systems. Human Systems Management. Vol.4 : 275 - 279.

Neslin, S.A. February 1981. Linking Product Features to Perceptions - Self-Stated Versus Statistically Revealed Importance Weights. Journal of Marketing Research. Vol XVIII : 80 - 86.

Neumann, S., Segev, E. 1979. A Case Study of User Evaluation of Information Characteristics for System Improvement. Information and Management. Vol. 2 : 271 - 278.

O'Brien, J.A. 1979. Computers in Business Management : An Introduction. Revised Edition. Illinois. Richard D Irwin.

O'Brien, J.A. 1985. Computers in Business Management : An Introduction. Fourth Edition. Illinois. Richard D Irwin.

Opsahl, R.L., Dunnette, M.D. 1966. The Role of Financial Compensation in Industrial Motivation. Motivation and Management. Vroom, V.H., Deci, E.L. (Editors). U.K. Penguin Education. 127 - 159.

Oxenfeldt, A.R. 1979. Cost-Benefit Analysis for Executive Decision Making. AMACOM. American Management Association.

Parker, M.M. 1982. Enterprise information analysis : Cost-benefit analysis and the data-managed system. IBM Systems Journal. Vol. 21(1) : 108 - 121.

Patton, M.Q. 1978. Utilisation-Focused Evaluation. California. Sage.

Patton, M.Q. 1980. Qualitative Evaluation Methods. California. Sage.

Radford, K.J. 1978. Information Systems for Strategic Decisions. Virginia. Reston.

Richards-Carpenter, C. May 1982. Computers in Personnel - New Needs, New Methods, New Opportunities. Personnel Management. Vol. 14(5) : 26 - 30.

Russ, H.L. May/June 1984. Information Technology 2 : Using Personal Computers to Increase the Productivity of Compensation Specialists. Personnel. Vol. 61(3) : 28-33.

Saaty, T.L. 1980. The Analytic Hierarchy Process. New York. McGraw-Hill.

Sanzatto, D. 1977. Motivational Theories and Applications for Managers. USA. AMACOM.

Schuler, R.S. 1981. Personnel and Human Resource Management. USA. West Publishing Company.

Shim, J.K., McGlade, R. October 1984. The Use of Corporate Planning Models : Past, Present and Future. Journal of the Operational Research Society. Vol. 35(10) : 885 - 894.

Sibson, R.E. 1974. Compensation. USA. AMACOM.

Siegel, S. 1956. Nonparamteric Statistics for the Behavioral Sciences. Kogakusha. McGraw-Hill.

Simon, H.A. 1960. The New Science of Management Decision. New York. Harper & Row.

Simon, H.A. 1980. Cognitive Science : The newest Science of the Artificial. Cognitive Science. Vol. 4 : 33 - 46.

Smith, I. 1984. The Management of Remuneration - Paying for Effectiveness. London. Gower.

Smith, R.D. September 1983. Measuring the Intangible Benefits of Computer-based Information Systems. Journal of Systems Management. Vol. 34(9) : 22 - 27.

Social Sciences Citation Index. 1984.

Sprague, R.H. Jr., Carlson, E.D. 1982. Building Effective Decision Support Systems. New Jersey. Prentice-Hall.

Stabell, C.B. 1983. A Decision-Oriented Approach to Building DSS. Building Decision Support Systems. Bennet, J.L.(Editor). USA. Addison-Wesley. Chapter 10.

Statistical Economic Review in Connection with the 1985/86 Budget WPB/85.

Steiner, G.A., Miner, J.B. 1986. Management Strategy and Policy. Third Edition. New York. MacMillan.

Thierauf, R.J. 1982. Decision Support Systems for Effective Planning and Control : A Case Study Approach. New Jersey. Prentice-Hall.

Thompson, Jr. A.A., Stickland III, A.J. 1984. Strategic Management : Concepts and Cases. Third Edition. Texas. Business Publications Inc.

Tromp, D. 1980. 'n Bedryfsielkundige Ondersoek na die Vergoeding van Bestuurlui in 'n Geselekteerde Groep Suid-Afrikaanse Ondernemings. Doctoral Dissertation. University of Stellenbosch.

Tromp, D., Wegner, T. February 1985. The Computer's Role in Personnel Management with specific reference to Compensation Planning. Occasional Paper 9. Stellenbosch University Business School.

Tull, D.S., Hawkins, D.I. 1976. Marketing Research : Meaning Measurement and Method. New York. MacMillan.

Vaid-Raizada, V.K. November 1983. Incorporation of Intangibles in Computer Selection Decisions. Journal of Systems Management. Vol. 34(11) : 30 - 36.

Vazsonyi, A. November 1978. Decision Support Systems : The New Technology of Decision Making ? INTERFACES. Vol. 9(1) : 72 - 77.

Vazsonyi, A. February 1982. Decision Support Systems, Computer Literacy, and Electronic Models. INTERFACES. Vol. 12(1) : 74 - 78.

Vroom, V.H. 1964. Work and Motivation. New York. John Wiley and Sons.

Wagner, G.R. April 1981. Decision Support Systems : The Real Substance. INTERFACES. Vol. 11(2) : 77 - 86.

Walker, J.W. 1980. Human Resource Planning. New York. McGraw-Hill.

Watson, H.J., Hill, M.M. October 1983. Decision Support Systems or What Didn't Happen with MIS. INTERFACES. Vol. 13(5) : 81 - 88.

Weiss, C.H. 1972. Evaluation Research - Methods of Assessing Program Effectiveness. New Jersey. Prentice-Hall.

Whittington, G.P. 1984. Establishing the Exempt and Management Pay Structure. Handbook of Wage and Salary Administration. Rock M L (Editor-in-Chief) Second Edition. New York. McGraw-Hill. Chapter 19.

Wille, E., Hammond, V. 1981. The Computer in Personnel Work. London. Institute of Personnel Management.

Wolf, G., Leo, M. February 1980. A Systems Approach to Total Compensation. Business Management/Executive Compensation Report. Vol. 37(5) : 46 - 48.

Wolf, M.G. 1984. Solving Technical Problems in Establishing the Pay Structure. Handbook of Wage and Salary Administration. Rock, M.L. (Editor). New York. McGraw-Hill. Chapter 20.

APPENDIX 1

QUESTIONNAIRE ON COMPUTERS IN HUMAN RESOURCE MANAGEMENT

UNIVERSITY OF CAPE TOWN

DEPARTMENT OF BUSINESS SCIENCE

questionnaire

INFORMATION

1 The numbered blocks are for office use only.

2 The questionnaire has three sections :

Section 1 gathers demographic information,
Section 2 gathers data on the use of computers in Personnel, and
Section 3 requests data on your compensation structure.

3 Each section may be completed by a different person if necessary.

4 Please return the completed questionnaire in the enclosed postage paid envelop,

5 If your company would like a copy of the report, please return the attached slip either under separate cover if you wish your responses to remain anonymous, or with your completed questionnaire.

6 Omit questions you cannot/do not wish to answer.

SECTION 1 COMPANY DEMOGRAPHICS

Q 1 Indicate with a tick in the appropriate block the approximate number of employees in your company.

5

Less than 1000		5001 - 8000	
1001 - 3000		8001 - 10000	
3001 - 5000		More than 10000	

Q 2 To which economic sector does your company belong? (Use preferably the J.S.E. classification, e.g. Mining, Transport, etc.)

6

Q 3 What percentage approximately , of your company's total personnel activities in terms of manpower and time is devoted to each of the following two activities? (ensure the percentages sum to 100%)

8

Management and Planning of Human Resources	%	+	Administrative activities	%	=	100%

2

SECTION 2 COMPUTER USAGE IN PERSONNEL

12

Q 4 Does your company own or have access to a computer? | YES | | NO | |

***** If "NO", please go to section 3 and continue. *****

Q 5 Is the computer used to perform any Personnel-related activities? 13

YES		NO, but plan to in next 2 years	
NO, but plan to in next 5 years		NO PLANS for the future	

***** If you answered "YES", proceed to question 7. Otherwise complete question 6 only, then go to section 3 and continue. *****

Q 6 If no personnel activities are currently computerised, is it because: 14

there is no commitment from top management	
there are too few employees to warrant computerisation	
the costs will exceed potential benefits	
expertise is not available in personnel systems	
Other (specify)	

Q 7 Indicate by means of a tick in the appropriate block, the phrases which most closely describe the extent of present computerisation of personnel activities.

* Also indicate (by a tick in the "would like" column) which activities the personnel dept. would like to see computerised.

	Extent of Present Usage			Would like	18
	Not at all	Partly	Consider-able		
1 Administrative:					
- Basic Payroll Processing (cheques)					
- Employee Records : Data capture					
* demographics (name, age, adress, marital status,sex, etc)					
* job related (title, salary,time in job,grade,pension,med. aid)					
* qualifications (academic,skills, experience,courses completed)					
* job performance (merit awards, promotability ratings, training needs identified,etc)					
* labour relations (discipline, grievance data, etc)					

3

	Extent of Present Usage			Would like	26
	Not at all	Partly	Considerable		
2 Reporting Systems:					
- age analysis reports					
- salary analysis reports					
- labour costing/budgeting reports					
- salary survey reports					
- labour turnover analysis reports					
- skills inventory and analysis reports					
- merit award identification reports					
- promotion potential reports					
- managerial potential identific. report					
- training needs identification reports					
- labour grievance analysis reports					
- Other					
3 Planning Systems:					
- manpower planning models					
- compensation planning models					
- career path planning models					
- organisation charting models					
- succession planning models					
- Other					

Q 8 What benefits, if any, have you derived from computerisation in Personnel. More than one benefit may be ticked.

46

No significant improvements have resulted		
Clerical savings		
Smoother administration		
Improved timeliness of reports		
More accurate information		
Better control over personnel activities		
Improved planning in personnel activities		
Facilitates easier decision making		
More time for managerial/planning activities		
Other		

55

4

SECTION 3 COMPENSATION MANAGEMENT

Q 9 What percentage approximately, does your salary and wages bill constitute of your company's total annual operating costs?

5

Less than 10%		11 - 30%		31 - 50%	
51 - 70%		71 - 90%		More than 90%	

Q 10 What is the approximate percentage of total remuneration contributed by fringe benefits for each of the employee categories below?

6 7

Unskilled	%	Professional	%
Clerical/ skilled	%	Managerial	%

Q 11 How many separate pay curves (structures) do you have in your company? (E.g. Do you have different curves for different regions, etc.?)

14

1		2		3		4		More than 4	

Q 12 Which one job evaluation system is used for most of the jobs?

15

Peromnes		Paterson		Another point system	
N I P R		Hay		Any other system	

Q 13 Does your company participate in any country-wide salary/wage surveys?

16

YES		NO	

Q 14 If "YES" (to ques. 13), name two of the most used surveys in your company.

17

1.
2.

NOTE: Questions 15 to 21 refer to the design aspects of your pay structure. If more than one structure exists (refer question 11), use your dominant structure as your reference in answering these questions.

18

Q 15 How many job grades are used in your pay structure design?

Q 16 Tick the method used for computing the pay scale ranges, and fill in the missing values for the option chosen.

20

tick	
	a fixed percentage of ....% above and below the midpoint
	for the lowest job grade a percentage of ......% is used, which is increased by ......% per job grade
	Other ....

30

Q 17 Do the pay scales overlap? YES NO

31

Q 18 If "YES" to ques. 17, complete the appropriate sentence below, else proceed to question 19.

tick	
	the overlap is a fixed percentage of ......% across all grades
	the overlap varies from ......% to ......% across job grades

37

Q 19 In setting your pay levels, which sources of data listed below are consulted? (More than one source may be ticked)

Salary Surveys		Wage Determination Acts	
Union Agreements		Breadline Studies (PDL, MSL, etc)	
Other		Other	

Q 20 How often is any element in your company's salary structure reviewed?

43

more than once per yr		more than 3 yearly	
annually		only when pressures dictate	
every 2 - 3 years		never	

6

44

Q 21 Which of the following factors have caused a review of your salary structure(s) over the past few years? (More than one may be ticked)

Inflation		Salary survey reports	
Union pressures/ agreements		Internal review through job evaluation	
Labour market forces		Government Legislation	
Other		Other	

50

Q 22 Is the computer used in any way in the design and/or review process of your company's compensation structure?

YES		NO	

51

Q 23 If "YES" to question 22, briefly outline its role.

Q 24 Read the following quotation and indicate your personal response with a tick below.

"Rapid and often unstructured growth in organisations as well as labour pressures frequently result in pay decisions being made on an ad hoc basis with little idea of the longer term financial implications nor internal consistency. Consequently discrepancies tend to creep into the salary structure, resulting in frequent dissatisfaction, and persistent demands for salary increases, and greater parity".

52

strongly disagree		disagree		agree		strongly agree	

Q 25 Which of the following functions would you like to see a computer perform in assisting in the design and review of a salary structure. (More than one may be ticked)

53

I believe the computer cannot assist in any way	
Use the computer to cost out a proposed structure	
Use the computer to produce a visual diagram of a proposed structure to examine its suitability	
Use the computer to visually produce a structure (as above), but have the facility to alter inputs at a screen to examine alternative structures	
Use the computer to produce distributions of pay	
Other	

58

THANK YOU FOR YOUR COOPERATION.

APPENDIX 2

INSTRUCTIONS TO USE COMPLAN

COMPLAN USER INSTRUCTIONS

PURPOSE :

COMPLAN is a Decision Support System designed to assist compensation planners in formulating an appropriate compensation structure for their organisation.

DEMONSTRATION COPY LIMITATIONS :

Since both programmes and database reside on a single disk, there is a limitation on the size of problem that the demonstration version can accommodate.

The demonstration version is limited to a database with a maximum of 1500 employee records and 16 job grades.

HARDWARE REQUIREMENTS :

COMPLAN requires an color monitor with at least 256K of memory. A hard disk facility would be preferable in a commercial environment. COMPLAN can be run on either an IBM or a SPERRY microcomputer system.

SOFTWARE ENVIRONMENT :

COMPLAN is written in BASIC on a SPERRY PC. It has been compiled using QUICKBASIC (version 2.0) with a DOS (version 2.11) Operating System.

To Execute COMPLAN :

1. Insert COMPLAN Diskette in Drive A

2. Switch on System (COMPLAN is self-booting)

USER INSTRUCTIONS :

1. Follow screen instructions.
2. Refer to Chapter 6 for the COMPLAN logic and illustrative output.
3. The BACKPAGE FACILITY can be envoked at any screen by pressing the <F1> key.
4. A HARDCOPY OUTPUT of any screen can be obtained by pressing the <Shift> and <PrtSc> keys simultaneously.
5. Two demonstration databases are available :

   a] BRASS consists of 120 employees in 13 job grades

   b] WOOL consists of 1290 employees in 10 job grades.

   Employee Codes :

BRASS	:-	1001	to	1120
WOOL	:	0001	to	1290

APPENDIX 3

QUESTIONNAIRE FOR FORMATIVE EVALUATION STUDY

QUESTIONNAIRE

EVALUATION OF THE COMPLAN SYSTEM FEATURES.

Recall the Compensation Planning Decision Support System demonstrated to you earlier. The questions contained in this questionnaire relate both to the user-friendliness of the COMPLAN Model and to the nature of the information produced by the Model.

Please answer each question by placing a cross (X) in the relevant block. Also, please provide critical comments where requested.

SCREEN DISPLAYS:

1. Rate the CLARITY of the Model MENUS and PROMPTS. (i.e. Is their meaning clear ? Are Instructions easy to follow ?)

Very Poor Fair Excellent

1	2	3	4	5

2. Rate the EASE of USE of the DATA CAPTURING facility. (i.e. how did you find the Model's ability to create the Parameter Data set ?)

Vey Poor Fair Excellent

1	2	3	4	5

3. Rate the EASE of USE of the EDITING facilities. (i.e. How did you find the Model's ability to CHANGE any of the parameter or salary file values ?)

Very Poor Fair Excellent

1	2	3	4	5

page 2

4. Rate the RESPONSE TIME of the Model.
(i.e. the waiting time between your command and the Model's response)

Very Poor | Fair | Excellent

1	2	3	4	5

5. Rate the CONSISTENCY of the Menu and Prompt FORMATS.
(i.e. how well does the Model use standard patterns in menu selection and prompting the user ?)

Very Poor | Fair | Excellent

1	2	3	4	5

6. Rate the USE of COLOUR texts to highlight various options, menus and prompts.

Very Poor | Fair | Excellent

1	2	3	4	5

7. Any COMMENTS on the SCREEN DISPLAYS ? ______________________

____

____

____

<u>THE MODEL OUTPUT:</u>

8. Rate the OVERALL USEFULNESS of the INFORMATION produced by the Compensation Planning Model.

Very Poor | Fair | Excellent

1	2	3	4	5

9. Rate the INFORMATION produced in the "COST ANALYSIS" and "EMPLOYEE DISTRIBUTION" tables using the following criteria :

a. the AMOUNT of information provided COMPARED to currently available information.

Much less	Marginally less	The Same	Marginally more	Much more

b. the RELEVANCE of the information in Compensation Planning.

None relevant	Some relevant	Most relevant	All relevant

c. the COMPLETENESS of the information for Compensation Planning.

Poor - lacks essential information and contains redundant information.	
Fair - contains most of the essential information	
Good - contains all the essential information	
Very Good - contains all basic essential information AND additional interesting information	
Excellent - contains all basic essential information AND new essential information not readily available formerly.	
Other : (please comment here if your view is not adequately represented by any of the above)	

____

____

____

____

page 4

10. What ADDITIONAL information related to COSTS and EMPLOYEE distributions would you like to see produced ?

None - the information produced is adequate ☐

Additional Information ☐

If Additional Information, please specify : ____________

11. What Information contained in the tables is REDUNDANT ?

None - it is all of value ☐

Certain Information Not Required ☐

If not required, please identify the redundant information :

12. Rate the GRAPHIC DISPLAYS of the salary structures and employee distributions in the Model.

Very Poor		Fair		Excellent
1	2	3	4	5
☐	☐	☐	☐	☐

13. Rate the NECESSITY for these GRAPHS.

Completely Unnecessary - can be removed ☐

Unnecessary - nice to have, but not essential ☐

Necessary - they complement the tables ☐

Completely necessary - promote rapid identification of the problem and facilitate finding solutions ☐

Other response not mentioned above (specify) : ____

14. Do you wish to see ADDITIONAL GRAPHS ?

YES ☐ NO ☐

If NO, please specify a reason : ______________________
____
____
____

If YES, indicate the type of GRAPHS desired : __________
____
____
____

OVERALL DESIGN FEATURES:

15. Rate the FLEXIBILITY of the Model to cope with a variety of actual of situations.

Very Poor | Fair | Excellent

1	2	3	4	5

16. Rate the clarity of the MODEL LOGIC. (i.e. how well does the sequence of the Model follow the natural decision making process in Compensation Planning ?)

Very Poor | Fair | Excellent

1	2	3	4	5

17. Is the Model sufficiently USER-FRIENDLY ?

YES ☐ NO ☐

If NO, indicate what can be done to improve its user-friendliness : ______________________
____
____
____

page 6

18. What FEATURES do you LIKE about the Model ?

None	Some	All

Please elaborate : ____________________

____

____

____

19. What FEATURES do you DISLIKE in the Model ?

None	Some	All

Please elaborate : ____________________

____

____

____

20. What ADDITIONAL FEATURES would you LIKE TO SEE in the Model ?

None - it is sufficiently comprehensive ☐

Other Features ☐

If Other Features requested, please specify : __________

____

____

____

21. What ADVANTAGES, if any, do you feel the COMPLAN Model has over current Compensation Planning practices ?

Please elaborate : ____________________

____

____

____

22. What FEATURES would you like to see REMOVED from the Model ?

None - all facilities are desired	☐
Features Removed	☐

If Features to be removed , please specify : ____________

____

____

____

____

23. What DIFFICULTIES, if any, do you foresee with the INTRODUCTION of such a Decision Support System such as COMPLAN into the BUSINESS environment ?
(e.g. End user resistance, lack of support from Computer Personnel, etc.)

Please specify : ____________________________

____

____

____

24. Rate how well you feel the Model ACHIEVES its OBJECTIVE as a DECISION SUPPORT TOOL.

Not at All		Fair		Extremely Well
1	2	3	4	5
☐	☐	☐	☐	☐

page 8

25. If you were to allocate 100 % amongst a number of potential benefits derived from using a Compensation Planning Model, HOW would you DISTRIBUTE the total ? Consider the following list.

Potential clerical time and labour savings	
Improved utilisation of management time	
Improved management decision making capabilities	
Promotes clearer appreciation and understanding of the problem	
Promotes better utilisation of data	
Improves Planning and Control	
Permits deeper and wider exploration of alternatives	
Improves communication between managers	
	100 %

26. How do you see the Information produced by the Compensation Planning Model being USED in the Organisation ?

To be used within the Personnel department only by the Compensation Planner	
By the Personnel Director as submission to the Board in support of proposed Compensation policies	
Both	
None of the above	
Other (specify) : ____________________	

____

____

27. Assume you are responsible for the Compensation Management function in your Organisation. How OFTEN would you use a Compensation Planning Model such as COMPLAN during a compensation review exercise ?

Never	☐
Seldom	☐
Occasionally	☐
Often, but not always	☐
Always	☐

Reason for choice : ____________________

____

____

____

28. Under what CIRCUMSTANCES would you USE a Compensation Planning Model such as COMPLAN ?

____

____

____

____

29. Under what CIRCUMSTANCES would you NOT USE a Compensation Planning Model such as COMPLAN?

____

____

____

____

Thank you for your cooperation.

APPENDIX 4

QUESTIONNAIRE FOR BENEFIT SEGMENTATION STUDY

BENEFIT SEGMENTATION STUDY

QUESTIONNAIRE

I would very much like to obtain your views on the classification of potential benefits which can arise from the use of a computer-based Decision Support System - such as a Manpower Planning Model, or a Compensation Planning Model in the Human Resource Planning Function.

FIRSTLY, I would like you to carefully read through the list of 8 potential benefits which have been identified through both a literature and empirical study.

The BENEFITS are :

A - Potential clerical time and labour savings.

B - Improves utilisation of management time.

C - Improves management decision making capabilities.

D - Promotes clearer appreciation / understanding of the problem.

E - Promotes better utilisation of data.

F - Improves planning and control.

G - Permits deeper and wider expolration of alternatives.

H - Improves communication between managers.

SECONDLY, carefully read the 3 SCENARIOS presented below. Each scenario describes in broad terms an area of impact of the potential benefits.

The SCENARIOS are :

SCENARIO 1 : Personal Development of the Individual DSS User.

SCENARIO 2 : Overall Organisational Advancement.

SCENARIO 3 : Operating Level Efficiencies.

NOW, what I would like you to do is the following :

Consider each BENEFIT in turn. Then, by placing a CROSS in the appropriate block in the table below, grade each benefit on the 1 to 7 scale accordong to how closely you believe the benefit can be associated with each given scenario.

For EXAMPLE, if you feel benefit A is best associated with Scenario One, and is rather inappropriate in describing the other two scenarios, then respond as follows :

SCENARIO

	ONE							TWO							THREE						
Benefit	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A							X	X								X					

where the scale reads as follows :

most inappropriate			unsure			most appropriate
1	2	3	4	5	6	7

3

NOW PLEASE COMPLETE THE TABLE BELOW AS DESCRIBED.

SCENARIO

Benefit	ONE							TWO							THREE						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
A																					
B																					
C																					
D																					
E																					
F																					
G																					
H																					

THANK YOU FOR YOUR COOPERATION.

APPENDIX 5

QUESTIONNAIRE FOR SUMMATIVE EVALUATION STUDY
: BENEFIT RANKING WITHOUT COST CONSIDERATIONS

A] QUESTIONNAIRE

B] CARD DECK OF BENEFIT COMBINATIONS

A] QUESTIONNAIRE

QUESTIONNAIRE THREE

ASSUME that there are NO SIGNIFICANT COSTS involved in developing and implementing the COMPLAN DSS.

1. EXAMINE the accompanying deck of cards numbered A to L. Each card shows a combination of likely DSS benefits.

2. SORT the CARDS into THREE PILES initially.

   A) PILE ONE should contain cards showing combinations of benefits which, in your opinion, are the MOST IMPORTANT in JUSTIFYING a Decision Support System.

   B) PILE TWO should consist of those combinations of benefits of LESSER IMPORTANCE.

   C) PILE THREE should contain combinations of benefits of LEAST IMPORTANCE in JUSTIFYING a DSS.

3. Now SORT each PILE from MOST IMPORTANT to LEAST IMPORTANT.

4. Now MERGE the THREE PILES to give a RANKING from MOST IMPORTANT (rank 12) to LEAST IMPORTANT (rank 1) of all 12 CARDS of benefit combinations to JUSTIFY a DSS.

5. RECORD each card's CODE in the correct position below.

RANKING	CARD CODE
12 (Most Important)	______
11	______
10	______
9	______
8	______
7	______
6	______
5	______
4	______
3	______
2	______
1 (Least Important)	______

Thank you for your cooperation.

B] CARD DECK OF BENEFIT COMBINATIONS

CARD A
1. Potential CLERICAL TIME and LABOUR SAVINGS
2. Improves COMMUNICATION between MANAGERS
3. Permits WIDER and DEEPER EXPLORATION of ALTERNATIVES.

CARD B
1. Promotes BETTER UTILISATION of DATA
2. Improves COMMUNICATION between MANAGERS
3. Improves MANAGEMENT DECISION MAKING capabilities

CARD C

1. NO OPERATIONAL Benefits

2. Improves COMMUNICATION between MANAGERS

3. Promotes CLEARER APPRECIATION and UNDERSTANDING of the PROBLEM.

CARD D

1. Potential CLERICAL TIME and LABOUR SAVINGS

2. Improves PLANNING and CONTROL

3. Improves MANAGEMENT DECISION MAKING capabilities

CARD E

1. Promotes BETTER UTILISATION of DATA
2. Improves PLANNING and CONTROL
3. Promotes CLEARER APPRECIATION and UNDERSTANDING of the PROBLEM.

CARD F

1. NO OPERATIONAL Benefits
2. Improves PLANNING and CONTROL
3. NO PERSONAL Benefits

CARD G

1. Potential CLERICAL TIME and LABOUR SAVINGS

2. Improves UTILISATION of MANAGEMENT TIME

3. Promotes CLEARER APPRECIATION and UNDERSTANDING of the PROBLEM.

CARD H

1. Promotes BETTER UTILISATION of DATA

2. Improves UTILISATION of MANAGEMENT TIME

3. NO PERSONAL Benefits

CARD I

1. NO OPERATIONAL Benefits

2. Improves UTILISATION of MANAGEMENT TIME

3. Permits WIDER and DEEPER EXPLORATION of ALTERNATIVES.

CARD J

1. Potential CLERICAL TIME and LABOUR SAVINGS

2. NO ORGANISATIONAL Benefits

3. NO PERSONAL Benefits

CARD K

1. Promotes BETTER UTILISATION of DATA
2. NO ORGANISATIONAL Benefits
3. Permits WIDER and DEEPER EXPLORATION of ALTERNATIVES.

CARD L

1. NO OPERATIONAL Benefits
2. NO ORGANISATIONAL Benefits
3. Improves MANAGEMENT DECISION MAKING capabilities

APPENDIX 6

QUESTIONNAIRE FOR SUMMATIVE EVALUATION STUDY
: BENEFIT RANKING WITH COST CONSIDERATIONS

(IDENTICAL CARD DECK USED AS IN APPENDIX 5)

QUESTIONNAIRE FOUR

> ASSUME that there ARE SIGNIFICANT COSTS involved in developing and implementing the COMPLAN DSS.

1. EXAMINE the accompanying deck of cards numbered A to L. Each card shows a combination of likely DSS benefits.

2. SORT the CARDS into THREE PILES initially.

   A) PILE ONE should contain cards showing combinations of benefits which, in your opinion, are the MOST IMPORTANT in JUSTIFYING a Decision Support System.

   B) PILE TWO should consist of those combinations of benefits of LESSER IMPORTANCE.

   C) PILE THREE should contain combinations of benefits of LEAST IMPORTANCE in JUSTIFYING a DSS.

3. Now SORT each PILE from MOST IMPORTANT to LEAST IMPORTANT.

4. Now MERGE the THREE PILES to give a RANKING from MOST IMPORTANT (rank 12) to LEAST IMPORTANT (rank 1) of all 12 CARDS of benefit combinations to JUSTIFY a DSS.

5. RECORD each card's CODE in the correct position below.

RANKING	CARD CODE
12 (Most Important)	______
11	______
10	______
9	______
8	______
7	______
6	______
5	______
4	______
3	______
2	______
1 (Least Important)	______

Thank you for your cooperation.

APPENDIX 7

QUESTIONNAIRES FOR SUMMATIVE EVALUATION STUDY
: SELF - EXPLICATED RATINGS METHOD

A] RATING OF INDIVIDUAL BENEFITS

B] RATING OF BENEFIT GROUPS

A] RATING OF INDIVIDUAL BENEFITS

QUESTIONNAIRE ONE

INSTRUCTIONS

1. READ the list of statements on page 2 CAREFULLY. They relate to the POTENTIAL VALUE of DECISION SUPPORT SYSTEMS (DSS) to users.

2. Now RATE each statement on the scale from 1 to 10 which MOST CLOSELY EXPRESSES YOUR AGREEMENT OR DISAGREEMENT with the statement as a likely DSS benefit.

The scale is as follows:

1	2	3	4	5	6	7	8	9	10
Disagree Strongly		Disagree		Unsure		Agree			Agree Strongly

page 2

Please place the appropriate SCORE in the block provided next to each statement.

	Score
A - Potential clerical time and labour savings.	
B - Improves utilisation of management time.	
C - No personal benefits to the individual user in terms of self development.	
D - Improves management decision making capabilities.	
E - Promotes clearer appreciation and understanding of the problem.	
F - No potential contribution to Organisation development.	
G - Promotes better utilisation of data.	
H - Improves planning and control.	
I - No potential improvements in operating level efficiencies.	
J - Permits deeper and wider exploration of alternatives.	
K - Improves communication between managers.	

Thank you for your cooperation.

B] RATING OF BENEFIT GROUPS

QUESTIONNAIRE TWO

INSTRUCTIONS

1. The benefits have been GROUPED under THREE general HEADINGS which reflect AREAS of most likely IMPACT.

2. STUDY the benefits within each grouping CAREFULLY.

Group 1 : OPERATING LEVEL ECONOMIES

A - Potential clerical time and labour savings.

B - Promotes better utilisation of data.

Group 2 : MANAGERIAL / ORGANISATIONAL EFFECTIVENESS

C - Improves utilisation of management time.

D - Improves planning and control.

E - Improves communication between managers.

Group 3 : PERSONAL DEVELOPMENT OF DSS USER

F - Improves management decision making capabilities.

G - Promotes clearer appreciation and understanding of the problem.

H - Permits deeper and wider exploration of alternatives.

3. Now DIVIDE 100 points amongst the THREE GROUPS to reflect the relative IMPORTANCE you attach to each of the areas of likely impact of DSS as shown by the GROUP HEADINGS.

	%
Group 1 : Operating Level Economies	
Group 2 : Management / Organisational Effectivess	
Group 3 : Personal Development of DSS User	
	100

Thank you for your cooperation.