Alan Daniels and Don Yeates

PRACTICAL SYSTEMS DESIGN

Practical Systems Design

Edited by

Alan Daniels
Director
Institute for Industrial Training,
Brunel University

Don Yeates
General Manager
Datasolve Education

PITMAN

PITMAN PUBLISHING LIMITED
128 Long Acre, London WC2E 9AN

PITMAN PUBLISHING INC
1020 Plain Street, Marshfield, Massachusetts 02050

Associated Companies
Pitman Publishing Pty Ltd, Melbourne
Pitman Publishing New Zealand Ltd, Wellington
Copp Clark Pitman, Toronto

© Alan Daniels and Don Yeates 1984

First published in Great Britain 1984

British Library Cataloguing in Publication Data
Practical systems design.
1. System analysis
I. Daniels, Alan II. Yeates, Don
003 QA402

ISBN 0–273–01939–2

Library of Congress Cataloging in Publication Data

Main entry under title

Practical systems design
Bibliography: p
Includes index
1. System design 2. System analysis. I. Daniels, Alan. II. Yeates, Donald.
QA76.9.S88P73 1984 003 84-1877
ISBN 0–273–01939–2

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording and/or otherwise, without the prior written permission of the publishers. This book may not be lent, resold, hired out or otherwise disposed of by way of trade in any form of binding or cover other than that in which it is published, without the prior consent of the publishers. This book is sold subject to the Standard Conditions of Sale of Net Books and may not be resold in the UK below the net price.

Printed in Great Britain at The Pitman Press, Bath

Foreword

The need for more information on systems analysis at a time when the use of technology in business and industry is growing rapidly and causing great change has brought about this second book. Systems analysis is an area of growing professionalism. Systems analysts are the individuals with primary responsibilities for implementing change. They are the staff professionals. The 'system' has developed as an activity encompassing people, procedures, materials, and equipment coordinated to provide a service and produce an end-product.

At the beginning of the 1960s, computers were considered technological marvels which awed many, especially management personnel. Today, technology has been recognized as an asset in the work-a-day environment and as a management tool, though it does have its own problems and solutions. It is essential for individuals who assist management to be well informed on the technological advances and on better ways to solve problems.

The changes which are occurring at a very rapid rate in our society are treated in this text. Each chapter moves from the philosophical to the practical, concentrating on the 'doing' aspects of the subjects discussed. The text presents philosophies, approaches, and proven techniques by which successful implementation can occur. Emphasis is placed upon the end-product. However, flexibility, intelligent caution, and considered decision-making are encouraged. The wide range of topics covered in this text provides an over-view of the increasing number of tools available to systems analysts and practical suggestions for their utilization.

I appreciate the opportunity for my continued involvement in this important endeavour.

S. Charp
President
American Federation
of Information Processing Societies

Acknowledgements

It is not possible to produce a book which covers such a wide range of topics as this without being able to draw on the help, advice and contributions of many friends and colleagues who are expert in their chosen fields. We are very fortunate that so many people have been willing to help. In particular, we would like to acknowledge the contributions of

Neville Boxer of Software Sciences

Brian Davis, Computer Consultant

Alan Peck of Datasolve Education

Dr Pete Thomas of the Open University

Derrick Croisdale, formerly with the UK Civil Service

Professor Frank Land of the London School of Economics

Stuart Rostron, a specialist consultant in office systems and technology

Martin Ould of Logica

Jim Wood of Brunel University

We are also grateful to Simpact Systems Ltd of Shedfield, Southampton, England, for allowing us to use PROMPT to illustrate methodologies for the management of systems development.

Finally, thanks to Sue Baker and Margaret Lailey for word processing it all.

试读结束，需要全本PDF请购买 www.ertongbook.com

Preface

This book is intended for students and practitioners in systems analysis and design who have gone beyond the basic concepts of systems work and now find themselves concerned with a wider range of systems problems and solutions. It therefore assumes an understanding of systems work as described in *Basic Systems Analysis*.

The book begins with a review of the scope of systems analysis and design, with emphasis on the role of the analyst as an agent of change.

Chapter 2 reviews the types of system with which analysts are now involved and categorizes systems according to their goals of processing transactions and providing operational and management control or information for strategic planning.

Chapter 3 deals with the management of systems development activities and is followed, in Chapter 4, by a more detailed treatment of structured design methodologies.

Chapters 5, 6 and 7 consider some typical systems design solutions and include a discussion of database, distributed and realtime systems. Data communications is dealt with separately in Chapter 8.

The role of the analyst in the design of office automation systems is considered in Chapter 9 and the 'people' side of systems work is brought together in Chapter 10.

The book is thus an introduction—and in some areas more than that—to a range of new or more advanced systems problems which a senior student or practitioner is likely to face. Inevitably, there is much more that could be written, but we think that this book is a digestible further bite into the world of systems analysis and design.

Alan Daniels
Don Yeates

Contents

Foreword x

Preface xi

Acknowledgements xii

1 The scope of systems analysis 1

2 Systems application studies 7
2.1 Introduction 7
2.2 Operational systems 11
2.2.1 Defining the system 11
2.2.2 Operational system outputs 12
2.2.3 Operational system inputs 17
2.3 Characteristics of control systems 19
2.3.1 Control system outputs 21
2.3.2 Control system inputs 24
2.4 Characteristics of planning systems 27
2.4.1 Planning system outputs 32
2.4.2 Planning system inputs 34
2.5 Summary 35

3 Managing systems development 37
3.1 Introduction 37
3.2 Traditional project management 39
3.2.1 The project manager 39
3.2.2 Planning and control aids 43
3.2.3 Investment appraisal 44
3.2.4 Estimating application software effort 53
3.2.5 Traditional project management—conclusions 59
3.3 Improving project management 61
3.3.1 Introduction 61
3.3.2 Desirable features of a methodology 63
3.3.3 A methodology for managing systems development 65

3.3.4 What the methodology aims to achieve 68
3.3.5 Quality assurance 70
3.3.6 Coping with change 72
3.3.7 Scaling the methodology 72
3.3.8 Techniques within the methodology 73
3.4 Summary 73

4 Structured methodologies 76
4.1 Introduction 76
4.2 Structured program design 77
4.2.1 Origins of structured design 77
4.2.2 Basic constructs 77
4.2.3 Objectives of the structured approach 79
4.3 Alternative approaches to program design 80
4.3.1 Functional decomposition 81
4.3.2 Data-oriented design 81
4.4 Coding implications 94
4.5 Structured systems design 94
4.5.1 The Yourdon and Constantine approach 95
4.5.2 DeMarco's structured analysis and system specification 100
4.5.3 LBMS system development methodology 106
4.6 Summary 109

5 Database systems 110
5.1 Introduction 110
5.2 Data control 111
5.3 The data dictionary 113
5.3.1 Types of data 114
5.3.2 Manual data dictionaries 114
5.3.3 Automated data dictionaries 114
5.4 Database administration 115
5.4.1 Role of the DBA 115
5.5 Database design 117
5.5.1 Logical database design 117
5.5.2 Data analysis 119
5.5.3 The data analysis process 120
5.5.4 Access analysis 122
5.5.5 Software evaluation 122
5.5.6 Physical database design 123
5.6 Database software 125
5.6.1 Significant developments 125

5.6.2 Data independence 126
5.6.3 Data structures 127
5.6.4 The programmer interface 129
5.7 Summary 131

6 Distributed processing 132
6.1 Introduction 132
6.2 Centralization versus distribution 135
6.2.1 Benefits of distributed systems 136
6.2.2 Overheads 136
6.3 Location of data files 137
6.4 Access to files 140
6.4.1 Mixed access 141
6.5 Local networks 142
6.6 Standardization and protocols 144
6.7 Examples of distributed processing systems 144
6.7.1 A bank 144
6.7.2 ACP 80 146
6.7.3 A tobacco company 150
6.8 Summary 154

7 Real-time systems 155
7.1 Introduction 155
7.2 Characteristics of a real-time system 157
7.2.1 Producing timely output 157
7.2.2 Keeping a record of the past 158
7.2.3 Handling concurrent input processing 159
7.2.4 Competing and cooperating processes 160
7.2.5 Coping with failures 161
7.2.6 Providing a reliable service 162
7.3 Defining the special requirements of a real-time system 162
7.3.1 Defining the system outputs 162
7.3.2 Defining the system inputs 163
7.4 Problems of real-time processing and their solution 164
7.4.1 The situation so far 164
7.4.2 Single process system 165
7.4.3 Multi-process systems 168
7.4.4 Speed and how it is achieved 170
7.4.5 Producing a resilient system 173
7.4.6 Producing a reliable system 175
7.4.7 Keeping historical record 177

7.4.8 Operating system support 177
7.5 Languages for real-time systems 181
7.5.1 CORAL 181
7.5.2 RTL/2 182
7.5.3 Ada 182
7.6 Transaction processing 183
7.7 Summary 190

8 Data communications 191
8.1 Introduction 191
8.2 Systems design considerations 191
8.3 Terminal devices 193
8.3.1 Synchronous transmission 194
8.3.2 Asynchronous transmission 194
8.3.3 Batch transmission 195
8.4 Interfaces for data communications 196
8.4.1 Multiplexer 197
8.4.2 Concentrators 199
8.4.3 Front-end processors 199
8.4.4 Data encryption 200
8.5 Data communications networks 201
8.5.1 Conventional services 201
8.5.2 Packet switched services 202
8.5.3 Other networks 203
8.5.4 Local area networks 205
8.5.5 Digital communications 206
8.5.6 Network control and programming 206
8.6 Summary 210

9 Office automation 212
9.1 The challenge of office automation 212
9.2 The analyst's approach to office automation projects 214
9.2.1 Establishing functional requirements 214
9.2.2 Data collection 215
9.2.3 Establishing the shape of the technical solution 217
9.2.4 Pilot trials 218
9.2.5 Organization for office automation 219
9.2.6 Company style 220
9.2.7 Problems to overcome 221
9.3 Components of office automation 223
9.3.1 Text processing 223

9.3.2 Voice processing 228
9.3.3 Image processing 233
9.3.4 Office communications systems 235
9.4 Summary 238

10 Social aspects of information systems 241
10.1 Introduction 241
10.2 Types of information 242
10.3 How information is used 245
10.4 Social policy issues 247
10.5 Preconditions for information systems implementation 248
10.6 Organizing for good social design 249
10.7 Summary 252

Suggestions for further reading 254

Index 255

试读结束，需要全本PDF请购买 www.ertongbook.com

1 The scope of systems analysis

In this introductory chapter there is one idea that is more important than any other; it is *change*. Typically, systems analysts are taught about the impact of change on people, how people cope with change and how changed systems and working practices can be implemented. Indeed, in our earlier book—*Basic Systems Analysis*—we talk about the systems analyst as an implementer of change or as a change agent. In this book we are concerned with the impact of change on the systems analyst. How is our analyst prepared to take his—or her—own medicine?

In principle, of course, we are all prepared to take our own medicine—so long as we think that we need it! The difficulty lies in the fact that we generally assume that we are fit and healthy and in no need of medication. Before reading on, therefore, we must ask you to recognize that, however things are now, they could be better; however your systems work is going, it could go more effectively. With this thought in mind, let us examine three fruitful areas for improvement: our own performance as analysts and the way we do our job; the way our systems projects are managed; and the intractable 'people' problem.

The way we were

In *Basic Systems Analysis* we represent the activities of the systems analyst as being neat and tidy, with a simple methodology to follow. Our analyst is described as '. . . able to discover the fundamental logic of a system, produce sound plans and appreciate the effects of new facts in planning. The analyst must be perceptive, but must not jump to quick conclusions, be persistent to overcome difficulties and obstacles, and maintain a planned course of action in spite of setbacks'. We also talk of a 'need for stamina, strength of character and a sense of purpose; a broad, flexible outlook, an orderly mind, a disciplined approach and logical neatness'.

While no apology is made for describing such a paragon, we must take for granted that, wherever a systems analyst finds himself, he is what he is—paragon or not. It seems most unlikely that there will be

sufficient systems analysts to meet the increasing need for their skills and although some people are more readily suited to systems work than others, we do all need to stop and take stock of the way we do our work to see if we can do it better and to see if we can identify those essential characteristics of the systems analyst.

One model, proposed by Parkin, puts systems analysis under the microscope and examines it in the light of the skills and knowledge

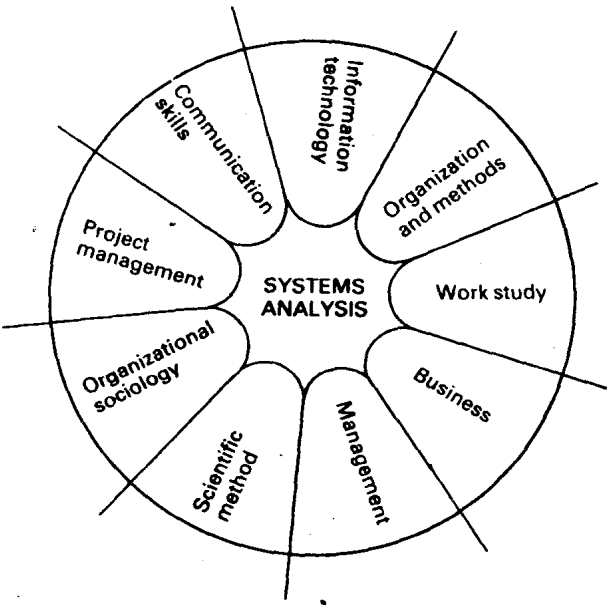

Fig. 1.1 Under the microscope

borrowed from other business or academic activities. This is shown in Figure 1.1. We can see from this model that skills and methods have been borrowed:

- from *other changemakers*: traditionally the pursuits of O & M and work study were the precursors of systems analysis and indeed provided an active pool from which analysts were recruited in the 1960s;
- from *business and management*: analysts solve business problems for managers—or such is a common view. It seems then only sensible to understand the problem areas and the client;

- from *science*—a twofold contribution: firstly, the approach to problem solving in a scientific way to imply the disinterested and completely objective method so necessary to systems work; secondly, the study of organizations and their social make-up which provides the backcloth against which the analyst works;
- from *project management*—included since all of our activities are carried out in a project structure;
- from *communications skills*—clearly important since a substantial part of the analyst's job is to listen, discuss and persuade.

Last of all is information technology: the thing which sets the systems analyst apart from other change-makers and which puts him in the driving seat of the new industrial revolution.

There remains, however, the as yet undefined 'something in the middle' which characterizes the mind or the attitude of an analyst. There are three words which fit this remaining gap:

- *Eclecticism*—our systems analyst has a greedy mind and collects ideas and experiences from all walks of life to apply to his work. The very thought of rejecting something because it is 'not invented here' is anathema.
- *Syncretism*—the nature of systems analysis is to reconcile technology and people in order to solve problems in a changing world. The ability to reconcile differing attitudes and to present solutions that are capable of wide acceptance is therefore clearly of importance.
- *Congruence*—the solution of problems is much easier when resources are unlimited and the time available is infinite. The analyst, however, is expected to deliver a system which is not only effective but also efficient. In other words, a congruent solution is required. Using a sledgehammer to crack a nut—the opposite of a congruent solution—is not appropriate.

This gets us started in knowing about our 'profession'—for such is it called these days. Indeed the very use of the word 'professional' when describing our activities implies a great deal: a 'computer professional' is not merely someone who is paid to do a specific job—a professional footballer as opposed to an amateur—but someone who applies himself to his job in a thoughtful, ethical, comprehensive and thorough way. There are no halfway houses on the road to professional systems analysis.

Innovating force

The systems analyst as the innovating force finds himself at the centre of a network of attitudes and practices which set the climate for the work he does (see Figure 1.2). Innovation in an organization will not

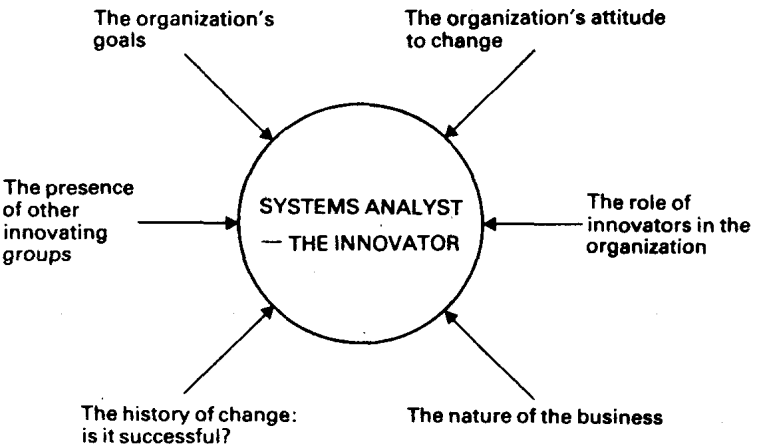

Fig. 1.2 The innovator

take place without the recognition and belief that a specific problem exists and that there is a mechanism, process or means to solve it. Management's appreciation of these factors—problem and solution—is, however, unlikely to be sufficient on its own to change the situation. An essential ingredient is the presence of innovating or change agent groups who have a vested interest in the implementation of change. Innovative activities typically occur through the efforts of groups who are outside the programmed activities of production deadlines and who have a specific responsibility for planning and improvement. Some researchers point to the need for social scientists to provide the drive needed by organizations pursuing a program of innovation in systems design and management control and, while many of their aims are far outside the scope of systems analysis, there is in one important area a role for systems analysts to play. This is concerned with the recognition of the importance of human factors in the design of new systems. We believe this to be of such importance to the success of systems analysis and design in the 1980s that Chapter 10 of this book deals with it in detail.

Such recognition cannot, however, be made without a change in the way systems work is done. Typically analysts are concerned with reconciling:

(1) organizational needs and objectives,
(2) the tasks to be done,
(3) technology,
(4) the individual's objectives and needs,

and usually in that order. If, however, we establish a design group drawn from both the client department and the systems development group, the system that is eventually designed represents the concentrated efforts of both groups and should be highly acceptable to users and to computer people.

Such a design is seen by the users as very much their own solution and highly acceptable as a future way of working. For the systems analyst, however, it requires a change of role from technical expert to that of an adviser able to offer a variety of solutions from which a choice can be made, rather than presenting the one unique solution. In addition, it requires that the human and technical parts of the design proceed together instead of the human parts being forced to fit a rigid technical solution. Also, we must accept the validity of participation by users and their right to develop the skills to enable them to design their own systems. Last of all we must recognize that a system which optimizes technical efficiency but which does not contribute to job satisfaction is unlikely to be adopted by the user group.

The driving force that will initiate this change will come either from systems users via revolution or from us by evolution; we can either plan for it or have it forced upon us. The reason is simple: our clients—and let us call them that since it begins to give them a wholly new role—have higher expectations of us than hitherto and a much lower tolerance threshold of incompetence. Attitudes towards information technology generally are often either hostile, as a result of bad experience, or expectant of a greater level of satisfaction than has previously been delivered. In short, the game's up; either we deliver or we are ignored.

Delivering new systems

A substantial part of the problem of delivering new systems to clients lies in the way we plan, control and manage the activities of ourselves and our systems teams. Chapter 4 draws a stark contrast between the traditional staged approach to conventional systems project development and the more rigorous and responsive approach being proposed in

some of the newer methodologies. Let us consider here just two additional points.

(1) *Getting started*
The beginnings of a systems project are entirely creative. This does not come about through the earth moving or in a sudden flash of lightning, but is the result of discussion, consultation and contemplation. Problems unresolved here can never be satisfactorily eliminated later. It is therefore a slow process and, while it may prove tedious, frustrating or even obstructionist to insist on a clear and widely accepted view of what is to be achieved, a slow start is a good start. Taking drastic action at the end of a project to tighten up and to control more and more of less and less of the work remaining is not the solution—it is putting all the effort in the wrong place.

(2) *Projects are people*
Projects and systems are run by people, and the interrelationships between the members of the development team and the client staff are complex. The effects of bargaining between groups and the use of informal systems complicates the analyst's tasks. Recognizing this, accepting it and using it where one can speeds the project, and although the participative approach and newer methodologies aim to avoid the need for such methods, for the time being we must accept that they have a place now.

In this chapter we have been able to do no more than touch on some of the issues which will tax the mind and heart of the systems analyst over the next few years. A recently published *A-Z of Information Technology* uses the term 'forgiving systems' to describe systems which allow a novice to make mistakes without chaotic or disastrous consequences and which enable confused users to call for help and to be led out of trouble. There seems no doubt that we shall need such systems ourselves.

试读结束，需要全本PDF请购买 www.ertongbook.com