

Norbert Szyperski | Erwin Grochla

Design and Implementation of Computer-based Information Systems



INFORMATION SYSTEMS

S&N

DESIGN AND IMPLEMENTATION OF COMPUTER-BASED INFORMATION SYSTEMS

edited by

Norbert Szyperski
Erwin Grochla

SIJTHOFF & NOORDHOFF 1979
Alphen aan den Rijn, The Netherlands
Germantown, Maryland, USA

Proceedings of the BIFOA Symposium, September 18-20, 1978,
Bensberg/Cologne, edited by

Norbert Szyperski

Professor of Business Administration and Planning
Theory, Director of BIFOA, University of Cologne,
Cologne, Federal Republic of Germany

Erwin Grochla

Professor of Business Administration and Organization
Theory, Executive Director of BIFOA, University of Cologne,
Cologne, Federal Republic of Germany

BIFOA is the Institute for Business Administration, Organization and Automation at the University of Cologne, Federal Republic of Germany.

© 1979 Sijthoff & Noordhoff International Publishers B.V., Alphen aan den Rijn, The Netherlands

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 or otherwise, without the prior permission of the copyright owner.

ISBN 90 286 0519 3

Printed in The Netherlands

DESIGN AND IMPLEMENTATION OF COMPUTER-BASED INFORMATION SYSTEMS

SIJTHOFF & NOORDHOFF SERIES ON INFORMATION SYSTEMS

Consulting Editors:

Richard J. Welke
McMaster University
Hamilton, Ontario, Canada

Ronald K. Stamper
London School of Economics
and Political Science, London, U.K.

This Series will incorporate that on Information Systems Analysis and Design
originated by the London School of Economics and Political Science

Preface

From 18th to 20th September, 1978, about forty scientists and practitioners from Australia, Canada, Denmark, Finland, Great Britain, the United States and the Federal Republic of Germany joined in an international symposium entitled “Design and Implementation of Computer-based Information Systems”.

This symposium was initiated by the invitation of the BIFOA (*Betriebswirtschaftliches Institut für Organisation und Automation an der Universität zu Köln*) as a part of the institute’s research project IMPLAN (Development of Tools for the IMPLementation of Computer-based PLANning Systems).

This book includes the opening address, the papers presented at the symposium—revised by the authors after presentation—the chairmen’s summaries of the various working group sessions, and an edited version of the concluding “Blueprint for Research on Implementation”.

Acknowledgements

The symposium was made possible by a federal grant from the *Bundesminister für Forschung und Technologie* (BMFT), Bonn, represented by the *Gesellschaft für Mathematik und Datenverarbeitung* (GMD), St. Augustin, who sponsored the whole IMPLAN research project and the symposium. We are extremely appreciative of their valuable cooperation and support; in this respect our special thanks go to Mrs. Katharina Gregor and Dr. Jürgen Marock of the GMD.

Our sincere thanks and appreciation are due to the authors for the many hours of work, for their contributions and for preparing and revising them after the symposium. We appreciate the valuable help of the chairmen for conducting the working sessions and preparing summaries of the sessions.

We should also like to extend our thanks to Mr. Frank Kolf, Mr. Hans-Jürgen Oppeland and Dr. Thilo Tilemann (all of the BIFOA) for their help in preparing the concept of the symposium. We appreciate the unstinting efforts of Mr. Hartwig Garmers and Mr. Albrecht Windler (both of the BIFOA) for their help in the organising and smooth running of the symposium. They also made valuable contributions towards the preparation of the present book.

Finally we express our sincere thanks to Sijthoff & Noordhoff International Publishers, especially to Mr. Arne Visser and Mr. Robert Lyng, for their support in editing the proceedings of the symposium and for the excellent care they have taken over printing this publication.

Cologne, August 1979

Erwin Grochla
Norbert Szyperski

Opening Address

by Prof. Erwin Grochla, Ph.D.

It is a great pleasure for me to welcome all of you as participants of this symposium. Since many of you are attending a BIFOA-symposium for the first time, I would like to give you some general information about our institute, its scope of activities and its research philosophy. BIFOA is an abbreviation which stands for Betriebswirtschaftliches Institut für Organisation und Automation an der Universität zu Köln. The institute was founded in 1963 by me in cooperation with managers from business practice. The main purpose of the institute has been to intensify research in the fields of Business Administration and Management as well as Organization and Automation.

Throughout the past years the institute developed its particular research philosophy which has proved to be very successful up to now. To make this clearer let me shed some more light on this particular aspect. First of all, the institute attempts to emphasize the practical application of its research results. This is achieved through a close cooperation with pilot user-companies and software companies in the various projects that have been undertaken by the institute and through the manifold seminars and workshops that are offered by the institute for managers from business practice.

Apart from this close cooperation with business practice, the institute emphasizes the permanency of its contacts with academic institutions such as universities. Especially to be mentioned are personal relationships with the *Seminar für Allgemeine Betriebswirtschaftslehre und Organisationslehre* (Department for Business Administration and Organization), the *Seminar für Allgemeine Betriebswirtschaftslehre und Planung* (Department for Business Administration and Planning), the *Institut für Informatik* (Institute for Informatics), all of which belong to the University of Cologne. Apart from this, the BIFOA has a strong personal relationship with the University of Essen.

The activities of the BIFOA are to communicate, show applications, and to elaborate research results in special study circles consisting of members from the institute and from business practice, in workshops, seminars, and international symposia as well as in publications. To be able to undertake its projects, the institute participates in governmental programs such as the Federal Government programs for the development of automatic data processing, information and documentation, and the humanization of work organization. It is essential for the institute to perform all of its activities in close cooperation and with intensive feedback from German industry. German industry is represented in an association that was founded for the financial and nonfinancial support of the institute. This association was founded in 1963 by fourty business firms; currently this association has about 140 member firms.

The milestones in the past work of BIFOA were:

- First memorandum of BIFOA published in 1968:
“Application Systems for Automated Data Processing: The Gap between Research and Education in the Federal Republic of West Germany.”
- Second memorandum, published in 1969:
“Business Informatics as a Necessary Application Oriented Supplement to General Informatics.”
- Model for the Development of an Integrated Data Processing System (KIM—*Kölner Integrationsmodell*)
- Proposition of a MIS-research program to the Federal Ministry of Education and Science.

Currently the institute has a broad range of research activities which seem to be of high practical interest. One field is the production of data. Another field of research is office automation and automated text processing, both being of utmost importance in German industry. Yet another subject of BIFOA-research are methods of systems planning and documentation. Besides this, a broad field is the development of practical aids for particular managerial decisions. The three decision areas currently studied are materials management, organizational delegation and the selection of ADP-facilities. Another area of BIFOA-research is the organizational implementation of systems which is the topic of this symposium.

Former symposia were held on

- Model and Computer-based Corporate Planning
- Management Information Systems—A Challenge to Research and Development
- Organizational Structure and Structure of Information Systems
- Man-Computer-Interaction in Management Planning
- Modelling Tools for Corporate Planning.

After these introductory remarks let me try to give a first definition of what is to be understood by implementation, and let me equally describe the context of the present symposium.

The general purpose of implementation is to transfer conceptual schemes into reality, that is to say into actual running systems. Implementation processes always have to focus upon two aspects, a systems technical aspect, and an organizational aspect. Both are equally important and require a broad set of concepts and techniques in order to be performed in an efficient way.

The organizational implementation includes the setting of systems-specific and organizational rules for the users of a prospective system as well as the systematic training of the users to enable them to interact with the system. The system implementation process thus covers a whole set of technical, organizational, and, last but not least, psychological problems that still require thorough research.

The background of the present symposium is the BIFOA project IMPLAN (as mentioned in the foreword). The structure of the proceedings reflects that this project is composed of two related subprojects of the institute. The first is PORGI

which stands for Planning of Organizational Implementation. It deals with organizational and human aspects of implementation, as an attempt to develop procedural and substantial concepts and tools for preventing and overcoming implementation problems. The second is APIS which stands for Development of Models for Analysis and Planning in Interactive Systems. APIS deals with problems of modeling methods and data processing-technical questions in the design and implementation of systems. It is intended to give procedural help especially for medium-sized firms.

Due to our experience in the development of running systems (ISAS, CORPIS) and methods (SIMMIS) in MIS-research, we became aware of the problems of organizational implementation. Our experiences gave us the know-how that is necessary for dealing with the problems. We discovered a lack of knowledge especially in the following respects:

- Organizational and human resistance in the development of systems
- There are few efficient instruments for overcoming the problems of resistance and a lacking acceptance.
- It is necessary to analyze which strategies are efficient in which situations and how to design and shape them in an operational way.
- It is necessary to analyze which of the relevant factors can be influenced at all and in which way they can be influenced.
- It is necessary to analyze which support can be offered to system designers in order to enable them to evaluate design alternatives and alternative models and to identify their consequences.

It has been the objective of this symposium to discuss the problems mentioned so far and possibly others with the participants, and to discuss the results of the project IMPLAN achieved so far and to compare them with other research results and developments.

I would like to emphasize the working atmosphere of this symposium which can already be seen from the fact that most of the participants out of the reasonably small number will present a paper here. Contributions from all of us are needed to tackle the broad set of problems lying ahead of us. The institute therefore highly appreciates all of your submitted papers and welcomes your contributions to the discussions that are to be expected.

Table of Contents

Preface	xi
Acknowledgements	xii
Opening Address, by <i>Erwin Grochla</i>	xiii
A. Basic Considerations on Design and Implementation of Computer-based Information Systems	1
I. Introduction	3
1. State of the Art of Implementation Research on Computer-based Information Systems, by <i>Norbert Szyperski</i>	5
1. Introduction	5
2. Basic Notes on the Implementation Game	6
3. Contributions from Research to System Design and Implementation	19
4. Some Preliminary Remarks on Consequences for Implementation Research	25
2. Evaluating the Quality of Information Systems, by <i>Charles H. Kriebel</i>	29
1. Introduction	29
2. Conceptual and Operational Issues	30
3. A Survey of the Research Literature	33
4. Conclusion	38
II. Technical Aspects of Systems Design and Implementation	45
3. The Modeling Process: Steps Versus Components, by <i>H. Müller-Merbach</i>	47
1. The Topic	47
2. The Role of the Model	48
3. The Plea for the Assemblage-of-Components Concept	51
4. The Components of the Modeling Process	54
5. Modeling, an Art or a Science?	57

4. Implementation of Planning Models: Presentation of the APIS Approach, by <i>Thilo Tilemann</i>	61
1. Introduction	61
2. Diagnosis of Problem Areas	63
3. Consequences in the APIS Project	66
4. APIS Results	70
5. Conclusion	74
III. Organizational Aspects of Systems Design and Implementation	79
5. Basic Considerations in Organizational and Human Aspects in Systems Design: the State of the Art of Implementation Research, by <i>Henry C. Lucas, Jr.</i>	81
1. Introduction	81
2. Approaches to Implementation Research	81
3. Research Designs	84
4. Three Examples	85
5. Future Research	89
6. A Design-Oriented Approach in Implementation Research: The Project PORGI, by <i>Frank Kolf</i> and <i>Hans Jürgen Oppeland</i>	91
1. Statement of the Problem	91
2. Research Design of Project PORGI	93
3. PORGI-Implementation Handbook: The Concept	94
B. Working Group: Technical Aspects of Systems Design and Implementation	101
I. Selection of Planning Methods. Chairman: <i>Charles H. Kriebel</i>	103
7. The Feasibility of Linear Planning Models in Business Administration, by <i>Bernhard Bleuel</i>	105
1. Survey	105
2. Methods and Tools for Planning	105
3. Implementation of the Planning System	108
4. Problems of Evolution	109
5. Feasibility Problems	109
6. Future Development	110
8. Application Areas for Planning Software, by <i>Horst L. Burwick</i>	111
1. The Purpose of Planning Software	111
2. Categories of Planning Software	113
3. Features of Planning Languages	114
4. The Planning Languages PLATO, PS1, ITS/73, ITS/DMS	116
5. Various Applications of a Planning Language	119

II. Modeling Methodology. Chairman: <i>H. Müller-Merbach</i>	121
9. A Data-Centered, User-Evolutionary Approach to the Development of Planning Support Systems, by <i>Richard J. Welke</i>	123
1. Development Strategies and Design Approaches	123
2. Detailed Considerations in the Data-Centered Design Approach	127
3. A User-Evolutionary Approach to Planning Model Development	134
4. Conclusion	137
10. Implementation and Design Problems of Corporate Simulation and Planning Systems, by <i>Friedrich Rosenkranz</i>	139
1. Introduction	139
2. Languages, Systems, and Operation	143
3. Organization, Task Structure, and Planning Process	147
4. Personal and Behavioural Aspects	154
5. Conclusions	158
11. An Information System on Planning Models: A General Concept, by <i>Wolfgang Schuler</i>	163
1. Objectives, Necessity, Goals	163
2. Problematic Nature of Models: Definition, Process of Model Design	164
3. Descriptive Characteristics of Models	166
4. System Organization and Operation	169
5. Special Model Files Prototypes—Present Work	172
III. Tools for Model Implementation. Chairmen: <i>Norbert Szyferski</i> and <i>Thilo Tilemann</i>	175
12. Interactive Modelling: Problems in Design and Practical Use, by <i>Hermann Kampffmeyer</i> and <i>Klaus-Dieter Steffen</i>	179
1. Interactive Modelling: A Way of Getting Better Answers More Quickly	179
2. A Framework for a Reasonable Use of the Interactive Approach	179
3. Modelling Process and Planning Functions: When to Recommend Direct Communication with the Computer	181
4. Planners and Analysts: What Must Be Their Abilities?	189
5. Software Tools	190
6. Conclusion	194

13. User-Oriented Programming Languages—Tendencies of Development, by <i>Joachim Gries</i>	195
1. Introduction	195
2. Features of Planning Languages	195
3. Generations of Planning Languages	196
4. Tendencies of Development	201
5. Final Remarks	202
14. On Designing LP Interface Structures, by <i>Kari Kallio</i>	205
1. Concepts and Notations	205
2. LP Matrix as a Relation	206
3. The Case Model	207
4. The LP-Matrix Definition	209
5. Computer Implementation	210
C. Working Group: Organizational Aspects of Systems Design and Implementation	213
I. Participative System Design. Chairman: <i>Michael J. Ginzberg</i>	215
15. Consensus Systems Design: An Evaluation of this Approach, by <i>Enid Mumford</i>	221
1. Introduction	221
2. Participative Systems Design: Its Rationale	221
3. Participative Systems Design: Different Approaches	222
4. Procedures for Consensus Design	223
5. Problems of Using a Consensus Design Approach	225
6. Advantages of Using a Consensus Design Approach	227
7. Training, Monitoring and Development	228
8. Conclusions	229
16. Concepts and Experiences with Participative Design Approaches, by <i>Hasse Clausen</i>	231
1. A Practical Example	231
2. Why Participation?	232
3. Socio-Technique in the Hands of Computer Specialists	234
4. The Activities of the Unions	236
5. Some Consequences of Taking the Participation Problem Seriously in Connection With the System Design Process	239
6. Summary	241

17. High Level Languages—A Basis for Participative Design, by <i>D.N. Podger</i>	243
1. Introduction	243
2. The Setting	243
3. Role Centered Systems Design	243
4. The Nature of Change	244
5. Role Maps	246
6. The Accounting Map	247
7. Applying the Model to Systems Design	249
8. The Solution	252
9. A Language Design	255
10. Conclusion	258
II. Evaluation of Systems. Chairman: <i>F.F. Land</i>	261
18. Effectiveness Measurement of Computer-Based Information Systems through Cost-Benefit Analysis: Empirical Research and Perspectives, by <i>Michel Domsch</i>	265
1. Problem Definition and Initial Situation	265
2. Pilot Study on System Investments	267
3. Analytical Study for Evaluating System Investments	270
4. First Formulation of Hypotheses and Further Research	278
5. Summary	281
19. User and Specialist Evaluations in System Development, by <i>Dietrich Seibt</i>	285
1. Processes of Goal Definition and Evaluation to Start System Development	285
2. Definitions of and Relationships between Effectiveness and Efficiency of CBIS-Development	288
3. Different Levels of Goal Definition and Evaluation	290
4. Examples of Goals Belonging to Different Levels	290
5. Organizational Consequences of Differentiation and Integration of Goal-Levels	296
20. The Evaluation of an Information System Implementation, by <i>E. Burton Swanson</i>	301
1. Introduction	301
2. Activity Analysis	302
3. Possibility Analysis	303
4. Utility Analysis	304

III. Instruments and Tools for Organizational Implementation. Chairman: <i>H. C. Lucas, Jr.</i>	307
21. Early Diagnosis of Implementation Failure: A Plan For Research, by <i>Michael J. Ginzberg</i>	311
1. Overview	311
2. The Concept of Early Warning	312
3. Is Early Diagnosis Possible: Theoretical and Empirical Clues	315
4. A Program of Research	317
5. Phase 1	318
6. Preliminary Results, Discussion, and Conclusion	323
22. Concepts and Experience with the PORGI-Implementation Handbook, by <i>Frank Kolf</i> and <i>Hans Jürgen Oppelland</i>	327
1. PORGI-Implementation Handbook: The Concept	327
2. Practical Application of PORGI-Tools	328
3. Implications and Limitations of the PORGI-Approach	346
D. Review	351
Challenges and Consequences for Future Research on Implementation, by <i>Norbert Szyperski</i> and <i>Thilo Tilemann</i>	353
1. Introduction	353
2. Actual Challenges in Information Systems Implementation	354
3. Consequences for Future Research	358
List of Participants	365

A.
Basic Considerations on Design
and Implemenation of
Computer-based Information
Systems