Mike Sharples (Ed.)

Computer Supported Collaborative Writing

计算机支持的协同写作

Springer-Verlag 光界的まま版公司 Mike Sharples (Ed.)

Computer
Supported
Collaborative

Writin 海苏工业学院图书馆 藏书章

Springer-Verlag

光界用长出版公司 北京·广州·上海·西安

书 名: Computer Supported Collaborative Writing

作 者: M.Sharples (ed.)

中 译 名: 计算机支持的协同写作

出 版 者: 世界图书出版公司北京公司

印刷者:北京中西印刷厂

发 行: 世界图书出版公司北京公司 (北京朝阳门内大街 137 号 100010)

开 本: 大32 开 850 × 1168 印 张: 7.5

版 次: 1998年8月第1版 1998年8月第1次印刷

书 号: 7-5062-3927-2/TP• 33

版权登记: 图字 01-98-0119

定 价: 36.00 元

世界图书出版公司北京公司已获得 Springer-Verlag 授权在中国境内独家重印发行。

Mike Sharples, BSc, PhD School of Cognitive and Computing Sciences University of Sussex Falmer, Brighton BN1 9QH, UK

Series Editors

Dan Diaper, PhD
Department of Computer Science
University of Liverpool
PO Box 147, Liverpool L69 3BX, UK
Colston Sanger
GID Ltd
69 King's Road
Haslemere, Surrey GU27 2QG, UK

ISBN 3-540-19782-6 Springer-Verlag Berlin Heidelberg New York ISBN 0-387-19782-6 Springer-Verlag New York Berlin Heidelberg

British Library Cataloguing in Publication Data Computer Supported Collaborative Writing. - (Computer Supported Cooperative Work Series)

I. Sharples, Mike II. Series 808.00285 ISBN 3-540-19782-6

Library of Congress
A catalogue record for this book is available from the Library of Congress

© Springer-Verlag London Limited 1993 Printed in Germany

The use of registered names, trademarks etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant laws and regulations and therefore free for general use.

The publisher makes no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility or liability for any errors or omissions that may be made.

This reprint has been authorized by Springer-Verlag (Berlin/Heidelberg/New York) for sale in the People's Republic of China only and not for export therefrom.

Reprinted in China by Beijing World Publishing Corporation, 1998

Contributors

Sebnem Baydere

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Eevi E. Beck

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

Tom Casey

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Shaw Chuang

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Ian Denley

Ergonomics Unit, University College London, 26 Bedford Way, London WC1H 0AP, UK

Andrew Dillon

HUSAT Research Institute, Elms Grove, Loughborough LE11 1RG, UK

Alan Dix

HCI Group, Departments of Computer Science and Psychology, University of York, Heslington, York YO1 5DD, UK

Steve M. Easterbrook

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

James S. Goodlet

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

Mark Handley

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Michael Harrison

HCI Group, Departments of Computer Science and Psychology, University of York, Heslington, York YO1 5DD, UK

Nermeen Ismail

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Steve Jones

Department of Mathematical and Computer Sciences, Dundee Institute of Technology, Bell Street, Dundee DD1 1HG, UK

Anthony R. Kaye

Institute of Educational Technology, The Open University, Milton Keynes MK7 6AA, UK

Jon May

Standard Elektrik Lorenz-AG, Hirsauerstrasse 210, D-7530 Pforzheim, Germany

John McCarthy

Department of Psychology, University College of Cork, Cork, Eire

Victoria Miles

GMAP Ltd, University of Leeds, Springfield House, Leeds, UK

Andrew Monk

HCI Group, Departments of Computer Science and Psychology, University of York, Heslington, York YO1 5DD, UK

Iulian Newman

Department of Computing, Glasgow Polytechnic, Glasgow G4 0BA, UK

Rhona Newman

Department of Sociology, University of Ulster at Jordanstown, Newtonabbey BT37 0QB, UK

Lydia Plowman

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

Angela Sasse

Department of Computer Science, University College London, Gower Street, London WC1E 6BT, UK

Mike Sharples

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

Andy Whitefield

Ergonomics Unit, University College London, 26 Bedford Way, London WC1H 0AP, UK

Charles C. Wood

School of Cognitive and Computing Sciences, University of Sussex, Falmer, Brighton, Sussex BN1 9QH, UK

Contents

List of Contributors	xiii
1 Introduction M. Sharples	1
2 Research Issues in the Study of Computer Supported Collaborative Writing	
M. Sharples, J.S. Goodlet, E.E. Beck, C.C. Wood, S.M. Easterbrook and L. Plowman	9
3 Social Writing: Premises and Practices in Computerized Contexts	
R. Newman and J. Newman	29
4 Computer Networking for Development of Distance Education Courses A.R. Kaye	41
5 How Collaborative is Collaborative Writing? An Analysis of the Production of Two Technical Reports A. Dillon	60
A. Dillon	69
6 A Survey of Experiences of Collaborative Writing E.E. Beck	87
Multimedia Conferencing as a Tool for Collaborative	
S. Baydere, T. Casey, S. Chuang, M. Handley, N. Ismail and A. Sasse	113

8 Reviewing Designs for a Synchronous–Asynchronous Group Editing Environment V.C. Miles, J.C. McCarthy, A.J. Dix, M.D. Harrison and A.F. Monk	137
9 A Case Study in Task Analysis for the Design of a Collaborative Document Production System I. Denley, A. Whitefield and J. May	161
10 MILO: A Computer-Based Tool for (Co-)Authoring Structured Documents S. Jones	185
References	203
Subject Index	213
Name Index	219

Contents

List of	Contributors	xiii
1 Intro	oduction	
M. Sha	rples	1
1.1	The Collaborative Tradition	1
	New Ways of Working Together	3
	Grand Plans or Small Tools	4
Collab	earch Issues in the Study of Computer Supported orative Writing	
M. Shai	rples, J.S. Goodlet, E.E. Beck, C.C. Wood,	
S.M. E	asterbrook and L. Plowman	9
2.1	Introduction	9
	Background	10
	Writing and Group Working	11
	2.3.1 Single-Author Writing	11
	2.3.2 Small-Group Working	12
	2.3.3 Collaborative Writing	13
2.4	Research Issues	13
2.5	Task Issues	14
	2.5.1 Strategies for Partitioning and Coordination	14
	2.5.2 Interleaving Tasks	16
2.6	Group Issues	17
	2.6.1 Substitutability and Interdependence	
	Between Group Members	17
	2.6.2 Roles	17
	2.6.3 Management of Conflict	18
	2.6.4 Sub-Groups	19
2.7	Communication Issues	20
	2.7.1 Identifying the Purpose of a Communicated	
	Representation	20
	2.7.2 Communication in Context	21

	2.7.3 Deindividuation and Media Effects	21
	2.7.4 Structured Communication	22
2.8	External Representation Issues	23
	2.8.1 What To Represent?	23
	2.8.2 Constraints	24
	2.8.3 Communication of Representations	25
	2.8.4 Effects of Media on Representations	26
	2.8.5 Version Management	27
2.9	Conclusion	27
2.6.	-1 variety in the land of the land	
Conte	al Writing: Premises and Practices in Computerized	
		20
K. New	man and J. Newman	29
3.1		29
3.2	0	30
	3.2.1 Perspectives	30
	3.2.2 Technology	33
3.3	Case Studies	34
	3.3.1 Case Study 1: A Specification	34
	3.3.2 Case Study 2: A Document to Support	
	Budget Allocation Decisions	36
3.4	Conclusions	39
	ion Courses	41
	Introduction	
4.2		41
4.2	4.2.1 Models of Course Development	42
	4.2.2 Course Team Work: An Instrumental	43
	Perspective	44
	4.2.3 Course Team Work: What it's Really Like	
43	Technology Support for Course Team Work	48
7.5	4.3.1 Networked Groupware	53 54
	4.3.2 Three Success Stories	5 4
	4.3.3 Factors Affecting Successful	20
	Implementation	60
4.4	Conclusion	63
7.7	Conclusion	03
5 How	Collaborative is Collaborative Writing?	
An Ana	alysis of the Production of Two Technical Reports	
A. Dillo	n	69
5.1	Introduction	69
5.2	Background and Method	71
5.3	Document 1: The Consultancy Report	72
	5.3.1 Authors	70

	5.3.2 Document and Facilities	. 7
	5.3.3 Design and Procedure	. 7
	5.3.4 Results for Document 1	
5.	Document 2: The Project Document	
Ů.	5.4.1 Authors	. 7
	5.4.2 Document and Facilities	. , . 7
	5.4.3 Design and Procedure	. <i>7</i>
	5.4.4 Results for Document 2	
5.5		
5.6	Conclusion	. 8
6 4 5	urvey of Experiences of Collaborative Writing	
	ck	87
6.1	Introduction	82
6.2	Method	9(
6.3	Results	9
	6.3.1 Document	91
	6.3.2 Organization of Work	93
	6.3.3 Group	96
	6.3.4 Orientation	102
6.1	Discussion	-
0.4		107
	6.4.1 Results	107
	6.4.2 Coverage	110
Writin S. Baya	timedia Conferencing as a Tool for Collaborative g: A Case Study ere, T. Casey, S. Chuang, M. Handley, N. Ismail and	
A. Sass	2	113
	Introduction	
7.1	THE OCCUPATION OF THE PROPERTY	110
	7 1 1 Collaborative Militia	
	7.1.1 Collaborative Writing	113
	7.1.2 Multimedia Conferencing	113
	7.1.2 Multimedia Conferencing	113 114
	7.1.2 Multimedia Conferencing	113 114 114
7 0	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study	113 114 114 115
7.2	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism	113 114 114 115 116
7.2	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System	113 114 114 115
7.2	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System. 7.2.2 Electronic Mail	113 114 114 115 116
7.2	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore	113 114 114 115 116 116
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control	113 114 114 115 116 116 117
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution	113 114 114 115 116 116 117 118
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support. 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System. 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution. 7.3.1 Generating Ideas.	113 114 114 115 116 117 118 118 120
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support. 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System. 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution. 7.3.1 Generating Ideas.	113 114 115 116 116 117 118 118 120 120
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development	113 114 115 116 116 117 118 118 120 120 122
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development 7.3.3 Review and Commenting	113 114 115 116 116 117 118 118 120 120 122 124
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development 7.3.3 Review and Commenting 7.3.4 Integration	113 114 115 116 116 117 118 118 120 120 122 124 126
7.3	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development 7.3.3 Review and Commenting 7.3.4 Integration 7.3.5 Decision Making and Conflict Resolution	113 114 115 116 116 117 118 118 120 120 122 124 126 128
	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development 7.3.3 Review and Commenting 7.3.4 Integration 7.3.5 Decision Making and Conflict Resolution Assessment and Evaluation	113 114 115 116 116 117 118 118 120 120 122 124 126
7.3	7.1.2 Multimedia Conferencing 7.1.3 Collaborative Writing with Multimedia Conferencing Support 7.1.4 Case Study Supporting Mechanism 7.2.1 CAR Multimedia Conferencing System 7.2.2 Electronic Mail 7.2.3 Shared Filestore 7.2.4 Consistency and Concurrency Control Document Evolution 7.3.1 Generating Ideas 7.3.2 Managing the Development 7.3.3 Review and Commenting 7.3.4 Integration 7.3.5 Decision Making and Conflict Resolution	114 115 116 116 117 118 118 120 120 122 124 126 128

x

7.5	7.4.2 SCCS	. 1
8 Rev	iewing Designs for a Synchronous-Asynchronous	
Group	Editing Environment	
V.C. N	liles, J.C. McCarthy, A.J. Dix, M.D. Harrison and	
A.F. M	onk	1.
8.1	Introduction	1,
8.2	Cooperative Work	1.
	8.2.1 Direct Communication	13
	8.2.2 Shared Artefacts	1
	8.2.3 Broad-Based Requirements	14
8.3	Issues in Computer Support for Direct Communication	14
	8.3.1 Some Ideas for Conversation Space Design	14
8.4		14
	8.4.1 Some Ideas for Shared Editor Design	15
8.5	gg	
	Shared Editor	15
	8.5.1 Establishing Referential Identity	15
	8.5.2 Providing a "Global" Conversation Space	15
8.6	8.5.3 Playback Facilities	15 15
	se Study in Task Analysis for the Design of a	
	orative Document Production System y, A. Whitefield and J. May	16
. Denle	y, A. Whitefield and J. May	
. Denle 9.1	y, A. Whitefield and J. May	16
. Denle 9.1	y, A. Whitefield and J. May Introduction	16 16
. Denle 9.1	Introduction	16 16 16
. Denle 9.1	Introduction	16 16 16
. Denle 9.1 9.2	Introduction	16 16 16
9.1 9.2 9.3	Introduction	16 16 16 16
9.1 9.2 9.3	Introduction	16 16 16 16
9.1 9.2 9.3	Introduction	16 16 16 16 16
9.1 9.2 9.3	Introduction	16 16 16 16 16 16
9.1 9.2 9.3 9.4	Introduction	16 16 16 16 16 16
9.1 9.2 9.3	Introduction	16 16 16 16 16 16 16 16 17 18
9.1 9.2 9.3 9.4	Introduction	16 16 16 16 16 16 16 16
9.1 9.2 9.3 9.4	Introduction	166 166 166 166 166 166 177 188
9.1 9.2 9.3 9.4	Introduction	16 16 16 16 16 16 16 16 17 18
9.1 9.2 9.3 9.4 9.5	Introduction Context of the Design 9.2.1 IBC and End-User Service Integration 9.2.2 Reasons for Undertaking the Design 9.2.3 The Selection of the Application The Task Analysis Concepts A Task Analysis of Multi-Author Multimedia Document Production 9.4.1 Task Observations 9.4.2 The Task Analysis 9.4.3 A Specific Instantiation of the Scenario Discussion 9.5.1 The Final Design 9.5.2 Concluding Comments Concerning the Task Analysis	166 166 166 166 166 166 177 188
9.1 9.2 9.3 9.4 9.5	Introduction	166 166 166 166 166 166 177 188
9.1 9.2 9.3 9.4 9.5 0 MII	Introduction	166 166 166 166 166 166 177 188
9.1 9.2 9.3 9.4 9.5 0 MII Structu	Introduction	16 16 16 16 16 16 16 17 18 18

10.2	Designing Systems for Use Now	186
10.3	Introducing MILO	186
	10.3.1 Related Systems	182
	10.3.2 Notes	188
	10.3.3 Creating Documents	190
	10.3.4 Amending MILO Documents	192
	10.3.5 Collaboration	194
	10.3.6 Communicating via MILO	194
	10.3.7 Viewing MILO Documents	197
10.4	Observations from Use of MILO	199
10.5	Future Work	201
10.6	Implementation	201
10.7	Summary	202
Referen	ces	203
Subject	Index	213
Name In	dex	219

Chapter 1

Introduction

M. Sharples

1.1 The Collaborative Tradition

Collaborative writing is nothing new. The description below is from the introduction to a book published in 1911:

Every page, however, has been debated and passed by the three of us. Our usual method has been, first to pick up a subject that interested us, perhaps a subject we had been talking about for a long while, then to discuss it and argue over it, ashore and afloat, in company and by ourselves, till we came to our joint conclusion. Then on a rough day, in a set-to discussion, I would take down notes, which frequently amounted in length to more than half the finished article. From the notes I would make a rough draft, which, after more discussion, would be rewritten, and again, after revision, typewritten. We would go through the printer's proofs together and finally, after reading the matter in print, we have once more revised it for book publication. Collaboration could not be more thorough. (Reynolds, et al. 1911, p. x)

The book, Seems So! A Working-class View of Politics, was written by an academic working closely with two fishermen. What makes it unusual, now as then, is its insight into the sharing of ideas and feelings as part of writing, and also its open celebration of joint authorship, as a means of recording the authentic voice of English working men:

Thus, the three of us have done together, as well as we could, what neither of us separately could have done at all – which, surely, is the essence of collaboration. (Reynolds et al. 1911, p. xii)

To gain from such a close collaboration each writer has to offer up ideas and experiences and has to be willing to accept the identity and consensus of the group. It can bring the rewards of creating a text which transcends the identity and knowledge of any single contributor, but at the cost of hard

work to overcome conflict, to coordinate the activities and to arrive at a shared understanding. Reynolds, in his own introduction to Seems So!, says that "every page was debated and passed by the three of us".

If the work is intended for publication then co-authorship may well not be worth the effort. Disincentives include the refusal of some universities to accept co-authored works in review for promotion, the omission of all but the first author in citations, and the difficulty for joint authors of fiction to fit into the whirl of book signings and publicity appearances. Ede and Lunsford (1990) offer as an example of co-authored fiction a novel, *The Whole Family*, published in 1908 by twelve authors including Henry James; although it is a unique exercise in collaborative literature, the novel gains no mention in the *Oxford Companion to English Literature*. We work in a culture which values individual responsibility for ideas and which promotes the ideal of the lone author struggling for self-expression. It is not surprising that (apart from scientific literature where research requires team effort) joint authorship is rare.

Far more widespread than acknowledged co-authorship is the practice of loose, informal collaboration: the sharing of ideas and opinions, supportive but critical reading of drafts, emotional support during the dark days of writer's block. Behind the imprint of a single author there lies a complex web of friends, colleagues and unacknowledged influences. Couture and Rymer (1991) differentiate between group writing, in which all or part of a document is jointly authored, and interactive writing, where the writer depends on a degree of interaction with colleagues at some point during the process of writing. This interaction may lead directly to text, as when a discussion in the pub or common room offers a writer new ideas or a new line of argument. Or it may come indirectly, from a circle of friends and the culture of the work-place. All writing is interactive in the sense that it arises out of an author's interactions with the surrounding world of talk, correspondence and activity.

Intellectuals have traditionally used written correspondence as a source of ideas and inspiration. The collected letters of Charles Darwin fill seven volumes and the foreword to the first volume notes that:

These letters place him in his social and intellectual contexts and clarify the extensive scientific network of which he was a part. The nature of his work and his poor health left him more than usually dependent upon correspondence in carrying out his investigations. (Burkhardt and Smith 1985, p. xv)

The inspiration of correspondence may not always be benign and abstracted. In Six Studies in Quarrelling, Brome (1958) picks out some delicious feuds conducted by letter among George Bernard Shaw, H.G. Wells, Hilaire Belloc and others.

Authors of fiction have formed into literary groups for mutual support and as a safe haven from which to sail out and challenge the literary establishment. The most celebrated of these was the Bloomsbury Group, but others included the friendship of Wordsworth, Coleridge, Scott and De Quincey, and the circle of Keats, Percy and Mary Shelley, Byron and others. In some cases the influence of informal groups on writing can be subtle but quite direct. In her introduction to Frankenstein, Mary Shelley wrote:

But it proved a wet uncongenial summer, and incessant rain often confined us for days to the house ... "We will each write a ghost story", said Lord Byron, and his proposition was acceded to ... At first I thought but of a few pages – of a short tale, but Shelley urged me to develope the idea at greater length. I certainly did not owe the suggestion of one incident, nor scarcely one train of feeling to my husband, and yet but for his incitement it would never have taken the form in which it was presented to the world. (Shelley 1985, p. 52–56)

1.2 New Ways of Working Together

The distinction between loose, informal collaboration in private and single authorship or formal co-authorship in public has been crumbling for some years. The growth of interdisciplinary studies, of international research projects, of team-based news reporting, of distributed work groups within large companies, of consortia to carry out pre-competitive product development, have all exerted political and organizational pressures on writers to be seen to be collaborating.

These writing groups often consist of people who rarely meet face-to-face and who come from widely differing cultures and organizations, yet they are expected to collaborate closely, and to tight schedules. For example, to gain funds from the ESPRIT European research initiative, a consortium must consist of partners in three or more different countries and be able to make revisions and write technical addenda to a proposal within days. An ESPRIT proposal, running to around 100 pages, must be jointly written and agreed by all the partners. There is no time for leisurely academic discussions or the painstaking work of scientific cooperation. The tools for this new high-speed semi-formal collaborative writing are the telephone, the fax and the computer.

At first sight, computers seem merely to extend the traditional means of collaboration: electronic mail (email) substitutes for letter writing, computer conferencing substitutes for meetings, shared databases stand in for filing systems and libraries. But each of these systems offers new ways of working and blurs the boundary between informal and formal collaboration.

The speed with which computer-based messages can be formed and transmitted means that email and bulletin boards are often used for informal discourse. They enable unstructured interest groups to form, exchanging knowledge and opinions rapidly across national boundaries; much of the academic debate about the possibility of "cold fusion", for example, was conducted over email. Studies of email discussion (Siegel et