

COMMERCIAL IN CONFIDENCE

SCIENCE AND ENGINEERING RESEARCH COUNCIL
RUTHERFORD APPLETON LABORATORY

INFORMATICS DIVISION

SOFTWARE ENGINEERING GROUP NOTE 109

DTI/MOD ALIGNMENT
Text of RWW's Presentation

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1. INTRODUCTION

1.1 The Alvey Software Engineering Programme will run from 1983-1989. It implements the first five years of a ten year plan outlined in the Alvey Committee Report (1982).

1.2 The Alvey SE Programme's long term objective is the creation of the Information Systems Factory (ISF). This is to be the culmination of three generations of Integrated Project Support Environment (IPSE). This ambition is predicated on progress in the two crucial areas of

1. Quality of the Software Product.
2. Productivity of the Software Development Process.

1.3 The Alvey SE Programme is trying to build up the

METHODS
SKILLS
TOOLS

to enable the UK to produce high quality, cost effective software to world leading standards.

1.4 To derive benefit from this work prior to the achievement of the ISF the Alvey SE strategy is attempting to encourage intermediate levels of technology transfer by establishing a pipeline of activities:

- i. Innovation: research and development to extend the methods, techniques and theoretical basis of software engineering.
- ii. Integration: the development of integrated sets of methods and tools for both the hardware and software components of systems, covering all phases of the System Life Cycle. The focus for this work is the ISF and IPSE goals.
- iii. Exploitation: encouragement, so far as Alvey is allowed, to ensure that existing methods are effectively used and their benefits gained by industry as a whole. Additionally, encouragement for the technology transfer of new methods and tools, with the associated requirement for training and investment. Industry must acquire new skills if it is to effectively exploit new methods and tools.

2. BUDGET POSITION

2.1 The total budget for the Alvey SE Programme is £65M over 5 years made up from:

ALVEY SE BUDGET (£M)		
DTI/MOD	25	
SERC	15	
Government	40	40
Industry		25
TOTAL		65

2.2 Strategically it was planned to divide these funds between:

Strategy Component	Budget (£M)	%
INNOVATION	20	30
INTEGRATION	28	44
EXPLOITATION	17	26
TOTAL	65	100

but now DTI IT Division are helping with 'Exploitation' so enabling Alvey to do slightly more 'Innovation' and 'Integration'.

2.3 We currently have some 84% of our budget committed. A more detailed breakdown of this position is given in Appendix A. This commitment currently employs about 300 man years per year for 1985 and 1986 on 71 projects:

- i. 28 fully collaborative projects involving 31 different firms, 17 different Universities, 5 Polytechnics and 3 Government Establishments (these are listed in Appendix B). These projects consume 90% of the grant money allocated so far and although many contain elements of both Innovation and Exploitation activity, they are mainly concerned with Integration.

ii. 20 "Uncle" projects involving 13 different Universities and RAL with 10 different firms as industrial "Uncles". These projects are almost exclusive concerned with Innovation (these are additional to the inherited SERC STI). A list is set out in Appendix C.

iii. 23 very small activities concerned with improving our general infrastructure ie more tools for research, interchange of workers and specialised workshops. Category (ii) and (iii) consume the balance of 10% of grants allocated to date.

2.4 The remaining 16% has already been provisionally allocated, either to known project applications or to planned future activities.

3. KEY TECHNICAL AREAS

3.1 Innovation

- i. Formal Specification
- ii. Verification and Theorem Proving
- iii. Reliability, Safety
- iv. Quality Certification
- v. Metrics
- vi. Reusability
- vii. IKBS for SE

3.2 The academic community is making good progress in the formal, theoretical topics. Industry is beginning to show some interest due to 'awareness' activities. Alvey is worried that industry as a whole will fail to exploit formal methods because it will not make the necessary investment in Training. Alvey is worried that not enough work in topics iii-vi is taking place. It is the scale which is too small rather than the quality.

3.3 Integration

- i. IPSE/ISF
- ii. Public Tool Interfaces
- iii. Software Process
- iv. Project Management

3.4 The Alvey Strategy calls for the development of three generations of IPSE; the first being file based, the second being database based, and the third being knowledge base based. The original idea of a file based UNIX IPSE was modified early to one which sought to establish two objectives for Alvey first generation IPSEs. The first (in line with the original idea) concerned early output and demonstration of what an IPSE could do for the developer. The second objective was to provide the basis for an incremental "bottom up" approach to the goals for the second generation IPSE.

3.5 In terms of the exploitation objective, the IPSE concept has now become well established - a number of tool providers are now pushing IPSEs either under the title of an IPSE or associating their product with IPSE concepts and values - ICL with its application builder set of products, BIS, IST and at least a few others.

3.6 The Alvey "bottom up", first generation projects ASPECT and ECLIPSE have now been running for over one year. ASPECT has now cut away from GEC; strengthened its MMI aspirations with ICL and has spent some considerable time revising elements of its plan and goals. Given that the new commitment of ICL is turned into good work, it would appear that ASPECT is now soundly based and its later deliverables will make a good/very good contribution to overall ALVEY output.

3.7 ECLIPSE has goals and approaches that are in part competitive and in part complimenting to those of ASPECT. It is clear, however, that significant replanning will be necessary if the project is to stay with original budget limits and overall it is likely that some additional funding will be necessary (as it is with ASPECT's MMI work) if we continue to aim for a good subset of the initial ambitions. However, as with ASPECT the deliverables will make good/very good contributions to the programme.

3.8 The ICL/STC led IPSE 2.5 project is the "top down" approach to the second generation and the project claims that it will go beyond the spirit of the second generation. We have now had a number of further discussions with the IPSE 2.5 team and we are in possession of their initial plan. Overall, we are now considerably more encouraged that the team are getting their act together and that we will shortly have a soundly based project and one which is, moreover, clearly differentiated from Aspect and Eclipse. It will continue to be the case, however, that much careful work will be needed with the project to turn these plans into actual outputs.

3.9 Overall ASPECT and ECLIPSE still need some work to confirm revised plans and goals. Both will require a level of additional ALVEY funding. Trial users will also need to be formally confirmed but given that both projects succeed, then the environments produced would appear to be quite competitive with any identified so far.

3.10 IPSE 2.5 could still be the most significant output for the programme. However, there remain real risks and much work to do.

3.11 Two additional points should also be recalled at this stage:

- i. The Advanced Project Support Environment study continues to provide a useful set of references.
- ii. The public tool interface position is still to be settled. We are increasingly taking the view that the most useful public tool interface will be that defined by the Esprit PCTE project. Brian Gladman of MOD knows of our intentions and is, we believe, supportive.

3.12 With respect to the third generation IPSE definition work, we have now a useful set of "IKBS for SE" projects in hand. The third generation IPSE definition is scheduled as an output for the back end of the programme and will draw substantially on lessons learned from other parts of Alvey - most notably IKBS. The first draft of a plan to achieve this study has now been produced and is on circulation within the team.

3.13 Process - little/no innovative work. All the IPSE projects pledge that they will support a wide variety of process models and phase 2 of the Data Library will aim to improve our understanding of current conventional models.

3.14 Management - no innovative work but some useful but unspectacular contributions from IPSE, Quality Management, Data Library, Reliability hand book projects. Do we stop here and complete the remaining interests via a link with the ESPRIT SPMS project?

4. ACHIEVEMENTS BY 1989

4.1 Industrially exploitable formal methods especially Specification Methods backed up by prototype toolsets for VDM and Z. Big impact imminent on VLSI/CAD with theorem proving beginning to solve problems which simulation cannot handle.

4.2 Two first generation IPSEs developing into prototype second generation IPSEs (ASPECT and ECLIPSE). Ready for first use on real projects.

4.3 Research prototypes of true second generation IPSE to support formal methods (IPSE 2.5). Not ready for industrial exploitation.

4.4 Paper study of ISF design.

4.5 Well established Software Data Library collecting statistical data about the software development process.

4.6 Small numbers of training aids (Reliability handbook, Mathematics for Programming course).

4.7 Major advance in industrial awareness of existence of new formal methods, capital intensive software tools running on sophisticated workstations with latest MMI techniques, use of IPSEs for whole life cycle project support.

4.8 IKBS techniques will have been assimilated into the normal software engineering repertoire. IKBS based tools will be available to help software development.

5. PROBLEMS

5.1 Lack of research into safety, reliability, reusability and metrics.

5.2 Lack of progress towards quality certification.

5.3 Impending discontinuity in both funding and strategy due to Alvey commitment finishing in 1986 and no prospect of new money or mechanism for some years.

5.4 Lack of technology transfer and development activity to exploit Alvey work. DTI IT Division is helping with Exploitation.

5.5 Industry still not got the 'research habit' unless government funded and driven.

5.6 Alvey has no direct way to foster development work and pre-production prototypes.

5.7 Lack of training for middle and senior levels will hamper take up of new ideas.

5.8 Lack of investment in training and new methods and tools likely to occur as too many small companies in the software industry cannot invest.

5.9 Reluctance of purchasers to take whole life cycle view of project costings. STARTS initiative is helping.

5.10 Aggressive foreign competition in the shape of research and development programmes much bigger than Alvey plus commercial aggression in the market place and takeovers etc.

5.11 Reluctance of UK companies to tackle software products market and exporting.

6. ISSUES FOR MOD/DTI COLLABORATION

6.1 Ada

6.2 IPSE evaluation and first use (STARTS?)

6.3 Joint research on safety, security, reliability

6.4 Joint work on formal methods

6.5 Help bring VLSI/CAD together with SE community as formal methods work showing that next leap forward in VLSI will be the use of theorem proving in CAD rather than simulation.

6.6 More commercial orientation of MOD policy (not Coral, Algol 68,)

6.7 Data for Software Data Library

6.8 Technology Transfer, Demonstrators, Pull Through

6.9 Reusability work to be supported by MOD(PE)?

6.10 Better UK industrial infrastructure (eg e-mail between all contractors)

6.11 Cooperation on establishment of Public Tool Interface specifications.

APPENDIX A

BUDGET/CURRENT COMMITMENT

ITEM	DTI/MOD fm	SERC fm	
Existing Grants	-	2.6	
Approved Alvey Grants 7/11/85	18.6	7.7	
Infrastructure/ Consultation etc	4.9	2.4	
TOTAL	23.5	12.7	36.2
BUDGET (COMMITMENT)	25.9	15.1	41.0
% COMMITMENT	91	84	88

- NOTES: 1. 84% of public funds (£40m) committed.
 2. £2.6m SERC STI 'repayable'.
 3. Total budget £65M; £25M from industry.

APPENDIX B

Collaborative Projects

<u>Firms</u>	<u>Universities/ Polytechnics</u>	<u>Govt. Establishments</u>
Baddely Associates	Aston	Harwell
BIS	Coventry (P)	NPL
British Gas	Edinburgh	<u>RSRE</u>
British Steel	Hatfield (P)	3
British Telecom	Imperial	<hr/>
BSI	Kent	
Camgraph	Lancaster	
CAP	Leicester	
CEGB	London (Queen Elisabeth College)	
Dowty	Loughbrough	
Datalogic	Liverpool	
Ferranti	Manchester	
GEC	Newcastle	
ICL	Oxford	
Imperial Software Technology	Sheffield (P)	
LBMS	Southbank (P)	
LDRA	Stirling	
Logica	Strathclyde	
Logsys	Surrey	
Mari	UMIST	
Michael Jackson	University College Wales	
NCC	<u>York</u>	
National Centre Systems Reliability	18 + 4	
Plessey	<hr/>	
Praxis		
Racal		
Scicon		
Systems Designers		
Software Sciences		
STC		
<u>Yard</u>		

APPENDIX C

Uncle Projects

<u>Universities/ Polytechnics</u>	<u>Firms (Uncles)</u>	<u>Govt Establishments</u>
*Bradford	**Acorn	RAL
*Cambridge	**British Aerospace	
Edinburgh	British Telecom	
*Essex	CAP	
Imperial	**CSR	
*Keele	ICL	
Kent	**Inmos	
Manchester	IST	
Newcastle	System Designers	
*Open University	**Topexpress	
Oxford		
Stirling		
<u>Umist</u>		
13	10	1

- * Universities with Unlce only projects
- ** Firms with Uncle only projects

ALVEY SE PROGRAMME

- * INFORMATION SYSTEMS FACTORY (ISF)
- * QUALITY OF SOFTWARE PRODUCT
- * PRODUCTIVITY OF SOFTWARE DEVELOPMENT PROCESS
- * INTEGRATED PROJECT SUPPORT ENVIRONMENT (IPSE)

STRATEGY COMPONENT	BUDGET (£M)	%
INNOVATION	20	30
INTEGRATION	28	44
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TOTAL	65	100

TECHNICAL STRATEGY

STRATEGY	INNOVATION AND UNDERSTANDING	INTEGRATION AND IMPLEMENTATION	EXPLOITATION AND EVALUATION
METHODS AND PROCESSES	SPECIFICATION V&V RELIABILITY QUALITY METRICS REUSABILITY	BLEND TECHNIQUES INTO LIFE CYCLE METHODS FOR BOTH HARDWARE AND SOFTWARE	MEASURE USE OF IPSE
MANAGEMENT	MODELS OF DEVELOPMENT AND MAINTENANCE PROCESSES AND METHODS	INTEGRATE DEVELOPMENT METHODS WITH MANAGEMENT TECHNIQUES	EVALUATE USE OF IPSE
ENVIRONMENT	INFLUENCE ON PRODUCTIVITY AND QUALITY MMI, IKBS, DCS	BUILD IPSEs	MAKE IPSE AVAILABLE VIA CENTRES

ACHIEVEMENTS

- * FORMAL METHODS - SPECIFICATION
 - VERIFICATION (S/W AND VLSI/CAD)

- * IPSE
 - ASPECT, ECLIPSE, IPSE 2.5

- * SOFTWARE DATA LIBRARY

- * TRAINING AIDS

- * AWARENESS
 - FORMAL METHODS
 - IPSE/ISF
 - NEED FOR INVESTMENT IN TOOLS AND TRAINING
 - WHOLE LIFE CYCLE APPROACH

- * USE OF IKBS TECHNIQUES 'NORMALISED'.