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issued by
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WORLD BANK REPORT
CHINESE UNIVERSITIES DEVELOPMENT PROJECT
Visit to South China Institute of Technology
Guangzhou, April-May 1986

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1. INTRODUCTION

It was a great privilege and pleasure to visit the South China Institute of Technology as part of the Chinese Universities Development Project sponsored by the World Bank in association with the Chinese Ministry of Education.

SCIT originally invited me to visit them in November 1985, so that I might accompany Mr John Burren, also of RAL, who visited Prof Ni Yong-ren between 10 November-7 December 1985. Unfortunately I was unable to accept the invitation due to my work for the Cabinet Office on the ACARD Report. The ACARD Report was submitted to the Prime Minister at Easter 1986 and about the same time I met Prof Zienkiewicz who indicated that a visit might still be possible if it could take place before the end of April 1986. Thanks to prompt work by Prof Chen of SCIT and Mr Beemer and his staff in Washington a visit to SCIT was organised very quickly. The actual visit took place between 20 April-18 May 1986.

It was of enormous benefit to me that Mr Burren had visited SCIT the previous November. Mr Burren was able to give me an extremely helpful briefing before my visit, as well as a copy of his detailed report, whose findings and recommendations I completely endorse.

My host for the visit was Prof Chen Xingye, Chairman of the Computer Science Department at SCIT who made me most welcome. Prof Chen and his colleagues were all most helpful as well as hospitable, and I am grateful to them all for their time and consideration.

2. OVERVIEW OF THE SCIT COMPUTER SCIENCE DEPARTMENT

Computing at SCIT spans the Computer Science Department, the Honeywell equipped Computer Centre and the Communications Department. John Burren's report gives an excellent description of the inter-relationship and details of these three so I will concentrate on the Computer Science Department.

SCIT itself was founded in the mid fifties and has gone through various reorganisations, expansions and contractions which mirror the development of the People's Republic of China since its establishment in 1949.

Since the end of the Cultural Revolution (1976 approx) China has been pursuing a vigorous modernisation policy, with considerable emphasis being given to science and technology which were considerably behind western standards by 1976.

Computing matters at SCIT were handled by the Department of Automation from 1958-1987. In 1981 a separate Department of Computer Science was formed, by people with a predominantly hardware background. In China, Institutes of Technology are exclusively engineering organisations, so SCIT contains no mathematics or basic sciences departments. This means that the Computer Science Department was formed by electrical

engineers with no mathematicians or physicists to call on in contrast to the 60s and 70s in European and the American universities where computer science departments were formed by mathematicians, scientists and engineers. China, even more than western countries, is short of software skills. This has delayed the build up of the software side of SCIT's activities.

The Department currently has 48 academic staff, including one full professor (Ni), 6 associate professors, 27 lecturers and 14 teaching assistants. Teaching assistants are qualified to at least MSc level. However they do not teach, but just help with course work using the Department's computing facilities and tutorial work. They can then progress to associate professor and full professor.

Each year the Department takes in 90 new undergraduates who follow a four year course to reach BSc level. Thus the Department has 360 undergraduates.

Being such a new department, SCIT CS has only 9 postgraduate research students as yet, 3 in the second year and 6 in the first. Two students, Mr Chen Gang and Mr Zhong, recently received their MSc degrees and have become Teaching Assistants in the Department. The postgraduate students take 3 years to gain their MScs. The first one and half years are taken up by taught courses, which are examined, with the second one and half years being spent on research work culminating in a dissertation.

There are no PhD students in the Department. To take PhD students requires special accreditation by the central authorities in Beijing. This typically requires a department to host a famous full professor (such as Prof Tang who visited us at the Alvey Directorate last year). A prospective PhD student must first gain an MSc, then pass another entrance exam for potential PhD students and then actually be accepted by a professor. The number of PhD places is very small in relation to the demand. This helps to explain

a. the extremely high standard of Chinese PhD students who have come to the UK,

b. why they are older than their UK equivalents

c. why they are so keen to seek foreign scholarships, in addition to the obvious advantages of studying in the more advanced western universities.

Under World Bank funded Chinese Universities Development Project Phase I the following PhD studentship distribution occurred:

USA	603
Canada	118
UK	83
Japan	15
Europe (non UK)	46
Australia	14
	879

The SCIT academic year consists of two 21 week terms, with a 6 week summer vacation and a 4 week winter vacation (a missing week!). The teaching is organised around 45 minute lecture periods, scheduled hourly. The working week in Guangzhou is 7.30-11.30 am, 2.30-5.30 pm, 6 days a week. Sunday is the day off. Undergraduates do between 2 and 6 lectures per day, MSc students do 2 classes per day. For some subjects 'double classes' occupy consecutive periods.

The Department has its own computing equipment, as well as using the Computer Centre; this is the same as UK practice. The Department now has:

1 Honeywell DPS6 minicomputer (housed in the Computer Centre)
- 4 terminals now but order recently signed for 15 more.

3 IBM PC/AT

5 IBM PC/XT

1 IBM PC/XT Compatible

2 IBM PC

50 Apple II Plus

15 Zilog Z80 single board micros

2 Tektronics 8301 Microprocessor Development System.

The Computer Centre has a Honeywell DPS8/49 with 68 terminals and a Gould CAD system, (one of 11 bought for various sites last year by Ministry of Education and Science with World Bank money), consisting of

Gould 32/2750 mini
Tektronics 640 x 420 colour terminal
Tektronics video hardcopy unit
H-P 36" colour pen plotter
Tektronics basic graphics software

During my visit I met

Bing-Zheng Xu (Prof, SCIT Vice President and Director of the Institute of Radio Engineering and Automation)

Ni Yongren (Prof, John Burren's host)

Chen Xingye (Chairman of CS Dept and my host) (assoc prof)

Guo Heqing (Mrs) (Vice Chairman) (assoc prof)

Zhang Reju (Mrs) (assoc prof)

Guan Shihong (assoc prof)

Chen Gang (Teaching Assistant)

Chen Dongfan (Teaching Assistant)

Wang SCIT Dept of Foreign Affairs

3. LECTURES

During my visit I gave lectures on the 'state of the art' in Software Engineering. The topics were:

Scope of Software Engineering
Software Crisis
Software Life Cycle
System Project Planning
Requirements Analysis
Software Specification (2 lectures)
Design (2 lectures)
Verification and Proof
Coding and Building
Testing
Maintenance

These lectures were mainly to teach the undergraduates about Software Engineering. Postgraduates and members of staff also attended. Each lecture took place in the Computer Centre as a two and half hour session with a short break in the middle.

Due to the rather rapid timescale in which the visit to SCIT was organised the desire on SCIT's part that I teach an undergraduate course did not get communicated to the UK before my departure. Hence I went to SCIT with a set of lectures about the state of the world software industry, the various national programmes of Software Engineering research in America, Europe and Japan, details of the UK national research programme and technical details of software engineering current research; topics which were requested in the original letter of invitation.

During my visit to SCIT I produced over 200 pages of notes, being the written version of the lectures I actually gave. A copy of this new material was left with Prof Chen.

The lectures were given in English with no interpreter. I was extremely impressed by the students' ability to absorb such technical material directly from lectures. I was encouraged to find that they laughed at the jokes, so good was their English (as opposed to my jokes), and that they were taking down good notes. I was delighted when one student found an error in an example I gave - this was very encouraging feedback on the comprehension question. All the students were attentive, friendly, polite and well behaved; it was a pleasure to work for them.

4. MATERIAL

I left a considerable number of papers with Prof Chen on current work in Software Engineering, details of the research being carried out in America, Europe and Japan, and the world software industry.

I left various books with SCIT and will be sending them further books and material as a result of the discussions we had.

5. DISCUSSION

I spent quite a long time describing the work going on in the field of software engineering generally as well as the UK and my own group at RAL.

Discussion were also held on the topics of teaching software engineering at SCIT, and postgraduate and staff research in software engineering at SCIT.

The Department has only recently entered the software engineering field and my views and recommendations on the current and future work at SCIT are given below. I also gave Prof Chen a more detailed set of comments and recommendations.

6. CURRICULUM DEVELOPMENT

1. The Computer Science BSc degree course has its origins in computer hardware and has only recently begun to encompass the software aspects of computer science. The course is now looking to have a 'hardware' and a 'software' stream. I would urge SCIT to try to avoid too great a polarisation into two 'factions'. Graduates need to be 'systems engineers' with a good grounding in both hardware and software principles. The idea of a common course in years 1 and 2, with options in the 3rd and 4th years is good. To avoid the hardware v software polarisation students should be able to choose both hardware and software options and not be too rigidly divided into one faction or the other.

2. The curre operating system course uses the source code of Unix ve ion 6 and Chinese language text books on V6 and V7. SCIT h no ability to actually run the Unix operating system. I suggest that, as Unix V6 has been obsolete for 10 years, and was considerably poorer quality than V7, its use should be replaced by a study of the current Berkeley system Unix, BSD4.3. Many good, up to date text books, in English are now available for Unix. (SCIT need to be able to run Unix too, see below).

3. Students should be encouraged to read, study and modify existing (large) source codes, not just write new small programs from scratch. This will give them a better feel for the scale of software engineering and a more realistic view of software engineering as the development and maintenance of existing code rather than always being new implementation work.

   The obvious large source code to use is Unix. This is already done at SCIT with V6 as a paper exercise but needs to be done with BSD4.3 on a real machine.

   It would also be extremely useful if other large source codes could be made available to students such as large application programs like stock control or engineering design calculations packages. These are not readily available from Chinese sources as Chinese industry is not so 'computerised' as the west. The World Bank could help by providing funds to supply such source codes. This would be a relatively small amount of money compared to buying new equipment but would be of great value.

4. The amount of computer science theory taught needs to be increased. Very little is done now. A fourth year option on 'theoretical aspects' should be introduced. This should encompass topics such as grammar theory, computability, recursive function theory, predicate logic, semantics, specification, proof of correctness. As this option gets established it should be used to feed back into the earlier years so that more computer science principles are introduced earlier, preparing the way for the 4th year course to extend its scope as the sophistication of both staff and students increases, in computer science terms, over the next 10 years.

5. SCIT should consider the advantages of teaching Pascal in the first year rather than BASIC (which could be done later in the second year if still considered necessary). The first programming language someone learns affects their development as a programmer more than any subsequent language. Pascal teaches a much better discipline of programming than BASIC and so should be taught first.

6. During the first two years four programming languages are taught (BASIC, Pascal, Fortran, C) but little tuition is given to the common principles of program design, layout, commenting, construction etc. This needs to be built up so that students gain an ability which is independent of programming language. I studied some student programs and they were poorly commented (perhaps the lack of Chinese language features is a hindrance) and poorly laid out.

Variable names were badly chosen (being difficult to disambiguate). Again the Chinese/English problem is likely to be the root. The programs I saw were written 'in English' which was in itself a quite impressive accomplishment. Concepts such as 'defensive' programming need to be taught.

7. The idea of students doing a small number of 'experiments', ie practical course work, in teams should be taken up. Real programming and software engineering is always a team effort and the advantages, disadvantages and human/managerial issues of team work need to be experienced by the students. Perhaps one team project per year, of 4 weeks duration would a good initial target. Team size 3-6 members. Assessment by 1) final software product (team), 2) written report by each member on his/her contribution and 3) short interview with staff assessor to verify individual's contribution.

8. Students should be given a short (2 week) course on operating a large computer such as the Honeywell in the Computer Centre. This course should be run by the Computer Centre and should include tuition in basic things such as loading, care and maintenance of magnetic tapes and disks, operation of input/output peripherals and supervision of the whole system via system console operation. Real experience of running a machine, scheduling work, offering a service etc should be communicated to the students. Year 3 would be a suitable point in the course.

9. The CS Dept is quite rightly going to improve its teaching of software engineering by introducing a new course, from September 1987, in Software Engineering and my lectures at SCIT were designed to help formulate this new course. It is very difficult to teach a subject whose problems are all about the scale and complexity of 'industrial' scale software production without the personal experience of these problems and a local industrial infrastructure which exhibits these problems. For industrial experience see recommendation (8.2).

   I suggest that at least some of the staff involved with teaching the new software engineering course should be funded by the World Bank to spend a year at a Western University helping an experienced Western lecturer or professor give his software engineering course. This will improve both the experience of the SCIT staff and provide more material for the SCIT course.

7. NEW TECHNICAL EQUIPMENT

1. The present quantity and type of hardware and software tools available to SCIT for teaching and research into programming and software engineering is considerably less than would be considered a viable minimum in the West. With over 350 undergraduates and over 50 staff and postgraduates, a 4-user Honeywell minicomputer plus some IBM PCs and a share of the Institute's Apple II machines is just not enough to enable students majoring in Computer Science to get adequate experimental experience and do enough practical course work. Research in such circumstances has little chance of getting off the ground.

   I suggest that the priority need is for a modern VAX minicomputer, big enough to handle 32 terminals, running the Unix BSD4.3 system. A Unix source code licence is also necessary. Amongst the peripherals should be a small 100 pixels/inch laser printer to give decent quality Chinese character output and graphics capability.

2. The VAX should be equipped with a modem and telephone line for remote diagnostic engineering purposes and to enable the VAX to be connected to the international Unix computer network, called Usenet. This will connect SCIT to the international computing 'grapevine' - a development which would bring many advantages to speed modernisation.

3. Unix should also be purchased to run on several of the larger IBM PCs. This will give a common system amongst disparate machines and reduce the training and documentation overheads. The PCs could then be connected via the UUCP protocols to the VAX enabling access to the larger peripherals, backing store and laser printer for Chinese output. Unix contains TCP/IP which runs over Ethernet and should be of interest to the Local Area Network group.

4. The Computer Centre should investigate the feasibility of running Unix on their Gould Minicomputer. The Computer Centre should gain experience of Unix which is becoming increasingly widespread in Western Universities and computer manufacturers.

5. The CS Dept should obtain the Kerninghan and Plauger Software Tools set in Pascal. These should be mounted on the Honeywell, PCs and Apples to give a common capability across the Department's resources. An excellent text book is available to accompany this software.

8. LIBRARY FACILITIES

1. The SCIT main library and departmental library have a much smaller stock of computer science and software engineering text books than would be considered adequate in a Western university. Perhaps World Bank funds could help here as text books are relatively expensive to purchase from the West and no doubt the Chinese will not wish to ignore the copyright question in order to save foreign exchange.

2. A reasonable selection of technical journals is available at SCIT although they seem to reach SCIT about 6-12 months later than they are available in the West. Perhaps Departments could purchase them directly from the West instead of having to wait for them to be copied and distributed in China?

3. The library has no access to computer based abstracts services or database search services. These are extremely useful to Western researchers and China is beginning to produce its own versions (I read in China Daily) so perhaps the SCIT library could have the use of a terminal, modem and phone line (that is all that is needed) to firstly gain experience by using the available Western services, so as to be ready to use the emerging Chinese facilities.

4. No facilities exist to handle microfiche. Many technical reports are available in microfiche in the West. It is cheap, convenient, saves storage space and inexpensive. The library should investigate this possibility.

9. STRENGTHS AND WEAKNESSES

9.1 Strengths

The Department has 350 students and 50 staff and postgraduates which means it is well above the minimum size for a viable department. The department has a good spread of ages and grades of staff too.

Everyone I met was keen and well motivated. They were all very keen to learn from others rather than reinvent for themselves. I was very impressed by Mr Chen, a new junior member of staff recently graduated at MSc level from Wuhan. His knowledge of theorem proving was better than most western academics. If SCIT can attract some more bright young staff like this they will make rapid progress in the next few years.

The SCIT campus, Guangzhou and the general climate and environment are all very good. Thus SCIT has these 'hygene factor' advantages.

9.2 Weaknesses

The Department is relatively new (formed 1981) and has been dominated by the hardware background of the founders. This has meant that currently there is a lack of software orientated staff and experience. More staff, and expanding the experience of existing staff, are both needed to bring the Department up to strength.

The Department is underequipped. In an engineering subject like Software Engineering a proper training can only be given if adequate practical experience can be given to the students. This is currently just not possible. The problems of software engineering have much to do with the scale of the activity and so an IBM PC cannot impart any insight or experience of this aspect. Only capital investment can cure this weakness.

9.3 Out of Phase with the West?

The Department is out of phase with the West. The use of Unix V6 ceased in the West some 10 years ago. The inability to run Unix at SCIT contrasts markedly with Western computer science departments who almost all have several Unix systems each.

The Department is 5 years out of phase with the West in its lack of use of software tools of the file-based type such as pretty printers, file comparators, macroprocessors. This can be cured fairly cheaply by purchasing software from the West.

A more difficult difference to remedy is the lack of industrial industrial experience and connections. Most western computer science departments have active links with local industries to whom they give advice and from whom they gain experience of industrial scale problems and student training requirements. Whilst SCIT has industrial links, the lack of computerisation of Chinese industry means that SCIT is 10 years behind the west in the amount of useful input it gets from industry. Such industrial input is vital to the healthy development of software engineering teaching and research.

10. OTHER COMMENTS

I was very impressed by how cheerful, happy and friendly were the people in Guangzhou, not just the SCIT staff. It is a very pleasant place to visit.

Many Chinese, especially students and hotel staff, like to engage Westerner in conversation so as to improve their English skill, especially pronunciation. SCIT does courses in Scientific English so perhaps visiting western academics should volunteer to help a little on such courses as well as teaching their technical speciality.

11. HOUSEKEEPING

Guangzhou is well set up to cater for Western visitors, being a centre for Chinese commercial dealings with non Chinese nations.

There is plenty of western standard hotel accommodation with English speaking staff. The hotels contains shops and other facilities so that the Western visitor will find life in Guangzhou straightforward.

I stayed in the Bai Yun hotel, next to the 'foreign goods' store so it was very convenient.

Guangzhou is easy to get to. Fly to Hong Kong (Kowloon) and then take the train from Hong Kong (Kowloon) to Guangzhou. Again this route is used to handling Western passengers.

APPENDIX TO WORLD BANK REPORT

SCIT UNDERGRADUATE COMPUTER SCIENCE SYLLABUS

First Year

Philosphy
Economics
Politics
Physical Culture
English
Advanced Maths
Basic Programming
Physics

Second Year

Philosophy
Economics
Physical Culture
English
Engineering Maths
Electrical Engineering
Electronics
PASCAL
Fortran
C Programming
Digital Logic

Third Year

Scientific English Reading
Numerical Method
Assembly Programming
Principles of Computers
Data Structure
Algebra Structure
Discrete Maths
Operating System (Unix)
Compiler Principles

Fourth Year

Microcomputers and their Applications
Database
Fundamentals of Software Engineering (from September 1986)
Business Management

Optional Course

Algorithms Analysis and Design
Chinese Character Processing
Computer Graphics
Computer Network Software
Artificial Intelligence)
Computer Performance Evaluation) not yet available
Microcomputer Local Area Network

In the last term, every student must spend 16 or 18 weeks to do a project.

There are 2 terms in a year, each lasts 21 weeks. Summer vacation: 6 weeks, Winter vacation: 4 weeks (but now a few Universities in China have begun to use 3 terms in a year)

Scientific Research Activities

The staff in the Department are now engaging in research activities on the following fields:

Microcomputer System and its Applications
Multi-Microprocessor System
Multi-Valued Logic Devices, Design and Application
CAD
Software Tools Studies
Chinese Character Processing Method Studies.

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