

**SOFTWARE ENGINEERING AND MANAGEMENT (SEM)
Overview of the Special Programme
at IIM, Bangalore**

by

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1. Introduction

India has the third largest pool of technical persons. Indian graduates have been acclaimed as good programmers and systems analysts by most of the advanced countries.

Software development is one of the high growth sectors of economy. It is noticed that India's contribution in 1991-92 has been barely 2% of the total global market. We have access to almost all the types of hardware and software facilities. The government has been encouraging this sector by giving more incentives and declaring more liberalized policies. The government has identified software export as a major thrust area. If India has to become a global player then it has to have trained manpower in Software Management along with the expertise in Software Engineering which is mainly concerned with "the application of engineering, scientific and mathematical principles and methods to the economical production of quality software". [2]

India's software export of \$164 million in 1991 will be at \$660 million in 1996. If proper steps are initiated, then this figure may reach to \$ 1 billion. Presently, it is 11.7% of "foreign opportunity" which will drop to 9% at \$660

million. It may be raised to 34% of "Foreign opportunity" at \$ 1 billion in 1996 [16].

The major topics of Software Management include :

- * Human Resource Management
- * Strategic Management
- * Marketing Management
- * Finance Management

Even if a person is highly qualified in the field of "Information Technology and Computer Science" topics, he has to get "Management Input" in successful development and marketing of software products, considering various limitations of finance and manpower. It is also remarked that "in the science of computer science and the engendering of software engineering, there is no strong experimental component" [6].

It has been reported by a number of researchers that a computer trained person is comfortable working the machine and is very poor in inter-personal relations. He must have basic idea about marketing, particularly in International Marketing. Ultimate success of any business venture is dependent upon the financial aspects of the activities.

According to Parnas [7], "... most computer science Ph.Ds are not scientists, they neither understand nor apply the methods of experimental science. They are neither mathematicians nor engineers". He further states that

because of lack of knowledge of logic and communication concepts, computer science graduates use fuzzy words like "knowledge" without the vaguest idea of how to define and distinguish it from older concepts like "data" and "information". They talk of building "reasoning" systems without being able to distinguish reasoning from mechanical deduction or simple search technique. According to him, a number of top industry researchers and implementors who are reluctant to hire computer science graduates at any level, prefer to take engineers or mathematicians, even history majors and teach them programming.

2. Why "Software Engineering and Management" Program?

Presently various training institutes in India train the students at Bachelors, Masters, post-graduates, etc. There are other institutes training the students in specific topics of Computer Science and Information Technology.

As stated by R.L. Glass [1], "Industry needs software engineers but universities are supplying computer scientists". Even though this statement is made in the context of U.S.A., it is not different in India. It is particularly important to note that a large number of private training institutes have links with the well-established training Institutes in U.S.A., Canada and EEC countries, from where they get most of the training materials. Even the DOE-IECT Accredited Examinations at 0,1,2,3 levels are influenced by these traditional training structures. There seems to

be lack of agreement on the current definition of Software Engineering. It is generally accepted that such a training is at the post-graduate level. It is also now accepted that Software Engineering is not part of either Computer Science or Information Systems [1]. The present course structures of software engineering are heavily influenced by the guidelines of Software Engineering Institute (SEI) [2,3], Seattle University [4], Boston University and Wang Institute [5].

Tomayko [8] is doubtful about the level of Software Engineering as taught and the expectations of a program at graduate level. He feels that most of the present Software Engineering courses can be easily understood by the Undergraduate students. The real way to make Software Engineering true graduate level material is to make certain that the higher levels of Bloom's Taxonomy [9] are being taught. There must be attention given to analysis, synthesis and evaluation. This means problems at ever-increasing levels of difficulty.

It is argued that traditional life cycle approach are still relevant along with recent advancements in prototyping and spiral modelling. This is the feedback of Software Engineering graduates who were sampled [10]. In the survey, the respondents felt that the topics from Artificial Intelligence, Computer Communications, Personnel Management and Motivation are very relevant. Close industrial

collaboration for project work and specific inputs from industries are very vital [2,3,11].

Present Software Engineering course structures are influenced by Software Engineering Institute (SEI) [2], Defence Systems and Electronics Group (DSEG), specifying military standards (MIL-STD) [12, 13], Task Force on the core of Computer Science, ACM of 1985 [14], ACM and IEEE Computer Society - Joint Curriculum Task Force [15], National Centre for Software Technology [17] and leading standard books on Software Engineering [18,19].

If India has to take a decisive lead in the software development and export, then "Software Engineering" is one of the required important specialization of the present computer related manpower.

Along with the Software Engineering, it is felt that there should be input from the relevant topics of various functional areas of Management concerned with Software Development and Export.

According to SEI [3], "... Essential non-technical skills such as written and oral communication, planning and technical project management (including management of the individual's aim work and career) are not sufficiently emphasized". It is important to have relevant management input so that software engineers can occupy a position of substantial responsibility within an organization in reasonable time. He should be able to manage effectively a

project of non-trivial size (at least 4-6 people over 1-2 years) [4].

According to IDC Report [16], Software Engineering Techniques and Project Management have been identified as the top two out of eight important skills which are presently inadequate in the Indian Software Industry. According to the report, the following training courses are required for the existing Indian professionals to increase the productivity potential and value.

* Two courses are needed to train existing professionals to become better businessmen. One is a 3-week introductory course for managers; the other is a 3 month, in-depth program for analysts. Both should cover the following topics :

- Business modelling techniques and tools
- Innovative uses of IT to support a company's strategic objectives
- Effective oral and written communications
- Techniques for marketing high value and professional services.

The report also suggests that following Information Technology topics are very important.

- Client/Server platforms
- RDBMS, DDBMS
- CASE tools
- Object Technology

Hence the present program in "Software Engineering and Management" (SEM) has three important modules :

- * Software Engineering
- * Functional Areas of Management
- * Information Technology

The total time may be divided in these three modules depending upon the need, importance and relevance.

The general structure of SEM Program is shown in the enclosed Figure.

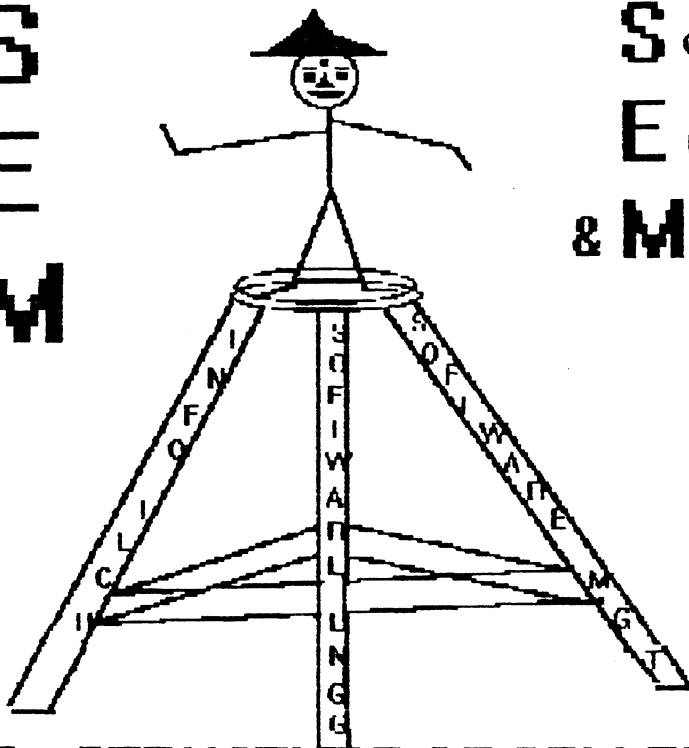
3. Structure of Software Engineering and Management (SEM) :

Based on the general remarks in the previous section, details of SEM program are described in this section along with other relevant details.

3.1 Duration of SEM

Presently this program is designed for 10 weeks. (This duration corresponds to one quarter of 10 weeks in MBA program at IIM-B). This period will be split into two semi-quarters called SQ-I and SQ-II. Each SQ will be 5 weeks duration. There will be six courses offered in each SQ. A course will be 3 hours of teaching per week. Hence, 18 hours/week instruction will be imparted. With 8 hours/day available, there will be 40 hours/week. It implies that

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FIG : STRUCTURE OF SEM PROGRAM

teaching will be slightly less than 50% of the time. It is expected that rest of the time will be used for seminars, assignments, projects, etc.

3.2 Structure of courses for SEM

The schedule of 12 courses is shown in Table 1 and details are described in Appendix A. Presently Software Engineering, functional areas of management and Information Technology Modules are in the ratio of 5:4:3 in the total duration of 3 months. The four courses in Software Engineering (SE) are influenced by Software Engineering Institute (SEI) Curriculum [2,3]. Similarly the three courses in Information Technology (IT) are based on the topics from the cutting-edge technology topics and IDC Report [16]. The five courses in functional areas of management (SM), show the relevant topics from strategic management, marketing (including international) management, human resource management and finance management. Some topics from IDC Report [16] from the functional areas of management have been specially included because this is the most recent and very extensive study of Indian Software activities.

3.3 Other Activities of SEM

As described earlier, following will be complementary activities, apart from teaching :

- * Structured Seminar by outside experts (each week)
- * Seminar by participants (2 participants/week)
- * Seminar on non-computer topic (2 participants/week)

TABLE 1 : SOFTWARE ENGINEERING AND MANAGEMENT --STRUCTURE OF COURSES

SQ-I (5 WEEKS)		SQ-II (5 WEEKS)	
Code	Title	Code	Title
SM1	Human Relations Management-I	SM2	Human Relations Management-II
SM3	Finance Management	SM5	Strategic Management
SM4	Marketing Management		
SE1	Software Project Management	SE3	Software Engineering-I
SE2	Structured Design & CASE tools	SE4	Software Engineering-II
IT1	Information Technology-I	IT2	Information Technology-II
		IT3	Information Technology-III

SM - Software Management
 SE - Software Engineering
 IT - Information Technology

3.4 Project Work of SEM

According to SEI [2], "Software Engineering Experience" is one of the important components in Software Engineering Education. Hence, after 10 weeks of Academic Program in the class room, the participants are expected to work on a "PROJECT" either in their organization or in IIM-B. The duration will be 5 weeks. There will be presentation by the participants at the end of this period. The standard of the report will be set high and these reports will form important resource material for future programs.

3.5 Evaluation of the Participants

This program is at the level of post-graduate for the participants who are already working in the software related organizations. Hence, there will not be a formal evaluation but a committee of faculty responsible for this program will recommend whether the participant has completed the program as expected. Participants with deficient performance will be asked to make up or they will be denied the Certificate of SEM to be offered at the end of the program by IIM-B.

3.6 Participants of SEM

This is a post-graduate level program. Hence a typical background of a participant will be

- * Graduate/Post-graduate in Computer related field
- * At least 5 years relevant work experience

- * Preferably organizational sponsorship
- * Initially 15-20 participants are expected to be enrolled for SEM program.

3.7 Administration of SEM

SEM is a joint effort of IIM-B and the participating organizations. There will be two committees for guiding and conducting the activities of SEM program.

- * SEM Advisory Committee : It is the Apex Committee of 10 members guiding SEM. There will be due representation from the academic and industry.
- * SEM Academic Committee : This committee will be responsible for the administration of SEM. It will also decide the names of participants for the award of the Certificate, who, in its view, have completed the SEM program satisfactorily. The Certificate of SEM will be called "Certificate in Software Engineering and Management".

3.8 Fees for the SEM Program

It is proposed that fee of Rs.20,000/- may be charged which will include :

- * academic fee
- * hand outs
- * computing facility (including email)
- * Library

- * Stay and food
- * Other incidentals.

4. Concluding Remarks

Following important remarks may be noted :

- a) Such a SEM program is being proposed for the first time in India.
- b) SEM program is targetted at the software specialists who also want to become successful software managers.
- c) SEM program should help in India's quest for a global player in Software Development and Export.
- d) Such a program should also attract foreign participants, for training in Software Engineering and Management.
- e) SEM Program will give opportunity to IIM-B faculty to be closely associated with software industry and may lead to better input to post-graduate/Fellowship programs.
- f) This program may also lead to meaningful research projects between IIM-B and software related industries.
- g) Bangalore is emerging as "the most favoured city" for the software related activities. This program will complement the activities of the Software Industry in Bangalore.
- h) Success of such a program is heavily dependent upon the participation of the software organizations in India (and particularly in Bangalore).

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Appendix A : Detailed Course Structure for SEM

Software Management (SM)

SM1 Human Relations Management - I (15 hrs, SQ-I)

- Motivation
- Training
- Inter-personal Relations
- Computer skills
- Leadership
- Ethics
- Organisation structure
- Work Team
- Written/Oral Communication
- Standard tests in computer related topics
- Changing pattern of computer manpower
- Body shopping
- Comparison with competing countries and target countries

SM2 Human Relations Management-II (15 hrs, SQ-II)

- Intimacy & Sharing
- Interpersonal Trust & Openness
- Interpersonal needs
- Trax Analysis
- Intra Group Collaboration & Conflicts
- Inter Group Collaboration
- Risk taking and Goal Setting
- Membership in Groups
- Issues of Authority
- Feedback & Councelling

SM3 Finance Management (15 hrs, SQ-I)

- Venture Capital
- Export/Import facilities for software
- Customers Notification
- International Finance
- Budgeting, P/L, Ratios Interpretation
- Cost/Benefit - Tangeable/Intangeable
- Evaluation/Selection of H/W & S/W
- EDP Audit
- Financial scene of software companies
- Some of funding considering stages in System Life Cycle
- Foreign Exchange and software companies
- Comparison with competing countries and target countries

SM4 Marketing Management (15 hrs, SQ-I)

- Global Market (USA, Europe, Japan, Russia)
- Indian Market
- Tie-up with companies abroad
- Software package - Product Development
- Tendering - Indian, Global, Negotiations
- Market Opportunities Assessment
- Joint Venture, Indian scenario
- OEM - Agreement
- Vendor Management
- Patents, Software piracy
- Foreign opportunity
- Marketing & Distribution channels
- Market segments & Targeting
- International Trade Agreements and Software Industry
- Contract writing
- Comparison with competing and target countries.

SM5 Strategic Management (15 hrs, SQ-II)

- Long Range Planning
- Technology Transfer
- Succession Planning
- Corporate Issues
- Alliances
- Innovation
- Software as Indian Economy Sector
- Foreign Opportunity
- Government Policies
- Infrastructure Strategies
- Comparison with competing & target companies

(Note : Competing Countries : Ireland, Singapore, Israel, Phillipines, Mexico, Hungary, China.

Target Countries : USA, Japan, UK, France, Germany, Italy).

Software Engineering (SE) (ALTERNATE PROPOSAL 1)

(Prepared by Faculty of QMIS, IIM-Bangalore)

SE1 Project Management (15 hrs, SQ-I)

- Project Life Cycle
- Project identification
- Project Appraisal, Cost/Benefit analysis
- Project Implementation/Maintenance
- Time & Cost Estimation
- Software packages

SE2 Structured Systems Analysis & Design (15 hrs, SQ-I)

- SSAD methods
 - Requirement
 - specification
 - design
 - implementation,
 - maintenance
- System Integration
- CASE tools
- Prototyping spiral modelling
- Configuration Management
- Re-engineering, Reverse Engineering
- Repository
- Systems with Control
- Real Time SSAD
- Object Oriented SSAD

SE3 Software Quality, Audit, Security (15 hrs, SQ-II)

- Software Quality Assurance (SQA)
- TQM
- ISO 9000/IEEE/ISI
- Benchmarking standards
- Productivity
- Software Audit
- Security
- Recovery
- User Interface
- SEI Scale of "Process Maturity"

SE4 Recurring Concepts of Software Engineering - II (15 hrs, SQ-II)

- Testing
- Reliability
- Validation
- Verification
- Integration
- Performance Evaluation
- Reusability
- Documentation & its standards

Software Engineering (SE) (ALTERNATE PROPOSAL 2)

(Based on Software Engineering Institute (SEI) Curriculum [2])

SE1 Software Systems Engineering

- Requirement analysis
- System Design
- System integration
- Human interfaces
- Software Operations Issues

SE2 Software Analysis & Design

- Specificatioin
- Embedded Real-Time Systems
- Software Design
- Human Interfaces

SE3 Software Development, Maintenance & V-V concepts

- Software generation
- Software implementation
- Software maintenance
- Software quality issues
- Software quality assurance
- Software testing

SE4 Software Project Management

- Software engineering process
- Software evaluation
- Project organisatiion and management issues
- Software project economics
- Software quality assurance
- Configuration management
- Software Operations issues

Information Technology (IT)

IT1 Information Technology -I (15 hrs, SQ-I)

- Data Structure
- Parallel Computing
- OOPS, Languages (C++, PASCAL, SMALLTALK, EFFIL)
- Hypertext
- Fault Tolerant Computing
- Trends in O.S
- Multimedia Systems

IT2 Information Technology - II (15 hrs, SQ-II)

- DBMS
- RDBMS
- C/S Architecture
- Knowledge Base Systems
- Distributed DBMS
- LAN, WAN, email
- RIGHT SIZING
- Standards for RDBMS, SQL
- ODBC Standard

IT3 Information Technology -III (15 hrs, SQ-II)

- AI/ES
- DSS
- ESS
- EIS
- Groupware
- LISP/PROLOG
- ES Shells
- Design of ES applications