

EDUCATION IN PHOTOGRAMMETRY AT ITC, A NEW CONCEPT, A NEW PROGRAMME

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ABSTRACT:

Efficient mapping to produce reliable, up-to-date map and geo-information products in support of planned resource development, conservation, management and administration, is not possible without Photogrammetry. However, the convergence of computer, communication and control technologies is yielding new tools and production processes. Some of those tools are complementing, some are replacing established technologies in traditional map making. As a result, mapping organisations need personnel to manage the transition from existing to new technologies, to develop new skills and to decide how old and new processes may be best integrated to serve the user's needs. Following this concept, the department of photogrammetry of the ITC has developed a new educational programme, to contribute effectively to the education of this personnel and thus strengthen the innovation, production and management capabilities of mapping agencies. The paper reviews the concept and its realisation.

1. THE NEED FOR SURVEYING AND MAPPING EDUCATION:

Efficient mapping necessary for sustained industrial, rural and human settlement development is not possible without Photogrammetry. Evidence of this can be found in many U.N. and Worldbank publications reporting on mapping needs and investments as well as the large mapping tasks still ahead. Also the fact that the overwhelming majority of about 2800 ITC graduates in Photogrammetry are now either active in their national mapping organisations or are engaged in the training of photogrammetrists for these organisations indicates the viability of this well established technology.

A growing number of new tools is becoming available as a result of increasingly reliable combinations of computer, communications, and control technologies of which data base, navigation, satellite technology and expert systems are examples. In some cases these tools are replacing current technology, skills or traditional map production while in others they are complementing those. Sometimes they open up totally new and unexpected opportunities to meet the pressing needs for geo-information, in country development.

The new technology is forcing surveyors and mappers to critically review the premises of their activities not only technologically but also with respect to the user. While many new technologies are promising, implementing digital production lines that may have been proven in the lab is also a capital intensive, complex and time consuming task requiring scarce and high cost skills and support services and disciplined management. Expectations are usually high but one should assume it will take many years to realise the fruits of the investments through reliable and cost effective production lines.

Meanwhile, the demand for up to date maps and other information products is rising relentlessly under the pressure of urbanisation, the needs of resource management and exploitation, the development of agriculture, the protection of a livable environment and the need for security and political stability. Thus the mapping effort must go on using proven production technologies.

For the next decade, mapping organisations need personnel to manage the transition from existing to new technology to meet the escalating demand for maps and geo-information. Sensitivity to user needs coupled to the ability to determine for local circumstances the applicability of certain technologies and data sources and the combination of those into practical production lines are the key assets of personnel who will lead this transition.

The Photogrammetry Department of the ITC must contribute to the education of this staff and thus help strengthen the innovation, production and management capabilities of mapping agencies. Its research should be relevant to the production requirements of the lesser developed countries. Its consulting activity should assist those countries to implement responsive mapping programmes and to advise on that what is promising and demonstrated in the lab and that what is or can be made practical in day to day production.

2. THE RESPONSE OF THE PHOTOGRAMMETRY DEPARTMENT OF ITC:

2.1 The Educational Program.

To respond to the new developments and to maintain relevance to institutions involved in the production and dissemination of maps and geo-information the transfer of knowledge about Photogrammetry as the sole educational goal of the Department is clearly no longer adequate. Instead the current goal should be to develop the leadership in various functions of organisations that are engaged in the production and dissemination of geo-information with an emphasis on Photogrammetry. The major functions in these organisations are shown in Fig. 1

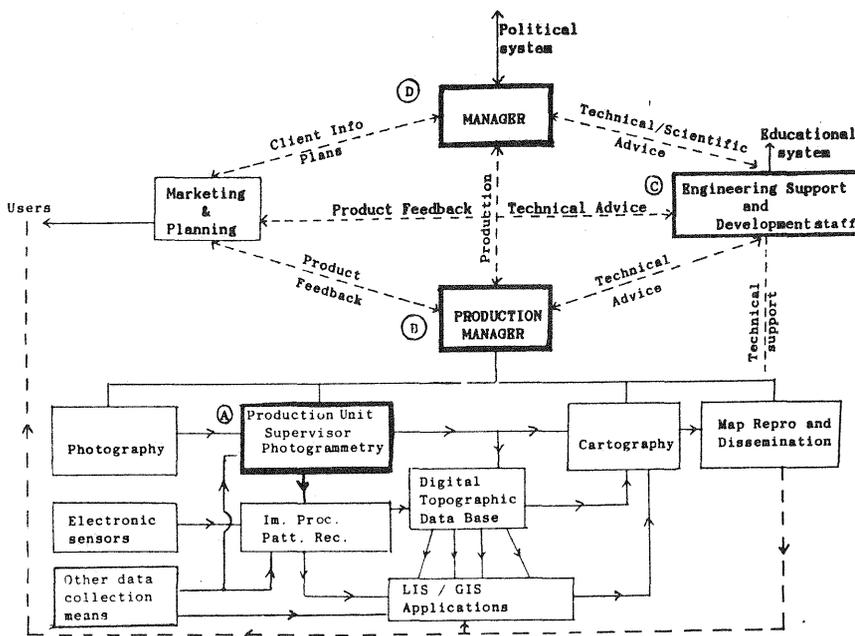


Fig. 1: Model of the key functions in a production organisation for maps and geo-information, including the major groupings of operations.

The consequence is that the educational programme must contain the following elements:

- technology
- management
- integration
- sensitivity to user needs

The principal target groups are identified in Fig. 1 by A, B, C and D.

- **Target group A:** Photogrammetry production unit supervisor, responsible for day to day production and links between units
- **Target group B:** Overall production manager, responsible for all aspects of day to day production and technology adaptation
- **Target group C:** Engineering support and development staff, responsible for the development of new production capabilities and technical support.
- **Target group D:** Executive of a National Surveying and Mapping Agency, responsible for inception, justification and execution of programme.

2.2 The courses in Photogrammetry:

To realize its educational mission, the Department of Photogrammetry is offering the following courses:

Post-Graduate Diploma Course in Production Photogrammetry (See appendix 1 for detailed information)

The course is aiming at preparing the future photogrammetric unit technical and production leadership (target group A) for organisations engaged in the production of maps and geo-information. It has been developed so that participants will be able to make judgements and choices as to equipment, production process and staff development. The course starts twice a year in February and September and is of 12 month duration. The course reflects aspects of:

- . technical specialisation in modern photogrammetry
 - . recognition of the whole process of map making in both analogue and digital environment.
 - . user relations
- and has a strong managerial component.

Certificate Course in Integrated Map and Geo-Information Production Management (See appendix 2 for detailed information)

The course is aiming at the upgrading of the staff, of organisations that are engaged in the acquisition, processing, transmission, presentation and dissemination of Map and Geo-Information, who will be responsible for the introduction and overall management of a digital integrated map and geo-information production facility (target group B)

The course has been developed for the management of complete production lines and focus on the introduction of digital technology in analogue production environments.

The course starts at least once a year in September and is of 4 months duration. It reflects aspects of:

- . integration (of digital map and geo-information production techniques)
- . management of system implementation and monitoring
- . users relations

M.Sc. Degree Programme in Integrated Map and Geo-Information Production
(See appendix 3 for detailed information)

The programme is aiming at the education of:

- the staff of organisations that are engaged in the acquisition, processing, transmission, presentation and dissemination of Map and Geo-Information, who will be largely concerned with the design, testing and introduction of integrated Map and Geo-Information production systems and/or lines (target group C) for the purpose of planning and administration of human environment, and/or
- teachers of tertiary education institutes involved in the design, introduction and running of courses in Integrated Map and Geo-Information Production.

The programme has been developed in an integrated map and geo-information production perspective, including elements of aerial photography, remote sensing, photogrammetry, cartography and computer science in terms of data capture, processing, representation and dissemination. It requires the preparation of an M.Sc. thesis in one of the contributing disciplines. The programme starts each year in September (as from 1989) and is of 24 months duration (the first 12 months may lead to a Post-Graduate Diploma in Integrated Map and Geo-Information Production for those not continuing with the M.Sc. thesis). It reflects aspects of:

- management (of system design and implementation)
- integration (of geo-information production technologies)
- users (sensitivity and interfaces)

The common part of the programme is well balanced in terms of:

- a judicious representation of subject matters from different disciplines, in an integrated perspective
- specific (question driven) versus inventory (data driven) products
- spatial (coverage) versus attribute (details) resolution

Workshop for Executives of National Surveying and Mapping Agencies

The workshops are meant to offer executives of National Surveying and Mapping Agencies (target group D) an opportunity for a structured exchange of ideas with colleagues from other countries on immediate and longer term strategies for national Surveying and Mapping programmes.

The first workshop entitled: "Entering the 21st Century: Strategies for National Surveys and mapping" was held at the ITC from April 10 to April 16, 1988. It provides a forum where executives had the opportunity, as a professional community to explore the barriers to a realistically paced evolution of their organisation in meeting the needs of their respective countries, and to formulate possible options and solutions. Proceedings of the workshop will be published.

3. CONCLUSIONS:

The Department of Photogrammetry of the ITC believes that its new education programme based on concepts of modern technology, management, integration and sensitivity to user needs will prove to be a relevant response to the needs of institutions involved in the production and dissemination of maps and geo-information in support of economic and social development at a time of significant technological change.

ACKNOWLEDGEMENT:

The authors are greatly indebted to many colleagues of the Departments of Aerial Photography and Remote Sensing, Photogrammetry, Cartography and Computer for their dedicated and concentrated effort in developing and implementing this new education programme. Thanks also to the ITC Directorate for supporting those new concepts and permitting to realize them.

APPENDICES

Appendix 1: Post-Graduate Diploma Course in Production Photogrammetry

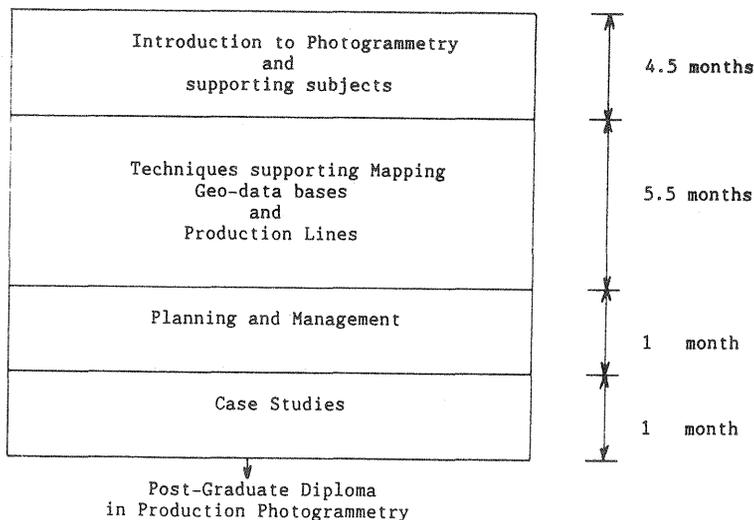
1. OBJECTIVES:

At the end of the course, the participants will be able to make judgements and choices as to equipment, process and staff development and in particular to:

- provide technical advice on equipment/system performance and maintenance, staff training requirements, and costs
- accept the relationships and respective impacts of one production unit on another
- evaluate production procedures and specifications and explain to staff for the purpose of work assignment
- select appropriate materials and tools
- train and demonstrate to staff the use of equipment and materials
- identify the cause of instrument breakdown, material deficiency and take corrective action
- define staff deployment and unit output
- motivate the staff to meet production objectives
- monitor output and where necessary take corrective action

2. STRUCTURE:

The course has been developed with the following structure



3. CURRICULUM:

- *:BLOCK I: Introduction to Photogrammetry and Supporting subjects(520 hours)
Lectures, practicals and workshops in:
 - Problem solving
 - Introduction to Surveying and Mapping
 - Linear Algebra
 - Coordinate systems and transformations
 - Theory of observations and quality control
 - Introduction to computers
 - Binocular vision
 - Primary data acquisition
 - Analytical approach to Photogrammetry
 - Orientation (analogue/digital)
 - Photogrammetry equipment (analogue/analytical/digital)
 - Testing of Photogrammetric equipment (analogue/analytical)
- * BLOCK II: Techniques supporting Mapping, Geo-data bases and Production Lines (610 hours)
Lectures, practicals and fieldwork in:
 - General aspects of mapping
 - Computer programming
 - Computer graphics
 - General aspects of image processing
 - Photo-interpretation
 - Techniques supporting mapping
 - Interpolation and filtering
 - Point determination systems
 - Aerial triangulation
 - Digital Image Processing
 - D.T.M.
 - Orthophotography
 - Field completion (fieldwork in South of France)
 - Data Base Management
 - Geo data bases
 - Cartographic processing
 - Production lines
 - . Graphical map production
 - . Digital map production
 - . D.T.M. production
 - . Photo map production
 - . Map revision
- * BLOCK III: Planning and Management (100 hours)
Lectures, workshops and case study in:
 - Executive management
 - Operational management
 - Facilities management
 - Process design
 - Selected subjects on aspects of Geo-Information production
- * BLOCK IV: Case Studies (160 hours)
During the case studies, group of participants, given parameters for specific production systems are planning and producing
 - a digital map or,
 - a DTM and a photo map or,
 - are updating an existing map
- * Other activities:
 - Several study trips to National Mapping organisations and to Geo-Information production organisations.

- Workshops on modern photogrammetric equipments and systems are organised by manufacturers.

Appendix 2: Certificate Course in Integrated Map and Geo-Information Production Management

1. OBJECTIVES:

At the end of the course, participants will be able to use and manage an Integrated Digital Map and Geo-Information production facility and in particular to:

- link data sources to user defined products through the use of integrated digital techniques
- assess the definition of a digital topographic data base including the classification of information, data structuring, and the qualification, organisation and digital communication of data.
- manage facilities with emphasis on hardware and software maintenance, documentation of changes, system security, tape library management, storage and back-up

2. CURRICULUM:

* Block I: Lectures, practicals and workshops in:

(i) Introduction to Integrated Map and Geo-Information Production
30 hours)

(ii) Techniques supporting Integrated Map and Geo-Information Production
(230 hours)

- Data capture
- Data processing
- Data presentation

in Point Determination, Computer Assisted Photogrammetry, Remote Sensing and Digital Image Processing and Computer Assisted Cartography and including techniques, hardware and software components and processes.

* Block II: Lectures and Case Studies in production lines (220 hours)

Groups of participants, given parameters for a specific production context are planning and producing:

- an updated topographic map
- a digital terrain model

These case studies are round-off by a report.

* Block III: Lectures, practicals and workshops (120 hours) in:

(i) Structure and management of GeoData Bases

(ii) Facility management and testing of an Integrated Map and Geo-Information production system.

(iii) Analysis and review of production operations.

Other activities:

- Study trip to a National Mapping Organisation and to Geo-Information Production Organisations.
- Workshops on map and geo-information production equipment and systems are organised by manufacturers.

Appendix 3: M.Sc. Degree Programme in Integrated Map and Geo-Information Production

1. OBJECTIVES:

At the end of the 2-years M.Sc. programme, participants will be able to:

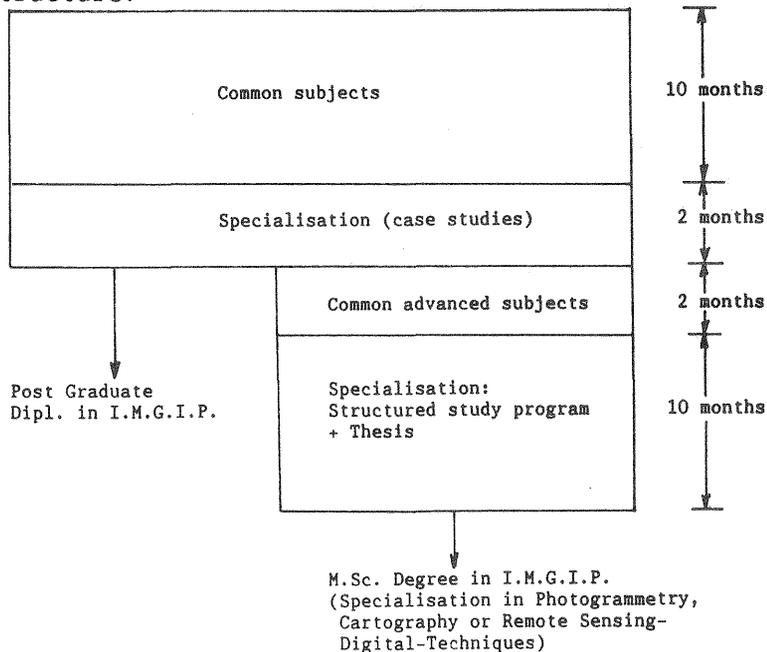
- understand the interaction required with the production manager and the change in respective responsibility in the transition from design to production.
- define and analyse the problem and explore possibilities for the design of a new Map and Geo-Information production system or modification of an existing one.
- prepare a functional design of production systems for Geo-information extraction and representation.
- prepare a technical design of the geo-information production system.
- develop a pilot-project (prototyping) and prove feasibility of the system.
- together with the production manager, prepare the system for its introduction in production.
- gather feedback from the production manager on system performances (quantity, quality, reliability and costs) and introduce modifications and improvements whenever necessary.

To achieve those objectives, participants will also have to be able to:

- communicate effectively with experts in the various fields involved, i.e. computer scientists, system engineers and marketing specialists.
- critically understand geo-information extraction and representation processes, their possibilities and limitations.
- use systems for geo-information extraction and representation and develop a conceptual framework of issues to be considered in use of those systems
- carry out R & D in a production perspective, critically review each phase of the system design process and prepare a plan for the next phase.
- draft tender evaluation procedures to provide technically objective advice on systems and services acquisition
- design quality control procedures that reflect a well considered balance between cost and system performance

2. STRUCTURE:

The programme has been developed in a 2-year perspective and with the following structure:



3. CURRICULUM:

3.1 First year of the programme:

3.1.1. Common subjects (1000 hours)

Lectures, practicals and workshops in:

Block I: Introduction to Integrated Map and Geo-Information Production

- * Information theory
- * Integrated Map and Geo-Information production systems
- * Interaction with user and producer of Geo-Information

Block II: Applied mathematics

- * Matrix and vector algebra
- * Coordinate systems, transformations and projections
- * Statistics and decision making
- * Interpolation and filtering
- * System analysis, transfer functions and filtering

Block III: Informatics:

- * Computer system hardware and software (mini/micro)
- * Computer programming
- * Computer graphics and image processing
- * Data base structure and management

Block IV: Techniques supporting Integrated Map and Geo-Information Production:

- * Data capture
- * Data processing
- * Data presentation

- With emphasis on Point Determination, Computer assisted Photogrammetry, Remote Sensing and Digital Image Processing and Computer assisted Cartography and,
- including techniques, hardware and software components and processes.

Block V: Integrated Map and Geo-Information Production system design and management:

- * Problem solving techniques
- * System design (incl. functional and technical design, prototyping, introduction in production and performance evaluation).
- * Systems management (incl. facility management and operational management)
- * Tendering and contracting

3.1.2. Specialisation (300 hrs)

Aspects of specialisation in Photogrammetry, Cartography or Remote Sensing-Digital Techniques are emphasized by means of case studies and supporting lectures in either:

- inventory mapping processes, or
- question driven processes.

During the case studies, groups of participants, given parameters for specific production systems are planning and producing different Map en Geo-Information products. Those case studies are rounded off by a report.

3.2 Second year of the programme:

3.2.1. Common advanced subjects (200 hours)

Lectures, practicals and workshops in:

- modelling of geo-related objects and processes
- network analysis
- knowledge engineering
- research methodology

Remark: This period is also used for the formulation of the research work.

3.2.2. Specialisation:

(i) Structured study programme (300 hours)

Is designed to deepen knowledge of the participants in the field of interest of the thesis. The programme can be structured around the following themes:

- Advanced computer assisted photogrammetry
- Advanced computer assisted cartography
- Structural pattern recognition and machine vision

(ii) Thesis (1500 hours)

- Standards for research work and thesis writing as defined in ITC M.Sc. Regulations.
- Research work can be executed in the following field of specialisation:
 - . computer assisted photogrammetry
 - . computer assisted cartography
 - . remote sensing/digital techniques

3.3 Other activities:

- Several study trips to National Mapping organisations and to Geo-Information production organisations
- Short field trips for verification purposes
- Workshops on map and geo-information production equipments and systems are organised by manufacturers