United Nations International Meeting on the Applications of Global Navigation Satellite Systems
Hosted by the United Nations Office for Outer Space Affairs
Co-organized and co-sponsored by the International Committee on GNSS (ICG)
United Nations Office at Vienna, Vienna International Centre,
Vienna, Austria, 12 - 16 December 2011

The Role of Training and Capacity Building on GNSS in the Developing Countries

Prof. Mustapha Amghar

Director of GIE Galileo Morocco Group
Professor associate at CRASTE-LF
Professor at Mohamadia School of Engineering – Rabat

Contents

- Introduction
- Training and Capacity Building on GNSS
  - Activities of GIE Galileo Morocco
  - Activities of CRASTE-LF
- Constraints
- Keys to a Successful Capacity Building Program
- Summary

.

Introduction:

- During these last years, the technology and the applications of GNSS knew a spectacular evolution.

- GNSS technology is currently being used in a wide range of sectors:
  - High precision applications
  - Land, Maritime and Aviation transport
  - Multimode transport
  - Safety of life
  - Professional , ...

- A number of studies and demonstrations have shown that all of these sectors will significantly benefit from the use of GNSS.

- Benefits include improved navigation coverage, accurate and also reliable information

Training and Capacity Building

- Therefore it proves to be important to maximize the benefits of the use of GNSS applications and the mastery of this technology by training and capacity building to support sustainable development particularly in developing countries.

- However, this situation meets the problem of the rarity of expertise and resources particularly in developing countries.

→ Therefore, some efforts must be deployed to allow these countries to have their local qualified expertise in the GNSS field and to exploit fully the benefit brought by this technology.

→ Programs must be realized to respond to this need that grows more and more.

✓ The approach must be adapted to the specificities of each country and take into account its objectives and constraints (technology transfer, infrastructures, cost, etc.).

Notice:

- The use of the GNSS in several developing countries is limited to very simple and isolated cases (mapping, personal navigation, tracking, ...).

- Syllabus especially dedicated to GNSS does not exist.

  Example: African countries generally do not have institutions dedicated to training on GNSS, with the exception of some regional and international training institutions in Space Technology and Telecommunication (CRASTE-LF, ARCSSTE-E, …).

In order to make actions permitting the development of local expertise in the GNSS field, the actions must cover the formation of both users and trainers and also the sensitization of decision-makers on the role of the GNSS applications.

➢**Activities realized by the GIE Galileo Morocco** (Economic Interest Group) created by the government in order to initiate and to encourage training, research and development in the GNSS field.

The activities presented concern notably training, initiating research projects in academic institutes, co-organizing workshops, developing GNSS applications, and collaboration with regional and international institution

➢**Activities of CRASTE-LF, Rabat** (Regional African Centre for Space Science and Technology Education In French Language)

Managing GNSS Projects in Morocco:

- Moroccan government created in 2007 an *Economic Interest Group (**GIE** Galileo Morocco Group)* whose main goal is to initiate and to encourage training, research and application/services development in the GNSS field.

- The GIE comprising:

1. Telecommunication Regulatory National Agency (ANRT).

2. Airport National Authority (ONDA).

3. National Centre of Scientific and Technical Research (CNRST).

4. Al Akhawayn University in Ifrane (AUI).

5. Federation of Moroccan ICT companies (APEBI).

Mission of the GIE :

- ***GIE Galileo Morocco Group*** is the official Moroccan interlocutor of GNSS program (especially GALILEO) with foreign partners (EU).

- Main missions of the group:
  - to promote training and research on GNSS and encourage experience exchanges in this field
  - to initiate, promote and encourage projects in the field of GNSS
  - to assist GNSS service provider companies in developing added value services
  - to conclude agreements of partnership.

A survey realized by the **GIE** revealed:

1. The existence of some local competence in various specialties related to the GNSS:
   - ☒ Remote Sensing and Geographical Information Systems
   - ☒ Satellite Communications
   - ☒ Signal Processing and Image Processing
   - ☒ Propagation, Antennas and Radiation
   - ☒ Coding and Communication
   - ☒ Real Time and Embedded Systems
   - ☒ Very High Frequency Systems
   - ☒ Navigation Systems
   - ☒ Positioning and Logistics
   - ☒ Meteorology
   - ☒ Geodesy
   - ☒ Mechanics of Satellites
   - ☒ …

❷ The actors are very few and dispersed in different organisms (universities, administrations and enterprises).

- EMI Mohammadia School of Engineering
- INPT Institut national des postes et télécommunications
- AUI Al Akhawayne University in Ifrane
- IAV Agronomical Sciences and Veterinary Medicine
- AIAC Mohammed VI International Academy of Civil Aviation
- EHTP Hassania School of Public works
- ENSIAS School of Computer Science and Systems Analysis
- CRTS Royal Centre for Remote Sensing
- CNRST National Centre of Scientific and Technical Research
- ENSA (Tanger, Marrakech, Fes, …)
- FST (Fes, Tanger, Marrakech, …)
- …

❸ The use of GNSS is very limited in both public and private sectors.

Main Applications of GNSS in Morocco:

- Transport (Aviation, Road, Railway, Maritime)
- Fishing
- Mapping
- Telecommunications

➔ **GIE** started a wide range of activities focusing on **capacity building**, specifically, in co-organizing workshops, initiating research projects in the academic institutes, developing a GNSS education curriculum, and establishing contacts with actors in other countries.

Objective:

- To increase awareness among decision makers and representatives research and academic community about ongoing activities and trends in the use of GNSS technologies, applications and services.
- To strengthen institutional and human capacity building in the area of GNSS.

✵ Training, awareness and pilot projects are key elements in the GIE initiative for the success of capacity building program.

- ✓ Training of trainers,
- ✓ Modification of academic syllabus,
- ✓ Developing infrastructure and materials,
- ✓ Financial aspect,
- ✓ Distance learning,
- ✓ Exchange of ideas between decision-makers,
- ✓ Collaboration with regional and international institutions.

GIE Activities:

- Cooperate in training programs and develop GNSS educational curricula.
- Promote research activities.
- Participate in committees and working groups (EU-AU EGNOS).
- Participate in GNSS projects:
  - National projects: Fleet management, Meteorology, Assistance to the blind persons, Management of natural disasters, …
  - European projects:
    - METIS: Transportation of dangerous goods, Multimodal transport, e-Tourism, …
    - Med-Tracking: Partner as Actor and end-users: GIE, ONDA, …

Approach:

- ✓ Initiate Research and Development in GNSS field with Universities and Research Institutions.
- ✓ Promote GNSS Services & applications in public and private sectors.
- ✓ Disseminate knowledge on GNSS technology.
- ✓ Establish partnerships with others national and international actors.
- ✓ Maintain effective communication between all the partners.
- ✓ Participate in structuring projects: Management of natural disasters, Road safety, …

Training:

Objectives:

- To provide the necessary knowledge and background about GNSS technologies, applications and services for professional/engineers and end-users;

Goals:

- Training of trainers.
- Provide short term experts.
- Promote the use of GNSS in public and private sectors and particularly for decision-makers

Forms:

- Classroom course.
- Education by research.
- Distance learning.

Distant learning seem to be interesting for developing countries:

- ✓ Wide geographic spread of the target audience.
- ✓ Always actual training courses.
- ✓ Large number of students.
- ✓ Best exploitation of the laboratory equipment.

Training

Partner:

- The **National Airport Authority, ONDA** has a multi-disciplinary training and research centre in the field of civil aviation**:** **Mohammed VI International Civil Aviation Academy.**

  - The Academy offers high quality multi-disciplinary training and benefits from support from the leading international bodies.

  - It accommodates 4 specialized training institutes:

    - Institute of Air Traffic Services.
    - Institute of Aviation Safety Systems.
    - Institute of Aviation Management.
    - Institute of Civil Aviation Security.

- **INPT Institut National des Postes et Télécommunications**

  - High school of engineering specialized in Telecommunication and Information Technology.
  - Engineers and Master degree.

Training

Partner:

- **Al Akhawayn University in Ifrane**.

  - Engineering school
  - Master and PhD degree
  - GNSS laboratory (EGNOS)
  - Incubator

- **Mohamadia School of Engineering.**

  - Engineering school: multi-disciplinary training (Electronics, Mechanics, Telecommunication, Computer Science, civil Engineering ,…)
  - Master and PhD degree.
  - GNSS laboratory (GPS and Meteorology)

Master curriculum on GNSS over 2 years (4 sessions)

- Course prerequisite is License (3-years University degree):

Session 1

M1 : Propagation, Antennas and Radiation 60
M2: Coding and Communication 90
M3: Systems and Development Tools 96
- OOP and UML
- Real-Time Systems and Embedded Systems
- Information System and Data Base

M4: Communication Networks 60

Session 2

M5: Microwave and Acquisition Systems 60
- Components Microwave
- Sensors

M6: Coding and Advanced Treatments 90
- Image Processing and Remote Sensing
- Image Coding

M7: Telecommunications Systems 60
- Mobile Telecom
- Telecoms / Satellite

M8: Distribution and Information System 84
- Distributed Architecture
- GIS
- Multimedia Database

Session 3

M9: Navigation Systems 104

- Geodesy
- Satellite Navigation Systems
- Positioning Techniques

M10: Applications 48

M11: Advanced Tools 60

M12: Seminars and Application Projects 80

Session 4

Project Work.

Module = Theory + Laboratory Experiments

Curriculum on GNSS (6 months Theoretical courses + 3 months project Work

- Communication system and Modulation Technique
- Antennas and Propagation
- Signal Processing
- Image processing
- Geodesy, mechanics and principle of navigation satellites
- GIS and remote sensing
- Embedded Systems
- Introduction to GNSS
- Timing, modulation and coding in navigation systems
- GNSS Receivers
- Positioning error, Integrity and Continuity of satellite signals
- GPS, GLONASS and Galileo
- The augmentation systems
- Applications and services based on GNSS
- Other positioning systems (Indoor and Outdoor)
- Legal issues in the field of GNSS

Training & Awareness program:

METIS (MEdiTerranean Introduction of GNSS Services)

- METIS funded by EU, managed by the European GNSS Supervisory Authority (GSA) and run by a consortium of private/public organizations from European and Mediterranean countries.
- METIS (2006 - 2009) has performed activities in support of the implementation of GNSS services in the MEDA countries: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestinian Authority, Syria, Tunisia and Turkey.

METIS performed 3 main activities:

1. Elaborating the **GNSS Regional Plan:** proposing a Euro-Mediterranean roadmap to facilitate the introduction of EGNOS and in the future Galileo, in the MEDA region, in the decade 2009-2019.
2. Implementing a **Training & Awareness program:** training and promotion events that gathered the interest of the MEDA stakeholders.

   The first METIS Master Training and Awareness took place in AUI in Ifrane : 15th and 16th March 2007.
3. Running several real-life **GNSS Service Demonstrations**: METIS run **9** real-life demonstrations of EGNOS applications.

METIS (MEdiTerranean Introduction of GNSS Services)

Demonstrations were carried out with the involvement of MEDA stakeholders, belonging to three or more countries (Wide Area Demonstrations), or one country (Local Area Demonstrations).

- Dangerous Goods Transport
- Freight Multimodal Transport
- Mobile surveillance and control on Airport
- e-tourism

	Project	Actors	Countries	Topic
1	Dangerous Goods	▪ GIS Provider ▪ Explosive and hydrocarbon goods transport ▪ Ministère de l'Energie et des Mines ▪ Direction de la Protection Civile	Morocco Algeria Tunisia	Dangerous Good Road
2	Freight Multimodal Transportation	▪ Freight Forwarded ▪ Shipping Liner ▪ International Multimodal Transport Operator	Tunisia Algeria Morocco	Freight and remote asset Tracking & Tracing
3	MEDaCoN Mediterranean Data Collection Network	▪ University ▪ Public / Private Research Centres	Morocco Algeria Tunisia Egypt Jordan Israel Turkey Palestine	Tool for supporting educational activities and test of local services
4	Mobile surveillance and control on Airport	▪ Technology Provider ▪ National Airports Authority	Morocco	Aviation
5	e-Tourism	▪ University ▪ Office of Tourism	Morocco	LBS & Mass Market

Training by research

Project Works (Engineering school, Masters and PhD degrees)

- Indoor Positioning
- Signals & Interference
- Land Transport Positioning
- Simulator of Galileo Signal
- Hybridization with inertial systems
- Urban Positioning
- Positioning in the Underwater Environment
- Optimization of Receivers

Activities of CRASTE-LF on Capacity Building in Space Sciences and Technologies

Regional African Centre for Space Science and Technology Education In French Language (CRASTE – LF)

Affiliated to the United Nations

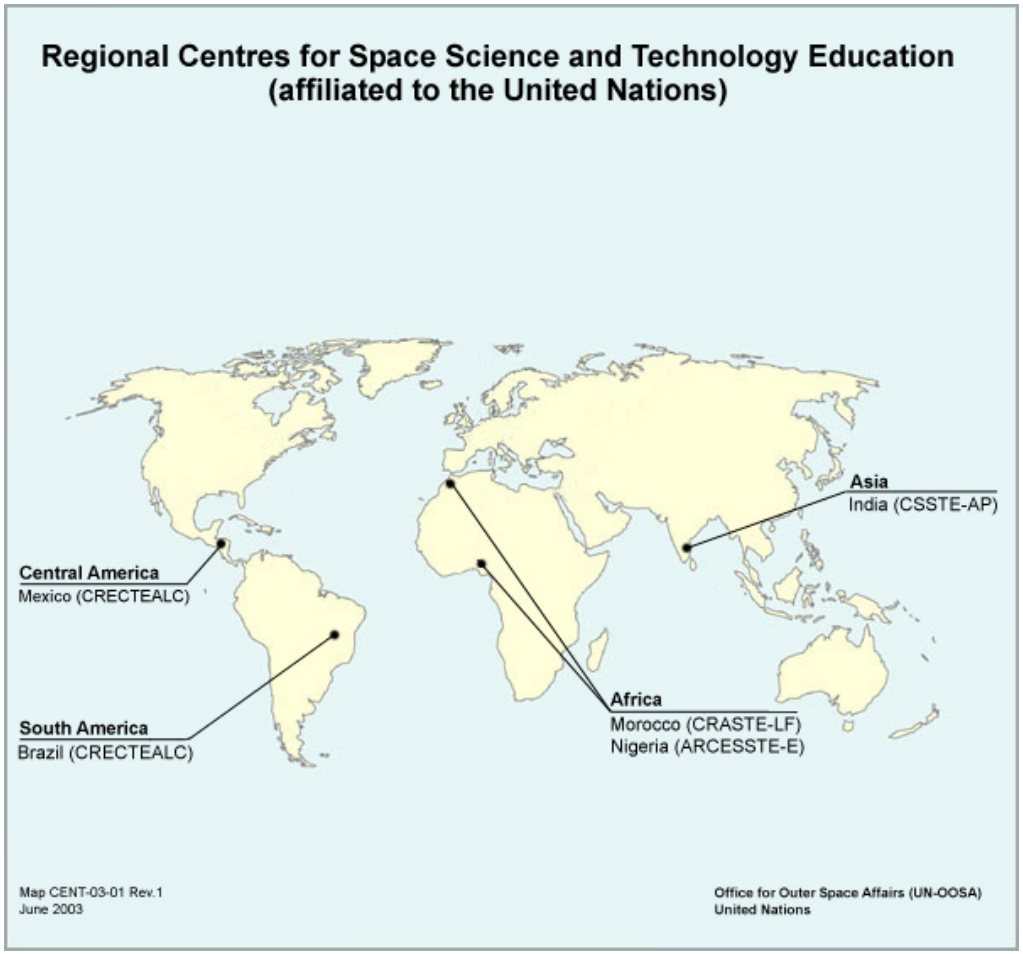
Director: Prof. Abderrahmane TOUZANI

www.crastelf.org.ma

CRASTE-LF

4 Centres affiliated to UN in different regions of the World :

- **India (Asia & Pacific),**
- **Morocco (Africa – French Language),**
- **Nigeria (Africa – English Language),**
- **Brazil – Mexico (Latino America & Caribbean)**



CRASTE-LF

- Created in Rabat, Morocco on October 1998. The affiliation to the UN took place on November 2003.
- 13 Member Countries: Algeria, Cameroon, Cap Verde, Central Africa, Cote d'Ivoire, D. R. of Congo (Zaire), Gabon, Morocco, Mauritania, Niger, Senegal, Togo and Tunisia.
- 13 Postgraduate courses (9 months).
- Long-term programs have benefited about 170 participants from 18 countries in the African region.
- 14 workshops and training courses.
- 850 experts are attending different Conferences and Workshops organized by the Centre in each fields in Space Technologies from 48 countries in Africa, Europe, Middle East and North America.
- International training course on GNSS was held in 2009 by UN/ICG.
- Training Workshop on GNSS in Togo 3 -7 October 2011.

CRASTE-LF

The Objectives of the Centre

- To increase knowledge in Space Sciences and Technologies by organizing courses, seminars, workshops, conferences at the Regional level,
- To improve the technical competence of the experts, teachers, decision-makers and to hold them informed about technical progress .
- To assist the countries of the region on the development of endogens capacities in space tools.
- To strengthen the Local and Regional capacities.
- To promote cooperation between the developed countries and states members as well as among these states.
- To develop expertise in Space Sciences and Technology.

CRASTE-LF

- **The Main Courses Programs:**
  - Remote Sensing And Geographic Information Systems
  - Satellite Communications,
  - Satellite Meteorology and Global Climate,
  - Space and Atmospheric Sciences
- **Target Public :**

  Professors, Researchers, Engineers, Administrators and Managers
- **Recovering Sectors:**

  Universities, Research Institutes, Professional and Private Institutes and Administrations
- **Research Projects:**

  The research projects cover several topics in preparation of the Memoir of the Master in Space Sciences and Technologies, relate to the applications of Remote Sensing and Geographical Information Systems on: *Cartography, Topography, Urban, Agriculture, Geology, Natural resources, Water, Ecology, forest, desert progress, coastal Managing, Migration of Population, etc…*

CRASTE-LF

International Training Courses in GNSS on Satellite Navigation and Location Based Services - 2009

The Centre organized the GNSS courses for 4 weeks from September 28 to October 24, 2009, Supporting by UNOOSA, ICG and others National and International Institution.

Number of Trainees: 35

Objective : Capacity Building in GNSS Applications, and to make the participants aware of the potential of Satellite Navigation Technology and its applications.

Target Public: Trainees from Institutions work and use Space Tools from Africa Region and speaking in French, and having high level education.

CRASTE-LF

- Contribute to Capacity Building by training in space sciences and technologies

- Constitute a data base of regional expertise in this field by an investigation near ex trainees or those which took part in a Workshop or Conference organized by the Center

touzani@emi.ac.ma

www.crastelf.org.ma

Constraints

- ✓ Rarity of expertise and resources
- ✓ Lack of material and equipment for some laboratory experiments
- ✓ Lack of companies in the area of GNSS for the reception of trainees
- ✓ Some difficulties to access the GNSS documentation.

Keys to a Successful Capacity Building Program:

- First steps: to improve capacity building inside local and regional organisations in developing countries, the goal is to build a core of technical competences inside these organisations that would constitute a locomotive for the others entities.

- **Capacity building**: technical training on GNSS systems and applications, training on project management (including risk management) and training on legal aspects.
  - ✓ Propose wide range of courses on the GNSS (undergraduates, post-graduates, professionals, regular courses/short term courses).
  - ✓ Qualified trainers: Professors and experts from enterprise
  - ✓ Training of trainers
  - ✓ Customised training and awareness
  - ✓ Infrastructures and laboratories
  - ✓ Pilot projects
  - ✓ Involvement of key actors
  - ✓ Regional and international cooperation.

Last but not least, to improve some developing activities such as financing of courses, GNSS University chairs, funding of support to GNSS application pilot projects, and technology transfer .

Summary

- Developing countries have to exploit the potential of applications based on GNSS. Today, GNSS can be a common tool for any user.
- The right steps mast be taken to maximise benefits from the use of GNSS technologies.

➔ **Capacity Building:** National and Regional levels.

- The rewards are not limited to corporate turn-over alone, a lot of new jobs can be created,
- Real opportunity to create economic growth in a wide variety of fields (transport, tourism, fishing, …) and to improve quality of life.

Summary

Notice:

- ✓ Students actively participate to the GNSS course activities.
- ✓ Seminars offered by international researchers and industrial experts were seriously welcome by the students
- ✓ Students come from different countries, some of them are now working in the GNSS field and some of them are asking for a post-graduate studies in GNSS field.

➔ It is interesting to keep touch with them and to see how they can work together in collaborative projects on GNSS.

Thank for your attention

amghar@hotmail.com