MIMU

Myanmar Information Management Unit

Canada

SYMPOSIUM REPORT

Building Capacities for Evolving Geospatial Needs in Myanmar

24-25 May 2018, Yangon

Contact

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- Heather Mac Bride, First Secretary, Embassy of Canada to the Union of the Republic of Myanmar
- Dr Victor Jetten, University of Twente, The Netherlands
- Dr Manzul Kumar Hazarika, Asian Institute of Technology, Thailand
- U Maung Maung Than, Director (retired), Forest Department, Ministry of Natural Resources and Environmental Conservation
- Dr Khin Than Yu, Yangon Technological University
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EXECUTIVE SUMMARY

The Myanmar Information Management Unit / MIMU organized on 24-25 May 2018 a two-day Symposium on "Building capacities for evolving geospatial needs in Myanmar". The aim was to reflect on current geospatial expertise, gaps and future capacity needs within Myanmar. The event gathered 127 persons from 27 universities, 19 government departments, 15 private companies and 18 development organizations. It also included the participation of 3 international universities from The Netherlands, Thailand and United States of America as resources to relevant experiences and lessons learned. The Deputy Director General of the Department of Higher Education, U Nay Win Oo, opened the ceremony. The first day was dedicated to discussion on the evolution of geospatial technologies and related competencies. The second day focused on steps geospatial trainers and professionals should be taking now to ensure capacity for future needs.

Rapid evolution of Geospatial Science and Technology

In the last two decades the world has been dramatically transformed by technology, especially by the combination of Geography, Information Technology and the spread of the Internet. The considerable development of geospatial sciences has radically changed the way we gather information, handle analysis and communicate with stakeholders. We have entered a new era where technological developments allow for:

An abundance of free data produced globally. Though this data may not be perfect, it helps to overcome limitations of locally produced data that are suffering from lack of availability, accessibility and quality.

Instant complete location awareness and use with the development of mobile phones applications, web-mapping, 3D visualisation and Augmented Reality.

Fast and powerful data processing performed by cloud computing where only the results are transferred to clients. Automated detection of objects and predictive trends are another revolutionary development thanks to Artificial Intelligence (machine learning) advancements and Big Data expansion.

This rapid expansion has brought the need for new skills to be able to understand and apply the recent technologies. It is crucial that training curricula now reflect these evolutions. Simultaneously, universities need to adjust teaching methods to train students to learn how to learn. Because technological advancement is moving far too rapidly, professionals cannot depend only on initial training and must keep on learning and developing competences throughout their professional life.

Geospatial sciences have become mainstream, known to a wide public and core to many types of work. Geospatial technology is no longer used exclusively by geomatics experts; many other parts of society also produce, analyse and depend on spatial data. With increasingly complex problems, geomatics specialists need to cooperate with domain experts (legal, natural resources, disaster management, urban planning, finance, etc.) and bring their spatial data expertise and geo-analytics skills within a multidisciplinary team. As such they need greater project team and communication skills.

Though Myanmar is still at an early stage of geospatial sciences applications, we can already see an increasing interest in government, academic and civil society; Geographic Information System (GIS) units have been established in many governments departments and universities. Geospatial applications are also key to growing engagement of citizens, and play a very prominent role in international reporting and projects (SDG, REDD+, etc).
In Myanmar, users have the technical skills to easily apply computer cartography, integrate new data and explore spatial analysis and geo-statistics. More advanced professionals develop spatial modelling especially in geophysics sciences. A multi-disciplinary approach is yet to be fully established, particularly for complex themes such as climate change, biodiversity mapping, crop growth projection, urban planning, etc. Communication and visualisation tools such as web-mapping are emerging but still in a nascent stage. Cutting-edge technologies such as Machine Learning and Big Data analysis linked with geographic patterns are yet to be developed in the country.

Current and Future Competencies needed in Myanmar

Despite this progress, Myanmar has yet to integrate the most recent technologies to its advantage. Practitioners often miss the fundamentals such as projection systems, data management, and quality control, and work with outdated technologies due to insufficient financial means to update them.
Participants noted the main current obstacles to be data issues (including lack of availability, cost, absence of a National Spatial Data Infrastructure and standards/NSDI), limited funds for equipment, lack of data policy (data sharing protocols, copyrights, protection), lack of support from senior decision-makers, gaps in human resources management and key competences such as:

- Limited highly qualified personnel
- Limited exposure of teachers to innovative technologies and to solution-oriented applications
- Missing attitudes such as critical thinking, analysis, creativity and communication abilities

The private sector engaged in geospatial technologies is more technologically advanced, and has voiced difficulties to find highly qualified personnel with the above-mentioned attitudes and knowledge of emerging technologies such as web-mapping.

Challenges of Geospatial Capacity building and training in Myanmar

In Myanmar, geospatial trainings in universities boomed in 2012-13 in Geography Departments throughout the country. A survey carried out by MIMU in 2018 indicated that 29 universities are providing some level of geospatial courses. Most of the courses are targeting undergraduate students, with basic knowledge and concepts of GIS/Remote Sensing (RS). Theoretical courses are predominant over hands-on exercises. There are limited highly qualified personal and few opportunities for external refresher courses. Academics have insufficient linkages with external partners (international universities, industry, development actors) to be exposed to research projects, new technologies and real case scenarios. Finally, equipment and material in universities are limited in most cases.

Steps to build up capacities

To bridge the gap, the participants recommended to:

Strengthen trainers' technical skills: an important step will be building up and maintaining longer-term teaching capacity. Several longer-term solutions were suggested: establishing a core group of national trainers to perform sustained Training of Trainers; organizing more refresher courses across universities to draw on the various skills and experiences; establishing a platform to promote exchange between universities and sharing of experience, lessons learned and resources. Teachers could also be encouraged and provided with the resources to engage individually in free online courses.

Develop links between higher education, research and business: one of the key solutions to improve and develop geospatial technologies in Myanmar is to extend research collaboration with external partners such as international universities and the private sector. Engaging with these stakeholders will expose teachers to innovative technologies and solution-oriented applications. This will fuel the practice of real case scenarios for students who can better understand the market realities. Closer links with the private sector and international universities will also drive the adjustment of curriculum to the market needs. Finally, the ability and opportunity to compete for demand driven research, whether as contract or consultancy, would be a strong incentive for universities to obtain materials and financial means.

Adjust curriculum and evaluation: update curriculum content to address the new scientific arena; increase hands-on exercises; link research and education to ensure required competencies can be developed through practical opportunities; set standard testing and evaluation methods to increase accreditation and quality control; introduce student-centred learning approaches.

Promote Policy making and financial support: efforts to educate policy-makers about the potential applications of geospatial technology are underway through practical applications. It is hoped that these initiatives will influence decisions regarding the allocation of public resources to geospatial science development and higher education.

To adopt new technology and innovation, universities must be open to some degree of change to strengthen delivery of these programmes such as competing for demand driven research, expanding collaboration with external partners, experimenting with new ways of teaching, etc. Such a shift will also depend on pending decisions around the future status and degree of autonomy of the universities.

1. INTRODUCTION

1.1 Background and Objectives

The considerable development of geospatial sciences over the last two decades have radically changed the way we gather information, handle analysis and communicate with stakeholders. The need to use technology and geospatial data to inform decisions on almost every sector is now very clear. This rapid evolution calls for changes in geospatial research and education to meet the demand for wider use of geospatial information for today and for the future.

With a growing number of individuals, organisations, government departments and companies recognizing the value of developing this sector in their day-to-day work and planning, Myanmar has a unique opportunity to take strategic approaches to build capacity in the geomatics sector. This Symposium provided the opportunity for all parties involved to think together about ways to best ensure that the next generation of trainees with geospatial skills can meet the needs of today's government, enterprise and development sectors. It was also the occasion to think together about effective collaboration to develop a stronger community of interest between academia, government, industry and development organizations.

To this end, the Symposium sought to:

1. Raise awareness of latest geospatial innovation, technologies and applications
2. Enable institutions teaching geospatial skills to discuss the market needs with government, industry and development actors to ensure that their courses are in tune with what is needed
3. Promote collaboration and networking between institutions

1.2 Structure of the Symposium

The two-day Symposium was organized by the Myanmar Information Management Unit / MIMU on 24-25 May 2018 to reflect on activities and expertise within Myanmar, while also looking to experiences of the academic sector in other countries and their relevance to Myanmar.
The Symposium aimed at answering the following questions:

- Do we have skilled geospatial workers in Myanmar who can meet the needs of today's academic, government, private and development sector?
- What steps should geospatial programs and professionals be taking now, to ensure capacity for future needs?

During the first day, international and national speakers presented the evolution of geospatial technologies and applications and their implication on new required competencies. Afterwards, the participants split into working groups to explore worker's skills against the demand. Presentations on the second day focused on experience in training and capacity building with participants then considering the required capacity areas and steps to move forward.

1.3 Participants

The Symposium brought together 127 persons from academic, government, private and development sectors. Among them were:

- 58 representatives from 27 universities involved in GIS/RS courses,
- 21 representatives from 19 Government Departments and Cities,
- 15 representatives from the Private Sector,
- 33 representatives from the Development Sector (International Organisations/NGOs/ United Nations agencies/Donors).

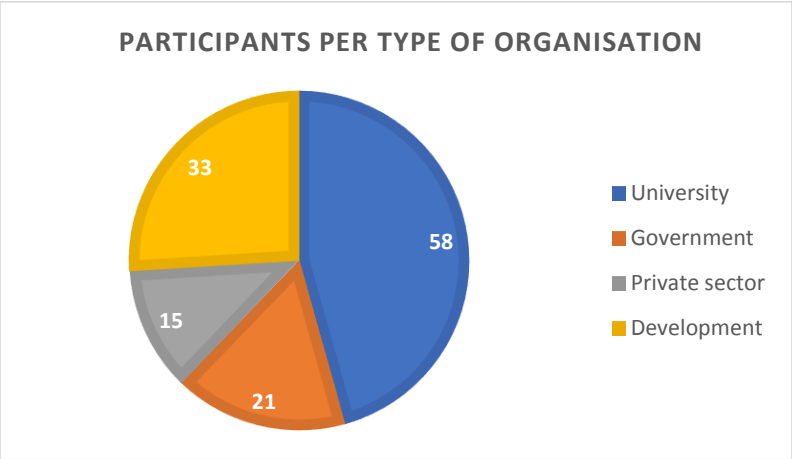

Figure 1. Distribution of the participants per type of organization

2. SUMMARY OF DAY 1: Current Situation

2.1 The Geospatial Evolution

In the morning, the speakers presented how technological innovation is driving the geospatial community in a wide range of new skills and competencies, globally and in Myanmar.

Presentation 1: Evolution of Geospatial Sciences and Technologies

(Dr Victor Jetten)

The last decade has brought innovative technologies which have radically changed the way in which maps are produced and used. Geospatial technologies have become a part of our everyday life – from Google Maps and Google Earth, to satellites orbiting Earth in outer space, all the way down to the mobile phone in our hand. In a brief period, geospatial technologies have changed the way we gather information and improved how we plan and handle daily life. From these recent developments we will look at three main trends:

- Global data abundance versus local data scarcity

National, local ground information is often scattered, incomplete or simply not available. A lot of basic data is still not digitized and is restricted, so not available in the public domain. There is a reluctance to share data, as well as missing metadata and unclear quality indicators.
In parallel, globally there has been an exponential increase in data availability and types, many of them free of charge. *Global free data tends to be used in place of missing local data*. Worldwide, data is produced by a wide range of sources in enormous quantities but it is not clear if it can be used on a detailed scale as there is very little metadata in terms of provenance, quality, indications. However, those data are perceived to be 100% true when that is not actually the case, especially when used at a large scale.

- Rapid development of spatial sciences

In reference to the Figure 2 below, we can see that in the 70's-80's, GIS technology was used for simple cartography and visualization. Spatial analysis and modelling developed in the 90's. Since the 2000's, more complex analysis is being undertaken, involving also multidisciplinary approaches.
Over the last decade, the complexity of types of data combined with wide-scale availability (Big Data) have resulted in multivariate spatial statistics along with new machine learning algorithms.

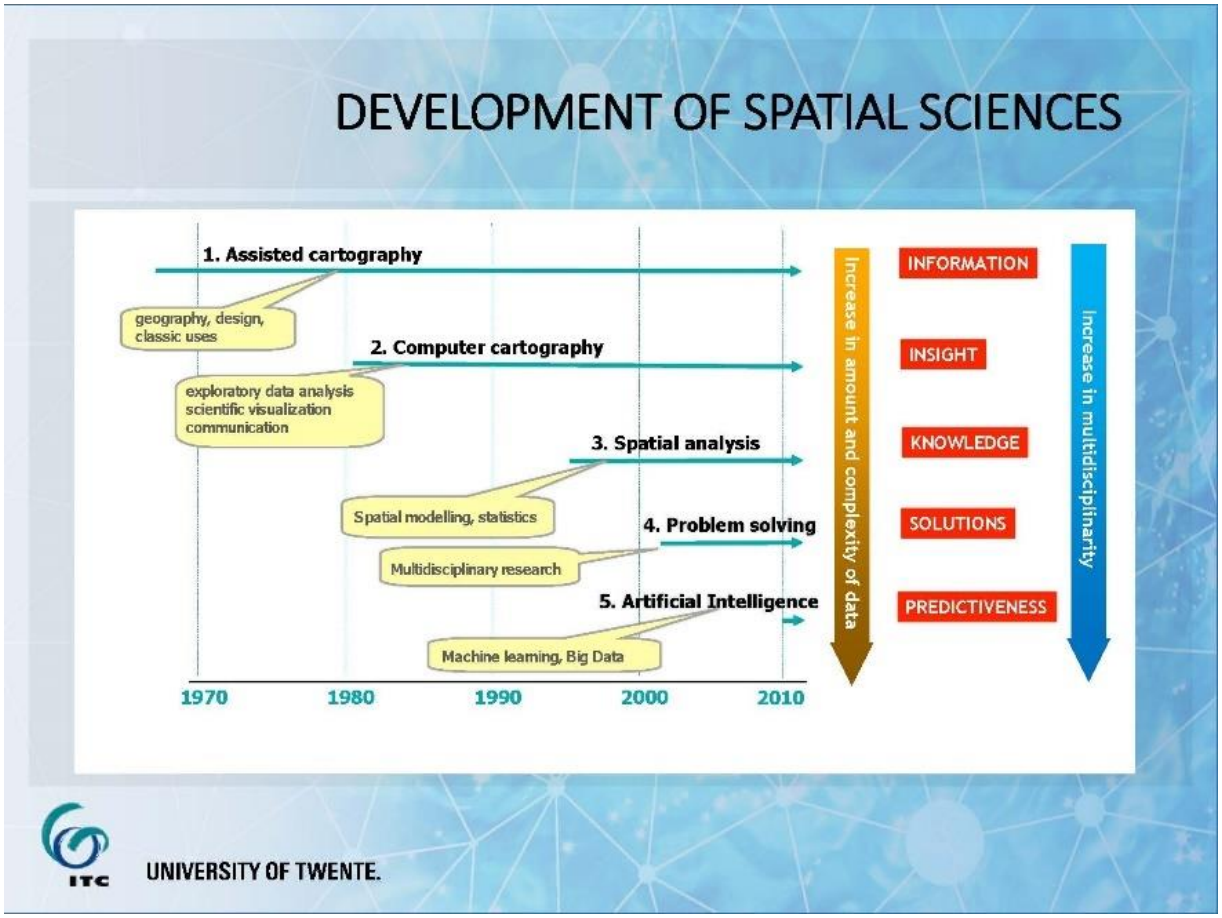

Figure 2. Development of Spatial Sciences

- Changing roles for Geomatics experts and others

The rapid expansion of geospatial technology has brought the need for new skills to be able to understand and apply the newly available tools – not just for GIS professionals but also for engineers, urban planners, rural development specialists, conservationists and many others.

Even though a lot of basic data is still not digitized and often scattered, the traditional role of GIS specialists as generators of spatial data is rapidly surpassed because many other parts of society produce data. The added-value of geomatics professionals tends to be their higher level of spatial data expertise with the ability to know the wide range of data available and to select the most appropriate data according to relevancy, source and quality.

Because geospatial technology is used in so many different domains with an increasing degree of complexity, geomatics professionals need to cooperate with domain experts (legal, natural resources, disaster management, urban planning, finance, etc.). In such cases geomatics experts translate a problem into GIS to perform a spatial-driven analysis along with a multidisciplinary team. As such they need more and more project team and communication skills.
Domain experts use spatial analysis to support the process of their analysis. They can generate primary data, process their knowledge, build-up advanced domain modelling, and have direct contact with stakeholders.

Therefore, what is needed is not only about knowledge and skills – it is increasingly about attitude, particularly the ability to work in a multidisciplinary team, to be creative, and to work collaboratively. Acquiring the necessary competencies – including practical skills, knowledge and attitude, also requires approaches in higher education to adapt curriculum and teaching approaches to be effective in transmitting the required attitudes as well as the knowledge and skills.

Presentation 2: New Fields of Application

(Dr Manzul K. Hazarika)

Several innovative technologies and new sensors have significantly changed the use of Remote Sensing (RS) applications.

- Increasing availability of RS data

  New sources of RS data are now becoming available:
  - Drones enable fast data acquisition over small areas. There is a wide range of sensors and potential to produce a large variety of high resolution data. For example, LiDAR (Light Detection And Ranging) uses lasers on drones to provide three dimensional data.
  - Free satellite imagery from Sentinel-1 and Sentinel-2 provides multispectral and radar earth observation data which is widely used for flood monitoring, surfaces deformation, vegetation index, land cover classification.
  - VIIRS (Visible Infrared Imaging Radiometer Suite) is the successor of MODIS to provide day and night observations. Night lights can be correlated with economic development.

- Cloud Computing for Data Processing

With Cloud Computing, data is hosted in the cloud and analysis is conducted by super computers with high processing power. Only the results are transferred to clients. Google Earth Engine is a good example of the powerful digital mapping processes available online.
Artificial Intelligence is another new opportunity allowing scientists to successfully detect various objects using high resolution satellite data. This has only recently become possible with alternatives to conventional classification algorithms.
Applications are limitless: drought monitoring, agriculture crop yield forecasting, urban area monitoring, disaster risk assessment, are just a few examples of their practical uses.

- Data sharing and visualization

Dr Hazarika presented an example of web-mapping interface that displays flooded areas based on satellite imagery complemented by pictures taken by inhabitants. This system centralised geo-localized photos taken by inhabitants sent via a mobile phone application, allowed for quick ground truth validation and future flood modelling.

- Geospatial Skills

GIS and Remote Sensing skills need to be combined with specific domain knowledge to perform advanced analysis. Dr Hazarika noted that many Asian universities now offer Science and Engineering degrees that include RS, GIS and WebGIS courses along with common programming skills (Python, JavaScript, HTML, CSS).

Emerging specific skills that are in demand on the market are:

- Synthetic-Aperture Radar (SAR) data processing. SAR technology is a form of radar used to create two- or three-dimensional images. It has wide applications in Remote Sensing and mapping such as topography, geology, urban growth, forestry, etc. It is independent of cloud cover so particularly useful during monsoon periods. Even though SAR technology has been on the market for 20 years, the general skill sets are still very poor.
- LiDAR is a recent technology that requires specific training.
- Digital photogrammetry is an old area which is gaining new interest.
- Big Data and Artificial Intelligence - abilities to work with these new and growing fields are increasingly required.

Presentation 3: Geospatial Development in Myanmar

(U Maung Maung Than)

After a brief recap of the history of GIS/RS in Myanmar, U Maung Maung Than emphasized four main stumbling-blocks for the development of geospatial use in Myanmar:

- **Lack of data availability**

Availability of basic GIS layers which are instrumental for applications of RS and GIS should be established as a priority with joint coordinated efforts of all sectors concerned. Sharing data in a centralised database, using clear data protocols, standards and policy should be set as a priority.

- **Limited national technical capacities**

Basic skills and knowledge for application of RS/GIS is still lacking in most of the sectors This could be solved locally with the establishment of a National Training Centre that coordinates the needs of natural resources, disasters, etc.

- **Lack of coordination and strategic support**

Coordination between Ministries to build up a National Spatial Data Infrastructure (NSDI) needs more support from senior decision makers in order to integrate and optimize the use of GIS/RS technologies in national initiatives. The newness of these technologies as well as the limited training which has been on offer in the past in Myanmar means however that these decision-makers may be unaware of its value and may not prioritize important investments to enable the integration of GIS/RS technologies. Targeted approaches are needed to build decision-makers' awareness and understanding on the potential and the limits of GIS/RS technologies for them to come up with realistic expectations.

- **Limited synergies with private sector**

Involvement of the private sector is important for all technology developments. With its market-orientation, the private sector has resources to adapt quickly, integrate and optimise the use of innovative technologies. Concerted efforts between the government and private sector to develop RS/GIS applications should be strengthened.

2.2 Summary of the Working Groups: Competencies needed

In the afternoon the Symposium participants discussed in working groups to identify the current capacities as well as today's and tomorrow's needs. They were asked two key questions:

- What are we good at in Myanmar in terms of geospatial competencies?
- What are the competencies we are missing - now and in the future?

Current geospatial applications

To answer the first question (What are we good at in Myanmar in terms of geospatial competencies?), the participants were invited to look at the current geospatial applications and uses.

Figure 3. Working group during Day 1 – What are we good at?

The graph "Development of Spatial Sciences" (Figure 2) presented earlier by Dr Jetten from the University of Twente was used to identify the current level of use and applications in Myanmar. According to the participants:

1. Assisted Cartography: map-making and visualization in hard and soft copy is performed by all sectors. Digitization of government paper maps is ongoing, with statistics now stored in xls format and linked to GIS software whenever possible. Geocoding and GPS data input is widely applied by government and private sector.
2. Computer cartography: exploring data with layers overlay, buffer, network analysis, geo-statistics analysis is reportedly performed by all sectors.
3. Spatial analysis: modelling in geophysics, land use and land cover classification, time series analysis, flood mapping, shoreline changes, agricultural productivity index are mainly developed in the academic sector, and to some extent in the government sector.
4. Problem solving: multi-disciplinary approaches have yet to be developed in Myanmar, especially in projects such as climate change projection, biodiversity mapping, crop growth projection, urban planning, etc.
5. Artificial Intelligence: Machine learning and Big Data analysis are virtually absent in the country. Though the fundamentals are being taught in a few universities, the link with the geographic patterns is yet to be developed.

Missing competencies in geospatial fields in Myanmar

The participants described the main stumbling blocks to the development of geospatial sciences in Myanmar. They are sorted in five categories:

1. Insufficient availability of local data: limited data sharing culture, absence of data standards;
2. Absence of a national data policy: lack of data sharing protocols, data protection and security, ownership and copyrights, absence of NSDI;
3. Insufficient and outdated equipment: the budgets of universities and government departments are too limited to equip and maintain their institution with adequate computers, printers, scanners, software, etc.
4. Limited decision-makers' awareness and support: this has implications on investments prioritization to enable the integration of GIS/RS technologies and optimize capacity building opportunities.
5. Missing competencies for qualified personnel: professionals using geospatial technologies are missing technical skills and knowledge as well as specific attitudes. Teaching capacities, training and curricula need to be strengthened too.

Below is the list of missing competencies as identified by the participants:

1. Technical skills and knowledge to be strengthened

- Basics understanding of the fundamentals of maths, physics, statistics, …
- GIS understanding independent of software choice
- English Language
- Geodatabase management
- Awareness of data standards
- Open data understanding (technology and rationale)
- Image processing
- Spatial analysis
- Drone technology
- Modelling expertise
- Programming (python, CSS)
- Web-mapping
- Mobile-based data collection tools and applications
- Big Data management
- Artificial Intelligence

Currently, technical skills needs are in line with, but mainly limited to, the current in-country use and application. As such they don't extend to many potentially valuable applications which may be common in other countries. With a wide variety of actors engaging in geospatial activities, it is not surprising that missing technical skills vary dramatically from "Basics understanding of the fundamentals of maths, physics, statistics", … to "Artificial Intelligence".

The participants expressed the need for strengthening students and professionals' knowledge and skills in the fundamentals of GIS and RS, including more systematic methods and methodology to apply basic and advanced GIS and RS skills.

2. Specific attitudes to be developed

- Analytical skills, critical thinking
- Problem solving
- Innovative/ Creative thinking
- Communication skills

With the evolution of the geospatial technologies and applications, ability to use sound judgment, articulate information requirements, ability to convey complex information and design solutions for disparate actors will become increasingly required. In such as fast changing technological environment, keeping abreast of new technology, willing to learn and actively seeking to apply innovative solutions will also be critical for any geospatial career.

3. Teachers technical knowledge and skills to be reinforced

- Lack of national professional trainers for Training of Trainers
- Raise awareness of innovative technologies
- Adapt and increase refresher courses
- Access to trainings in States/Regions

Participants noted that the exposure to new technologies is insufficient. Most teachers have not had adequate training to prepare them to use emerging technologies and are expected to gain these skills through refresher courses and peer collaboration.

4. Teaching methods and curriculum development to be reviewed and updated

- Update curriculum to new scientific arena
- Design curriculum in accordance with accredited programs
- Adapt teaching materials and teaching methods
- Establish on-the-job trainings for students / link between academics and industry
- Ease Financial access
- Integrate the teaching of GIS/RS in more disciplines and specialized domains

Teaching methods and curriculum development require a focus on content that includes:

- Developing technology knowledge and skills. The academic sector need to develop plans for teaching new and updated technologies and scientific methods to students.
- Establishing a clear connection between the technology and its applications "in real life". Students should be enabled to use appropriate technologies to address the actual needs and problems faced by geospatial professional practitioners. This link should be established in all exploration, analysis and production phases of the learning process.

- Implementing a student-centred approach. Although traditional definitions of learning have been based primarily on learning by heart, new definitions focus on critical thinking, creativity, and knowledge creation. Thus, teachers need to know how to facilitate these types of learning outcomes among their future students. That means they need additional knowledge of the pedagogical methods that facilitate student learning. For example, pedagogical knowledge needs to include how to develop students' abilities to work in interdisciplinary team or to take control of their own learning in a technological-fast evolving environment.

Figure 4. Working group discussion

3. SUMMARY OF DAY 2: Looking to the Future - Where we are heading

The morning was dedicated to the current geospatial training offers in Myanmar and best practices from international universities. Afterwards the participants split again in several working groups to explore viable way forward to bridge the gap between current needs and the existing geospatial trainings.

3.1 Presentations

Presentation 1: Overview of Geospatial Courses in Myanmar Universities

(Mrs Catherine Lefebvre, MIMU)

MIMU sent a questionnaire to all the universities involved in geospatial courses in Myanmar in April- May 2018 in preparation for this Symposium. The main findings are:

- 29 out of 134 universities in Myanmar provide geospatial-related courses.
- The number of trainings boomed in 2012-13 (see Figure 5 below).
- Two-thirds of the geospatial courses are delivered by the Geography Departments, however the number of other departments offering such courses is growing. Technological (engineering), Information Technologies and Computer Sciences are using innovative technologies such as mobile applications and web-mapping.
- As of 2018, these courses produce a high number of students with basic knowledge and concept of GIS/RS (around 2,500 students/year). Their practical skills are less clear. Among these, only around 12% (300 students) study GIS during their post-graduate degrees.
- Short courses for professionals have emerged in universities in the last couple of years.

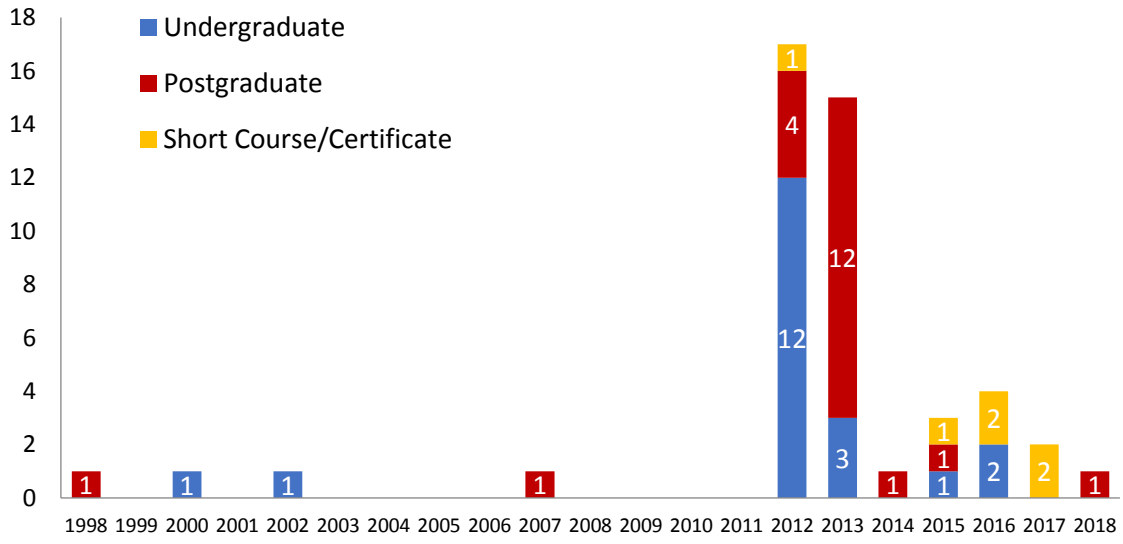

Figure 5. Launching of GIS/RS Courses in Universities per year

- Challenges
  - Courses tend to be more theoretical with less hands-on exercises.
  - Insufficient opportunities of external courses for teachers.
  - Equipment and material are limited in most cases.
  - Insufficient engagement with external partners.

Presentation 2: National GeoPortal for Cross-Sectoral Data Integration

(Dr Joan Bastide, OneMap Myanmar)

The OneMap Myanmar (OMM) Project aims to generate and share accurate land map (spatial) data on an online database to support land management and land use planning. It involves 26 line agencies from 11 Ministries and 3 City Councils, with the technical assistance of the Centre for Development and Environment from University of Bern (Switzerland) and the Land Core Group.

- The data challenges

OneMap Myanmar (OMM) emphasized the limited data quality, availability and accessibility:

  - Much data is still in paper format and not yet digitised
  - Digital data which is available is not always managed systematically
  - Low data quality due to old methods and lack of capacities (technical, financial, etc.)
  - No information sharing mechanism institutionalized
  - No data standards across agencies: data cannot be integrated between different sectors

- Opportunities

  - Increasing number of GIS users
    - Strong interest in government, academic and civil society
    - Establishment of GIS Units in many government departments
    - Increasing citizens' engagement leading to more demand for current information
  - Increasing accessibility and affordability of tools and data (financially and technically)
  - Network of universities with GIS capacities as a foundation
  - Sector-specific training schools for future professionals (Survey Department, Land Administration, etc.)
  - Online training opportunities available from international institutions
  - Prominent role of GIS in international reporting (SDG, REDD+, etc) as an incentive
  - More international projects promoting geospatial technologies

- Challenges in Capacities for Geospatial Technologies

  - Trainings are often task-specific, based on project outputs. They do not provide adequate understanding and overview.
  - Professionals often miss the fundamentals (eg: projection systems, data management, and quality control) and the high diversity of needs, requirements, and workflows need tailored approaches.
  - Capacity building programmes often do not put enough emphasis on consolidated workflows and quality control.
  - Institutions use outdated technologies because they can't afford the costs of maintenance after the projects end.
  - Lack of technical understanding of senior decision-makers with wrong expectations.

- **Concluding Points**
  - There is a growing availability of professionals with GIS capacities in Myanmar, but it is still insufficient.
  - Universities and the academic sector have a key role to play, including capacity building of future professionals, identifying needs and asking the right questions, developing tools and data, turning data into knowledge, conducting impartial research.
  - Geospatial data is still at a very early stage in Myanmar and support is still very much needed (funds, training, equipment, etc.).
  - Technologies are at a tipping point with the development of web-based GIS, satellite data sources and cloud computing. It is crucial that training curricula now reflect the technological changes.
  - Coordination is needed among donors and implementing agencies to avoid overlaps.

Presentation 3: Innovating Curriculum- Experiences from ITC

(Prof. Victor Jetten)

Whereas discussions on Day 1 focused on the needs to improve geospatial sciences in Myanmar, the OneMap Myanmar presentation highlighted the necessity of developing high-quality geospatial education. This is not only the responsibility of the academic sector - the society as a whole, industry included, have a role to play.

Geospatial technologies are emerging as an important enabling sector to support a wide range of professionals, activities and initiatives. Changing demands in society and industry, developments in science and technologies, emergence of new data sources, all require universities to keep adjusting their curricula to the demand.

- **Mix research and education**

The best way to keep up with innovation and technology is to involve staff and students in research and projects. MSc students can do valuable parts and learn how to translate a societal problem into a scientific problem, and vice versa.

- **Accreditation and quality control**

Dr Jetten presented several tools to make a logical and quality driven curriculum. Among them are the Meijer's criteria to create a curriculum using the logic of learning outcomes and quality control. The Bloom Taxonomy and Rubrics Matrix tools are useful to formalize testing of students.

- **Student-centred learning**

"Talking is not teaching, listening is not learning"

To improve student competencies (knowledge, skills, attitude) and conceptual thinking, Dr Jetten presented three examples of student-centred teaching methods: flipped classroom, peer learning and project-based education. There are many more methods and examples online that teachers are encouraged to browse for, experiment and evaluate with students.

Presentation 4: Activities of Remote Sensing and GIS Research Centre in Yangon Technological University (Prof. Dr Khin Than Yu & Prof. Dr Sao Hone Pha)

Prof. Dr Sao Hone Pha presented the activities of the new Remote Sensing and GIS Research Centre in Yangon Technological University.

- **Objectives**
  - Train undergraduate and postgraduate students in the fields of RS and GIS technology and Global Navigation Satellite System (GNSS) signal processing;
  - Enable effective and extensive use of RS and GIS technology in the postgraduate research work of the university;
  - Collaborate with other engineering departments and international organizations to promote effective use of RS and GIS technology in their corresponding research areas.

- **Trainings**

The Centre offers regular RS and GIS courses at PhD, Master and under-graduate levels. It also proposes short capacity building trainings of innovative tools (Google Earth Engine, Land use/Landcover, 3D Laser scanner, GNSS signal, 3D terrain and visualization, etc.) in collaboration with local and international organizations on various applications in engineering taught in the same university.
It is currently implementing a large research project (The SATREPS project) in partnership with the University of Tokyo.

- **Challenges**
  - The need for adequate staff and facilities – currently 13 posts out of 18 are still vacant
  - Absence of uniform academic standards and lack of networking
  - Lack of financial resources for international exposure
  - Majority of teachers require refresher courses to update their knowledge of emerging new technologies
  - Students curriculum should address the new scientific arena

- **How to Strengthen the Wider Geospatial Community in Myanmar**
  - Active collaboration and cooperation internally and externally
  - Hold seminars, workshops, conferences and trainings
  - Share knowledge and experience gained from national and international institutions for exposure to the extensive and effective use of geospatial technology
  - Create a platform enabling sharing and access of public geospatial data

Presentation 5: UAV-Based GIS/RS for Civilian Applications and Disaster Management

(Daw Zar Chi Pyae Pyae Soe)

- **Introduction and Research Goals**

Since 2007, the Unmanned Aerial Vehicle (UAV) research department at Myanmar Aerospace Engineering University (MAEU) has been researching and developing UAV design and autonomous capabilities. This project-based department implements several projects in geophysics, natural disasters, 3D modelling, agriculture and urban planning.

- **Challenges**
  - Human resources for UAV researchers and GIS technicians
  - In need of a suitable budget to upgrade UAV payload system
  - In need of more connections to international and local organizations for public benefits and disaster risk reduction in Myanmar

3.2 Summary of Working Groups: Addressing Myanmar's training and capacity building challenges

Participants were asked to work in small groups to answer the following questions:

a. How close are we to build up the competencies we are missing?
b. Why are we close or far away?
c. How to bridge the gap?

(a) How close are we?

The participants were asked to rank how close we are to building up competencies from 1 (the closest/easiest) to 3 (the furthest/most difficult). An overall average of the answers from among the groups was as follows:

Technical skills	Average
Understanding of the fundamentals of math, physics, statistics, ..	1.00
English Language	1.44
Image processing	1.44
Mobile-based data collection tools	1.56
Spatial analysis	1.67
Web-mapping and mobile applications	1.89
Geodatabase management	2.00
GIS understanding independent of software choice	2.00
Knowledge of Standards	2.11
Open data understanding (technology and rationale)	2.11
Programming (python, CSS)	2.22
Drone technology	2.33
Modelling expertise	2.67
Artificial Intelligence	2.67
Big Data management	2.78

The basic GIS skills and knowledge are perceived as easy to build up. The more complex and innovative the technology however, the greater the difficulty in finding opportunities to develop the skills and knowledge. Standards and Open Data understanding are perceived as moderately difficult, reflecting the lack of data sharing culture.

Teaching Capacity	Average
Basic equipment	1.89
Refresher courses	1.89
Lack of national professional trainers for Training of Trainers	2.33
Teaching materials	2.33
Innovative Technology awareness	2.44

According to participants, refresher courses for teachers and basic equipment don't seem to be a major obstacle. According to the MIMU survey, 76% of the universities provide refresher courses for lecturers, either internally or with the help of other universities (specifically Yangon and Mandalay Universities). There is little use of online courses, and limited connections with international and local organizations, which explains the moderate difficulty expressed by the university participants to keep aware of innovative technology.

Trainings and curriculum development	Average
Teaching methods	1.67
Improved quality of courses	1.78
Updated curriculum	1.89
GIS/RS to be taught in more disciplines and specialized domains	2.22
Access to trainings in State/Regions	2.33
Curriculum to be designed in accordance with accredited programs	2.44
On-the-job trainings for students / link between academics and industry	2.56
Financial access	2.78

Updating teaching methods and curriculum as well as improving the quality of courses are perceived as relatively easy. Financial access is the main obstacle, as well as connections with external actors, partnership with private sector and alignment with international standards.

Attitude	Average
Problem solving	2.22
Analytical skills, critical thinking	2.44
Communication skills	2.44
Innovative/ Creative	2.78

Developing the above-mentioned attitudes is very challenging. It can be summed-up in Dr Jetten's earlier presentation of the University of Twente vision; "*We want to train students to solve problems that we are **not** yet aware of, with methods that do **not** yet exist*".

This university has adopted the student-centred approach to enable students to construct deep conceptual thinking and connect it to knowledge and technical applications relevant to real situations. It encourages students to drive their own learning, as much as possible in real world experience. However, it also requires a challenging amount of change in the teaching approach.

The role of teachers changes; they are alternatively experts, tutors, mentors, and facilitators. Their role is to guide students in their learning and the self-evaluation process. To adopt this new teaching approach, teachers need to be willing to take risks, remain flexible, and be open to change.

Teachers need to see themselves simultaneously as scholars, researchers and lifelong learners who have the potential to change future practices.

Figure 6. Working group during Day 2 – How close are we?

(b) Why are we close or far away from building up the competencies we are missing?

This question allowed the participants to identify the challenges and stumbling blocks.

- Limited highly qualified personal

There are very few highly qualified GIS/RS professionals and scientists in Myanmar. The absence of a strong scientific institution partly explains the short supply of well-trained experts in-country. Highly qualified Myanmar GIS/RS experts are trained overseas. The low level of enterprise development and research opportunities results in the absence of local capacity to attract new graduates and retain senior local experts. This situation hampers the potential to create a pull of professional trainers who could lead the GIS/RS community in the long run, creating a cascading effect to strengthen the wider community of professionals with the required skills and attitudes.

- Lack of in-depth refresher courses

It appears increasingly clear that geospatial science is a life-long learning field. Refresher courses tend to benefit to a limited number of staff in government departments and universities.

Because their exposure to advanced technology is very limited these staff may not be in positions to use the learning. Although knowledge of technology is necessary, it is not enough if teachers do not also feel confident using that knowledge to teach their students. They need time and opportunities to experiment with new tools, to apply them in their current projects, to access teaching resources and to work with knowledgeable peers. Overall, Myanmar lacks adequately skilled national professional trainers able to provide sustained training of teachers over time.

- Limited interaction of universities

Limited connection across Departments

Exchanges and collaboration between universities departments are not sufficiently promoted. For example, IT and Computer Studies Universities provide courses on programming language to be used for mobile and web-mapping. However, systems are not in place to share this knowledge with other departments such as Department of Geography.

Limited partnership with international universities

According to the MIMU survey, 7 universities currently have an international partnership in the field of geospatial science with a university outside of Myanmar. Only 3 universities out of 24 (surveyed by MIMU) have PhD students involved in geospatial sciences in their premises.

Limited partnerships with industry

Apart from the UAV research laboratory of MAEU, no university collaborates with private companies. For universities, partnerships with industry can provide a longer stream of secure funding. They help modernize teaching and learning by fostering an exchange of ideas and developing people with the skills and competences needed. In Myanmar collaboration with industry is not frequent which limits stimulation for innovation, opportunities for jobs or internships and exposure to study real case scenarios.

- Theory vs practice

University courses are mainly theoretical, with insufficient opportunities for practice. As a result, students can do basic GIS and spatial analysis but are unable to translate a problem into GIS and do a spatial-driven analysis.

In government departments, the use of geospatial technologies often occurs in the context of externally funded development projects that have a geographic information component. Often these projects result in the delivery of short-term intensive training on how to operate a particular software with little knowledge of the basic concepts and principles of geospatial science. As a result, it becomes challenging to transfer specific skills developed in project-based training to other situations.

- Lack of adequate equipment

Lack of adequate equipment and facilities is a barrier to successful learning. Only one third of the universities surveyed by MIMU have a dedicated GIS laboratory. One third share a computer laboratory with all students, which limits students' access to ICT facilities. Many of the laboratories have no software licenses and outdated equipment. One third of the surveyed universities had no laboratory at all. Many universities have no wi-fi access.

- Discrepancy between job opportunities and recruitment

With limited exposure to ways in which their skills can be applied, university students see few job opportunities in geospatial sciences. This subsequently affects students' motivation to pursue these studies. Private, development and government sector posts are increasingly on offer however, with insufficient candidates to fill the various vacancies.

This suggested 1) students don't know where to look for information on job vacancies; 2) the young graduate competencies are not responding to the market needs.

(c) How to bridge the gap?

The participants responded to the above question and made the following recommendations:

Strengthen Technical skills

- Set up a core group of professional trainers to do ToT among government departments and universities.
- Promote web-based distance learning programmes. A variety of public and private sources can be used in continuing education for teachers as well as for professionals, though connection constraints were acknowledged, especially in remote State/Regions.
- Encourage refresher trainings across universities.
- Strengthen linkages with regional organisations that provide professional training in GIS and RS such as AIT.
- Establish a network across universities (Facebook group or other) to enable teachers and lecturers to share resources, lessons learned, experience. This will give teachers opportunities to discuss problems with peers and explore solutions over time.
- Organize and promote participation in workshops and conferences to give opportunities for geospatial professionals and teachers to meet, maintain and stimulate their network.

Strengthen links between higher education, research and business to drive innovation

- Develop international cooperation with universities. Along with research opportunities and cultural awareness, institutions can offer international experiences including study abroad programmes and staff exchanges. In terms of teaching, benefits include curriculum development and degrees formed in collaboration with partner institutions.

The partnership can be established for a single joint application for a grant, regular joint projects or key partner for long-term collaboration.

- Develop collaboration between universities and industry. Establishing dialogue with industry allows academics to better understand the market-driven needs of the private sector and share more information inside the universities on the professional career opportunities. Industry could also engage with universities to give guest lectures on real cases so that students have a better idea of what they are expected to do when they start their career. Eventually this type of collaboration is a way to find the money needed to undertake research projects.
- Encourage universities to respond to "demand driven research" as in contract/consultancy work such as calls from donors (World Bank, ADB, …) to obtain materials and financial means.
- Work with Myanmar nationals in the diaspora through research networks and regional cooperation so as to retain links to the latest sources of scientific and technological advancement and enable the diaspora to contribute to geospatial activities in their home country.

Enhance the quality of courses

- Do more field projects, project-based courses and mix research with education.
- Experiment innovative teaching methods such as student-centred learning to develop problem solving, analytical skills and innovative thinking abilities of students.
- Set standard testing and evaluation methods for curriculum.
- Establish short courses through universities to refresh professionals' skills, ensuring reach also outside Yangon.

Promote Policy making and financial support

Efforts to educate policy-makers about the potential applications of geographic information and geospatial technology are underway through practical applications. It is hoped that these initiatives will influence decisions regarding the allocation of public resources to geospatial science development and higher education.

On-going efforts to the establishment of the National Spatial Data Infrastructure should be pursued. However, it requires the Government to formulate and enact policies that ensure availability of geographic data and information with clear sharing protocols, data standards, and data protection frameworks.

4. CONCLUSION

This Symposium provided a rare opportunity for academics from universities across the country to get together to share experience and resources as well as to establish dialogue with other geospatial professionals in the public, private, development and research sectors. The working groups were purposely composed of geospatial workers from different professional backgrounds and sectors (academic, government, private and development) to foster exchange and open perspectives for a broader understanding and collaborative practice. Based on this experience, a momentum can be built to develop collaborative practice and partnership.

As highlighted by the international speakers, recent technological developments have opened a new era in the routine use of GIS and RS tools as well as the opportunities to use these technologies across many new fields. While its applicability to all fields is becoming clearer, the role and requirements of the geospatial labour force is changing; experts are being asked to be aware of data availability and relevance among an increasing number of sources and types, using new processing tools (cloud computing, specific RS processing, web-mapping, etc.). They are increasingly also expected to add a geo-analytics value in collaborative, integrated teams to meet the demand for growing and complex processes.

The academic sector in other countries has responded to this evolution by reforming and updating existing curricula and teaching approaches so as to meet the demand from government, private, development and academic sectors. This can be partly achieved with the development of research projects and collaboration between universities and teaching institutions – domestic and international – and with the establishment of a continuous dialogue between universities, private and development actors.

Myanmar's geospatial community is relatively new and small. Nevertheless, the number of universities offering GIS and RS-related courses has grown very fast since 2012-13, and such courses are currently offered through 29 universities, countrywide. In 2017, an estimated 2,400 students learned some GIS and RS at Bachelor degree level, and over 300 at post-graduate level.

Even so, courses tend to be largely theoretical due to limited resources. Universities will need to keep adjusting curricula to the new scientific arena, to strengthen their knowledge of emerging new technologies through research, and to adopt practical methods of teaching.

Universities will need the support of the Administration at Union level to develop a culture that encourages and supports research investments and experimentation, while making technical and pedagogical support readily available. This implies the establishment of new partnerships with private sector and expansion of collaboration with international universities. It needs, admittedly, a dramatic shift of mind sets for these institutions as project-based collaboration will change "the way it has always been done". The evolution of the academic sector will depend on pending decisions around universities future status and semi-autonomy.

ANNEX

Symposium Agenda: DAY 1

Time	
8:30-9:00	Registration
9:00-9:30	Welcome and Opening Remarks Group photo
09:30-10:00	Coffee break
10:00 – 10:30	Presentation: Evolution of Geospatial Sciences and Technologies – Implications for Education Dr Victor Jetten, University of Twente, The Netherlands
10:30 - 11:00	Presentation: New Fields of Application and Geospatial Skills Dr Manzul K. Hazarika, Asian Institute of Technology, Thailand
11:00 – 11:30	Questions and Answers
11:30 – 12:00	Presentation: Geospatial Uses in Myanmar U Maung Maung Than, Independent Consultant
12:00 – 12:30	Questions and Answers
12:30-13:30	Lunch
13:30 – 15:30	Working groups: Geospatial Competencies Needs in Myanmar
15:30 – 16:00	Moving Groups
16:00 – 16:30	Coffee break
16:30– 17:00	Wrap-up
18:30 – 20:00	Dinner at the Ballroom, Rose Garden Hotel

Symposium Agenda: DAY 2

Time	
8:30 - 9:00	Registration
9:00 - 9:15	Summary of Day 1
9:15 – 9:30	Presentation: Overview of Geospatial Courses in Myanmar Universities Mrs Catherine Lefebvre, MIMU
9:30 – 10:00	Presentation: National GeoPortal for cross-sectoral data integration Dr Joan Bastide, OneMap Myanmar
10:00 – 10:30	Coffee break
10:30 – 11:00	Presentation: Innovating your Curriculum – Why and Now? Dr Victor Jetten, University of Twente, The Netherlands
11:00 – 12:30	Working Groups: How to address the training and capacity building challenges in Myanmar – steps to consider and possible ways forward
12:30 – 13:30	Lunch
13:30 – 14:00	Viewing the Groups Results
14:00 – 15:00	Presentation: Introduction to Remote Sensing and GIS Research Centre in YTU Prof. Dr Khin Than Yu & Prof. Dr Sao Hone Pha, Yangon Technological University Presentation: UAV-Based GIS/RS for Civilian Applications and Disaster Management Daw Zar Chi Pyae Pyae Soe, Myanmar Aerospace Engineering University
15:00 – 15:30	Questions and Answers
15:30 – 16:00	Wrap-up and Closing
16:00 – 16:30	Coffee break