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D2.2 Vocational Education Training (VET) Content

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Work Package / Task:

WP2 - Development of SDI & EO curriculum & capacity building,

T2.2 - Vocational education training (VET) content

Short Description:

The report presents the methodology for defining VET courses and materials and proposes a set of VET courses to be implemented in the next stage of the SEED4NA project.

Keywords:

VET, development, training, SDI, EO, GI, professionals

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Table of Contents

1. Introduction	3
1.1. The SEED4NA project	3
1.2. Vocational education and training	3
1.3. Structure of the document.....	4
2. Methodology	5
2.1. Main workflow and process.....	5
2.2. The needs assessment.....	6
2.3. The collection of materials	6
3. Results.....	7
3.1. Results from the needs assessment – North African Partners’ survey.....	7
3.2. Proposed Vet/LLL Training Courses/Materials.....	8
4. Description of VET/LLL courses proposed by each partner:	9
4.1. Alexandria University (P6):.....	9
4.2. Fayoum University (P7):	9
4.3. Universite Ibnou Zohr Agadir (P8):.....	10
4.4. Institut Agronomique Et Veterinaire Hassan II (P9).....	10
4.5. Carthage University (P10).....	11
4.6. Universite of Jendouba (P11).....	11
4.7. CRTEAN Regional Centre of Remote Sensing of North Africa States (P12)	11
4.8. ORAN-1 University (P13).....	14
4.9. Universite Houari Boumediene (USTHB) (P14)	15
5. Discussion	16
6. Conclusions	17
Annex I - Needs Assessment Questionnaire for VET/LLL development	18
Annex II - Data collected for SDI/EO curricula and VET development	21



1. Introduction

1.1. The SEED4NA project

For many of the societal and environmental challenges that governments are facing, decision-makers strongly rely on spatial and earth observation data, to better target, monitor, and assess their actions and interventions. These data are now becoming more and more available, through the establishment of data infrastructures and platforms, which aim to improve the access to, sharing and use of data. The effective use of these data requires that professionals in the public, private and academic sector have the relevant knowledge and skills on spatial data infrastructures (SDI), earth observation (EO) and related technologies. This means that higher education institutions must have the knowledge and capacities to provide modern education to their students and offer professionals the right training programmes to raise the overall level of expertise in SDI & EO.

Initiatives to promote and coordinate the sharing of EO and spatial data are also emerging in the region of Northern Africa, at the local, national and regional level. Despite the growing availability and accessibility of data, there still are several barriers and challenges hindering the uptake and use of these data in policy making and implementation. Among these barriers and challenges is a lack of skills and knowledge on SDI and EO among practitioners, decision makers and other key stakeholders. Therefore, it is essential that academic institutions in the North African countries raise their capacities regarding SDI and EO.

The main objective of SEED4NA is to improve the quality of higher education in North Africa in the fields of SDI and EO, and to enhance its relevance for the labour market and society through the development of new and innovative SDI/EO curricula. The SEED4NA project aims to: 1) develop the required knowledge, skills and competencies on SDI & EO within partner universities; 2) help introducing modern SDI & EO courses in engineering and agriculture/forestry studies; 3) implement supporting relevant vocational training programmes; 4) help partner universities to support the development of SDI in their country and 5) promote a European approach to SDI & EO.

SEED4NA will result in the establishment of capable, well trained pools of experts within the involved North African academic institutions which will introduce a modern approach in academic and VET education on SDI & EO in their respective countries, thereby becoming promoters of SDI development and EO use.

1.2. Vocational education and training

One of the goals of the SEED4NA project is to support SDI and EO developments in the four partner countries of the project. An important mechanism to do this is the provision of vocational education and training to professionals and stakeholders in the SDI/EO domain.

In the SEED4NA project, there were two main tasks related to the design, development and delivery of vocational education and training:

- Task 2.2 – Vocational education training courses development, which dealt with the design, development and preparation of VET courses by the partner universities in Morocco, Egypt, Algeria and Tunisia
- Task 4.3 – VET courses execution, which entails the actual implementation and offering of the VET courses to the practitioners and stakeholders



This deliverable reports on the outcomes of task 2.2., i.e. design, development and preparation of VET courses by the partner universities in Morocco, Egypt, Algeria and Tunisia. The report presents the methodology for defining VET courses and materials and proposes a set of VET courses to be implemented in the next stage of the project.

1.3. Structure of the document

This report is structured as follows. After this introductory chapter, the second chapter discusses the approach and methodology applied for designing and developing the VET courses under SEED4NA. The third chapter presents the results of the VET needs assessments among the SEED4NA partner organisations and the proposals for VET courses to be implemented under SEED4NA. Detailed descriptions of these proposed VET courses are provided in chapter 4. The report ends with a short discussion (chapter 5) and some conclusions (chapter 6).



2. Methodology

This chapter briefly summarizes the methodology used for designing and developing VET courses to be offered under SEED4NA. After presenting the overall workflow, the applied approaches for the needs assessment and collection of relevant materials are discussed.

2.1. Main workflow and process

The work on developing the content of VET courses offered under SEED4NA was mainly in hands of 5 contributing universities that collaborated with the task leading institution: Alexandria University. The following table depicts the partner universities and their role in task 2.2.

Table 1. Task 2.2 responsible partners and their roles.

PARTNER	P. ACRONYM	COUNTRY	ROLE IN T2.2
P4	UNIZG University of Zagreb	CROATIA	CONTRIBUTOR
P6	AU Alexandria University	EGYPT	LEADER
P9	IAV Institut Agronomique et Veterinaire Hassan II	MOROCCO	CONTRIBUTOR
P11	UJ University of Jendouba	TUNISIA	CONTRIBUTOR
P12	CRTEAN Regional Centre of Remote Sensing of North Africa States	TUNISIA	CONTRIBUTOR
P13	UORAN1 University of Oran 1 , Ahmed Ben Bella	ALGERIA	CONTRIBUTOR

The adopted working methodology is described in figure 1, and includes two main stages:

1. The preparation stage, which includes the designing and carrying out of the needs assessment, as well as collecting relevant materials, either from previous projects/sources, or from the material prepared during the curriculum development stage (task 2.1).
2. The development stage, including the designation of VET/LLL courses based on the specific needs defined by each partner university. It also incorporates the description of the course contents, duration and targeted audience.

Two additional stages are also depicted in figure 1, namely the implementation and evaluation, feedback and review. The two final stages will be covered separately in task 4.3

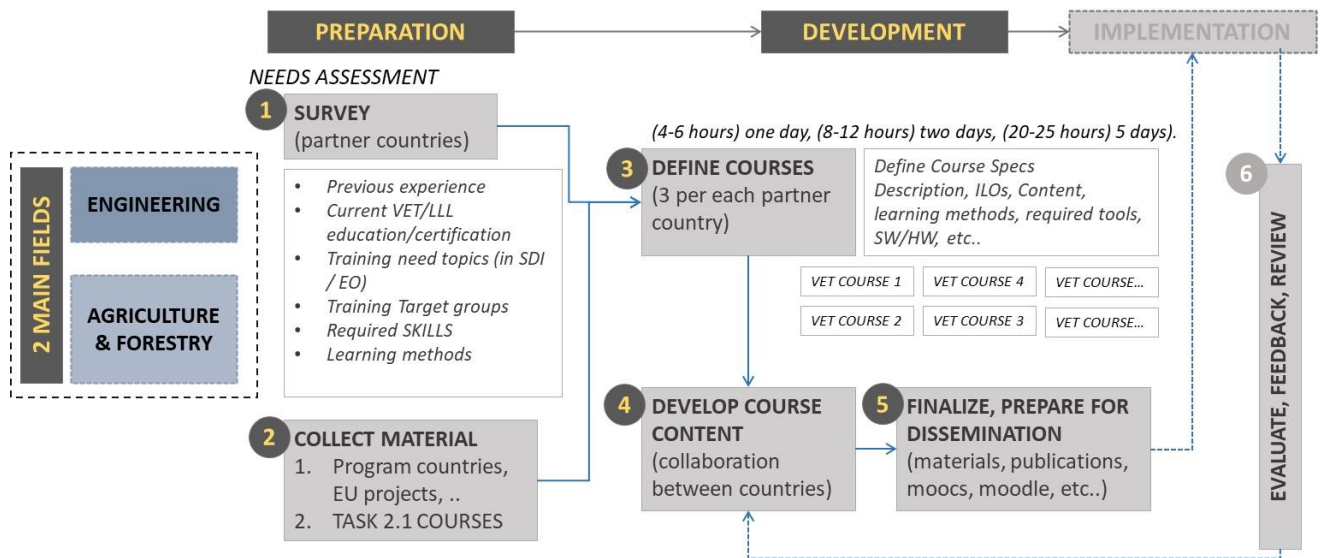


Figure 1. VET/LLL course development workflow.

2.2. The needs assessment

In line with the developed workflow, a needs assessment was carried out targeting the partners in the four partner countries and determining the local priorities for partner countries. First, a survey was executed to investigate the current experience and future needs for vocational training / lifelong learning in the Institutions - with special emphasis on Spatial Data Infrastructure (SDI) and Earth Observation (EO). Essential data were collected from the respondents, such as the current status of education, and certification, fields of application that each partner needs for development, training target groups, and competencies needed and their importance. The data were collected to cover 6 main VET related aspects:

- general information; describes the main information about the different partner institutions, their contact and their field of expertise.
- the current status of VET/LLL education and certification; explores each institution experience in conducting VET courses, and whether those courses are certified by the institution.
- fields of application; defines the VET course application fields (in the frame of teaching SDI and/or EO)
- VET/LLL education and training needs; defines the different competencies required to be achieved by the development of new materials.
- training target groups; describes the possible stakeholder groups that will be targeted by the developed VET/LLL courses.
- teaching and learning methods of vet/lll training: the expected teaching and learning methods that will be adopted in the implementation process.

2.3. The collection of materials

Different existing SDI/EO teaching and training materials were collected and delivered for use in both curricula development and VET preparation. The data collection process relied heavily on the previous experience of the European partner institutions and other EU-related SDI and EO projects. Appendix (B) depicts the list of data collected based on their sources, type, and possible use in this Project. Also, a link was provided, when possible, to the location of data. This overview of materials and the materials themselves were considered very valuable for the partner institutions in North Africa in developing their respective courses and training materials.



3. Results

3.1. Results from the needs assessment – North African Partners' survey

Based on the conducted survey, the information gathered was analyzed and summarized to describe each partner status and needs as follows:

- **(P6) Alexandria University, Alexandria, Egypt:** AU has existing courses provided by Faculty and Leadership Development Center (FLDC). These courses are offered for professional development of faculty members, leaders and manpower. There are training programs in five competencies: teaching, scientific research, communication, management & leadership, law & regulations, other specialized programs- NO SDI/EO training.
- **(P9) Institut Agronomique Et Veterinaire Hassan II, Rabat, Morocco:** There is an existing course to introduce the mobile GIS.
- **(P10) Carthage University, Amiclar Carthage, Tunisia:** Different courses are offered by Cartage University for Master's degree such as, Remote Sensing, Geodesy, and Spatial Data use in Agriculture and Environment; and Climate Change Impacts on Aquifers Recharge Water Resources Management.
- **(P11) Universite of Jendouba, Jendouba, Tunisia:** Geostatistics course is an existing course for Hydraulic and Planning specialization.
- **(P12) CRTEAN Regional Centre of Remote Sensing of North Africa States, Tunisia:** CRTEAN has a lot of courses related to GIS and remote sensing, listed as follows: (1) Developing geospatial portals and sharing scientific data, (2) Modelling the water erosion of lands using space data and GIS, (3) Spatio-temporal analysis of urban expansion by using GIS & remote sensing, (4) Uses of satellite imagery and GIS in monitoring climate changes, (5) Advanced training in "high-resolution space data and radar images in the field of sustainable development, and (6) Training workshop on Web mapping.
- **(P13) ORAN-1 University Es Senia, Algeria:** Currently, there are no VET/LLL training courses mentioned for ORAN-1.
- **(P14) Universite Des Sciences Et La Technologie Houari Boumediene (USTHB), Algiers, Algeria :** there is a training on remote sensing and image processing tools and applications (FITRA'2012), a Winter School in Image Processing (IPWS2013), and a third school specified to SAR Radar Imaging and its Applications in Geosciences 2017.

Concerning fields of applications, five North African partners declared having needs in Engineering (Alexandria University, HASSAN II, Cartage University, University of Jendouba, and CRTEAN). Besides, Fayoum University expressed its need in agriculture/forestry applications, and University of Ibn Zohr Agadir stated that its need is within Geosciences and Geoenvironment, as depicted in table 2.

Through the survey prepared, the partners expressed their interest in preparing courses meeting the needs of the national and regional professionals in government/administrations, and a similar interest for the academic trainers and assessors in education sector. Then, researchers, graduate students, and professionals in industry sectors such as natural resources, environment, and scientific and technical services with a moderate interest.



Table 2. VET needs in SDI/EO grouped after field of application.

Partner institution	Engineering	Agriculture/Forestry	Other
(P6) ALEXANDRIA UNIVERSITY, Alexandria, Egypt	√		
(P7) FAYOUM UNIVERSITY, Fayoum, Egypt		√	
(P8) UNIVERSITE IBNOU ZOHR AGADIR, Agadir, Morocco			√ Geosciences and Geo environment
(P9) INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II, Rabat, Morocco	√		
(P10) CARTHAGE UNIVERSITY, Amiclar Carthage, Tunisia	√		
(P11) UNIVERSITE OF JENDOUBA, Jendouba, Tunisia	√		
(P12) CRTEAN Regional Centre of Remote Sensing of North Africa States, Tunisia	√		

3.2. Proposed Vet/LLL Training Courses/Materials

A list of VET/LLL training and materials was proposed by each partner according to their local needs. A collection of one or two courses (per partner) was prepared in an interactive google sheet, where each partner who contributes to the survey selected the courses that are most relevant to their needs. According to the similarities between topics and application suggested, three workgroups were created for sharing their effort on the core modules. It was expected from each partner to work on case-based modules adapted to their local needs and target groups. Figure 2 depicts the survey results of the interactive google sheet.

Partner institution	EO/RS/Photogrammetry	GIS/SDI	OTHER
(P6) ALEXANDRIA UNIVERSITY, Alexandria, Egypt	<input type="checkbox"/> EO for urban growth surveillance	<input checked="" type="checkbox"/> GIS for Local authority <input type="checkbox"/> Land information system <input type="checkbox"/> SDI for urban management	
(P7) FAYOUM UNIVERSITY, Fayoum, Egypt		<input checked="" type="checkbox"/> GIS	
(P8) UNIVERSITE IBNOU ZOHR AGADIR, Agadir, Morocco	<input checked="" type="checkbox"/> RS applications	<input checked="" type="checkbox"/> SDI platform development <input type="checkbox"/> GIS applications	<input type="checkbox"/> Web mapping
(P9) INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II, Rabat, Morocco	<input type="checkbox"/> AdvancedRS image analysis <input checked="" type="checkbox"/> UAV for spatial data acquisition		<input checked="" type="checkbox"/> AI for GIS <input type="checkbox"/> Managing AI for GIS Project <input type="checkbox"/> Point cloud 3D modeling
(P10) CARTHAGE UNIVERSITY, Amiclar Carthage, Tunisia		<input type="checkbox"/> GIS <input type="checkbox"/> Advanced GIS	<input checked="" type="checkbox"/> Smart water management using EO, ICT and IOT <input checked="" type="checkbox"/> Application of EO and Machine learning in water management and mapping
(P11) UNIVERSITE OF JENDOUBA, Jendouba, Tunisia	<input checked="" type="checkbox"/> Application of EO, ICT & IoT in water management		
(P12) CRTEAN, Tunisia	Physical principles of Remote Sensing Digital data processing in RS	Database and Geodatabases, Advanced GIS	Spatial data acquisition and Exploring different data sources GIS Programming (mini-project) (python & R)

Figure 2. VET Local priorities online google sheet.



4. Description of VET/LLL courses proposed by each partner:

Based on the previous surveys, discussions and recommendations, each North African partner institutions proposed a list of VET courses, and a brief description of each course. In this chapter, we briefly summarize the courses proposed by each partner.

4.1. Alexandria University (P6):

For AU, there are three courses proposed related to SDI/EO, presented as follows:

a) GIS for local authority

This course presents the fundamental concepts of GIS and spatial analysis in urban planning. It is tailored to the specific needs and workflows of local authorities. It is built on the use of ArcGIS pro and ArcGIS online.

Basic Modules: The topics of this course include the following: (1) GIS basics and data structure; (2) basics of map design and projection; (3) working with tables, queries and database preparation; (4) editing features; and (5) spatial analysis in urban planning.

b) EO for urban growth surveillance

This course introduces the basics of earth observations and applications for urban growth surveillance.

Basic Modules: The topics of this course include the following: (1) Introduction to Remote Sensing and Earth Observation (Basics of RS bands wavelength and resolution, sensors / platforms and data acquisition); (2) pre-processing Techniques in RS (Geometric Correction, Layer stacking, band combination and mosaicking); (3) processing of satellite imageries (Digital Image Classification + case study); (4) mapping Spatial Growth (Time series change detection using satellite imageries).

c) SDI / LIS for Urban Management

This course presents the fundamental concepts of SDI and LIS, and explores the aspects of geospatial analyses, and its applications for the purpose of land governance and urban management.

Basic Modules: The topics of this course include the following: (1) Concepts of SDI for planning, decision making and development; (2) basics of LIS, modelling, design and architectures, processes, users and contexts; (3) GIS for urban planning and management (Database management systems); (4) Spatial Analysis and Modelling (Analytical capabilities, functions, and tools); (5) Workflow and Applications of Spatial Analysis: Spatial Questions; (6) Toolbox and Model Builder (Visual representation of a workflow using geoprocessing tools); (7) Suitability Analysis (Using suitability modeler + case study); (8) Land administration and cadastral Systems (Components & Challenges in urban and regional planning).

4.2. Fayoum University (P7):

One course is proposed by Fayoum University, described as follows.

a) GIS



This course introduces the basics of GIS and spatial analysis in natural resources management. It could be tailored to the specific needs of each target group of local authorities.

Basic Modules: The topics of this course include the following: Introduction to GIS, data models, map design and projections, geodatabase, spatial analysis, spatial modeling, and layout and reporting.

4.3. **Universite Ibnou Zohr Agadir (P8):**

a) RS applications

This course presents the fundamental concepts of Remote sensing.

Basic Modules: The topics of this course include the following: Electromagnetic radiation, sensors and platforms, data used, image correction, image analysis, image interpretation, Image classification, and some applications.

b) SDI platform development

This course provides the basic knowledge on Spatial Data Infrastructures (SDIs) with specific emphasis on their technical components and geospatial data models.

Basic Modules: The topics of this course include the following: SDI Architecture and SDI components, Geospatial and SDI standards: OGC, ISO 19100 Extensible Markup Language (XML), geography markup Language (GML), metadata and catalog services, data models and data specifications, and web services to access spatial data.

c) GIS applications

This course introduces the basics of GIS and spatial analysis in natural resources management. It could be tailored to the specific needs of each target group of local authorities.

Basic Modules: The topics of this course include the following: Introduction to GIS, data models, map design and projections, geodatabase, spatial analysis, spatial modeling, and layout and reporting.

d) Web mapping

4.4. **Institut Agronomique Et Veterinaire Hassan II (P9)**

a) UAV for spatial data acquisition

The course introduces the fundamentals of spatial data acquisition using UAV. It will explore the current state and future outlook of remote sensing and photogrammetry with unmanned aerial vehicles (UAVs or drones) for mainly environmental monitoring.

Basic Modules: The topics of this course include the following: UAV definition and terminology, Market and application sectors, Advantages and limitations of UAVs, UAV types (fixed wing and rotary), Launch and recovery systems, Regulations and safety considerations, UAV workflow (UAV data acquisition, Image processing, Ortho-rectification, Data modeling DEM/DTM, 3D feature extraction).

b) AI for GIS



The course introduces the basics of artificial intelligence techniques and how they can be applied into a spatial context. A review of the most important AI techniques will be presented with some real use cases related to the spatial landscape.

Basic Modules: The topics of this course include the following: Introduction to artificial intelligence, concepts of machine and deep learning, training/validating/testing an AI Model, AI applications on spatial data (vector data, image data, and point cloud data), some use cases using AI with spatial data (natural resource monitoring, agriculture, ..).

c) Point cloud 3D modelling

The course introduces the basics of point cloud 3D modeling and processing.

Basic Modules: The topics of this course include the following: Point cloud basics, point cloud engineering (derive valuable information from point cloud datasets), point cloud semantization, analysis and visualization, data structure and modelling, and python libraries exploration for point cloud processing.

4.5. Carthage University (P10)

- a) GIS
- b) Advanced GIS
- c) Smart water management using EO, ICT and IOT
- d) Application of EO and Machine learning in water management and mapping

4.6. Universite of Jendouba (P11)

- a) Application of EO, ICT & IoT in water management

This course is designed for operational engineers and water operators.

Basic Modules: The topics of this course include the following: (1) Principles, approaches, and methodologies of agriculture water management; (2) Real-time multi-satellite principles and approaches; (3) Notions of smart sensors, IoT, Cloud, ICT and application cases; (4) Concept and use of open data sets; (5) Participatory data collection to monitor water resources (Citizen science approach); (6) Analysis of Land Use and Land Cover Change Using Time-Series Data; (7) Irrigation management at different scales (plot, irrigation area, and regional level); (8) Case studies (Integration of wireless sensor network and remote sensing for monitoring irrigation areas).

4.7. CRTEAN Regional Centre of Remote Sensing of North Africa States (P12)

- a) Physical principles of Remote Sensing

Basic Modules: The topics of this course include the following: Meaning and definition of remote sensing, history of remote sensing, electromagnetic radiation and its interaction with earth, remote sensing imaging systems, remote sensing data types, principles of digital image processing, image enhancement, classification and visualization, and applications of remote sensing



b) Digital data processing in remote sensing

Basic Modules: The topics of this course include the following: Introduction to remote sensing (RS), remote sensing data collection, computing requirements, image quality and display, image correction, image enhancement, data merging, spatial and spectral filtering, image classification, change detection and advanced analytics, thermal data analysis, hyperspectral analysis, image sources and how to get them, and time series analysis of images

c) Database and Geodatabases

Basic Modules: The topics of this course include the following: Retrieving data from a relational database, relational database concepts and theory, build an oracle database, building a PostGIS/Postgres database, working with Esri's GeoDatabase, introduction to the GeoDatabase Enterprise, managing data in the GeoDatabase Enterprise

d) Advanced GIS

Basic Modules: The topics of this course include the following: (1) Introduction to the basics of GIS; (2) concepts of geographic information systems, roles of GIS components; (3) data models in geographic information systems; (4) create, edit and manage geo-databases; (5) addressing analytical examples in geographic information systems; (6) create and edit topological rules within geodatabases; (7) modeling the fourth dimension (time) in geographical databases; (8) network data modeling; geocoding data; and (9) basics of programming (C++).

e) Cartography and visualization

Basic Modules: The topics of this course include the following: Base maps and thematic maps, mapping templates and outputs, from data to design, static and optical variables, color and cobalt maps, bivariate maps, raster maps, graphics, flowcharts, multivariate maps, cartographic writing and cartographic output, beyond the map, and cartographic criticism.

f) Opensource GIS

Basic Modules: The topics of this course include the following: Transition from Maposaurus to Unified Geospatial Web Services, Interoperability of spatial data, Web GIS and service-oriented architecture, Concept of Spatial Data Infrastructure (SDI), OGC Web Map Directory Service (WMS) and Layer Descriptor (SLD), Working with GML in SDI, Service (WFS), Metadata and catalog services, Web Coverage Service (WCS), Web Processing Service (WPS).

g) Spatial Analysis and Modeling

Basic Modules: The topics of this course include the following: Basics and definitions of modelling, types of GIS modelling, creating a GIS model, model criteria and conditions, arithmetic overlay modelling, weighted overlay modelling, and applications of GIS Modelling

h) Geostatistics

Basic Modules: The topics of this course include the following: Basics and definitions of geostatistical analysis, basic review of probability and statistics, data correlation/regression, spatial interpolation of properties, stochastic simulation, modeling facies variations, advanced concepts, flow simulation in geological models, and dynamic data integration

i) GIS Project Management



Basic Modules: The topics of this course include the following: Method and principle of setting up projects, planning and monitoring, project life cycle, costing, risk management, design of deliverables, and Steering (MOA, MOE, AMOA)

j) GIS Applications

Basic Modules: The topics of this course include the following: GIS application, planning and creating, application in agriculture (agro-geoinformatics), application in water resources, application in geology and mineralogy, application in marine science and oceanography, application in environment, application in soil & land use, and application in urban planning.

k) Spatial data acquisition and exploring different data sources

Basic Modules: The topics of this course include the following:

1. The need for data and its types: the problem of data, defining data needs, the role of concepts, quantitative measurement in scientific research and management, and an introduction to some of the applicable methods for collecting and using data to meet specific needs.
2. Remote Sensing Data: the different ways in which data can be captured and collected remotely using various platforms, global positioning systems as well as other aerospace and space systems as valuable sources of spatial data.
3. Data Capture and Estimation: The various ways in which the accuracy of available digital data sources can be estimated and used in specific projects
4. Data quality: data standards and how they are used to enhance and/or maintain data quality, the different types and sources of error that we may encounter as part of the data flow that can be used for a particular project, the different ways in which we can check for errors and deal with them when using information systems Geographical data to assist in decision-making, methods of measuring, controlling and disposing of the quality of geographical data.
5. GIS and GPS skills: ways in which the Esri and Trimble software platforms can be used to support spatial data acquisition, analysis and visualization.

l) GIS Programming (mini-project) (python & R)

Basic Modules: The topics of this course include the following: (1) Introduction to GIS modeling and the Python programming language; (2) Customizing ArcGIS ModelBuilder, Python Language, PythonWin, Python Basics, Python Tools; (3) Lists, Decision Structures, Troubleshooting, Processing, etc; (4) Reading metadata, pointers, working with raster data; (5) Python functions and modules, reading and analysing text files, writing geometric shapes, and working with the map

m) Art of Cartography

Basic Modules: The topics of this course include the following: Introduction to cartography, Graphic semiology, Cartographic generalization, Topographic maps and thematic maps, and Application (Study and design of a map)

n) Multi-Criteria Decision Analysis & DSS

Basic Modules: The topics of this course include the following: Introduction to GIS-MCDA System (Elements of GIS-MCDA, Basic Concepts), GIS-MCDA methods, multi-objective improvement methods,



Indicative methods, dealing with uncertainties in the GIS-MCDA system, GIS-MCDA system for collective decision-making, Geospatial simulation methods, Problems of scale and GIS-MCDA system, Geographical information management, and GIS-MCDA based on web and mobile.

o) Geospatial problem solving

Basic Modules: The topics of this course include the following: Many geographic questions are complex and require the power of GIS technology to answer them. GIS is used to explore patterns, answer questions, and solve problems about many different topics. The course introduces a five-step process for investigating geographic questions.

p) Application Project

Basic Modules: The topics of this course include the following: The student is led to develop a problem from a specific professional situation. After the collection of empirical and theoretical data, their analysis and their linking, the student will translate the path of his reflection around a problem. It is a question of carrying out a work of reflection and rigorous analysis based on a question related to the geomatics sector chosen.

4.8. ORAN-1 University (P13)

a) Introduction to GIS

This course introduces the basics of Geographical Information Systems to a general audience.

Basic Modules: The topics of this course include the following: Introduction to GIS, data models, introduction to geodesy and map projections, cartography, satellite and aerial imagery, basic spatial analysis, raster analysis, spatial estimation, and data quality and standards.

b) EO/GI for Sustainable Farming Systems

This course presents a wide range of applications of EO and GI technologies in precision agriculture and sustainable farming systems.

Basic Modules: The topics of this course include the following: (1) Overview of GIS and earth observation (GIS components; Sources data; types of satellite images; application of GIS and RS in Agriculture); (2) Introduction to remote sensing techniques, digital mapping, total station, GPS, DGPS; (3) Introduction to aerial and satellite-borne imagery; high-resolution imagery, multi-spectral imagery; (4) SAR, LIDAR, and hyperspectral imaging; (5) digital image processing techniques in agriculture resource management; (6) calculating spectral indices from remote sensing data (NDVI, SAVI, VARI, ...); and (7) Precision farming using GIS and RS for crop management: crop health analysis using NDVI, Crop stress detection, Crop damage assessment using change detection, mapping soil variability (nutritional needs of plants), and predicting growth.

c) Introduction to Spatial Data Infrastructures

This course provides the basic knowledge on Spatial Data Infrastructures (SDIs) with specific emphasis on their technical components and geospatial data models.

Basic Modules: The topics of this course include the following: SDI Architecture and SDI components, geospatial and SDI standards (OGC, ISO 19100 Extensible Markup Language (XML)),



Geography Markup Language (GML), metadata and catalog services, data models and data specifications, and web services to access spatial data.

4.9. Universite Houari Boumediene (USTHB) (P14)

a) RS basics

This course presents the fundamental concepts of Remote sensing.

Basic Modules: The topics of this course include the following: Electromagnetic radiation, sensors and platforms, data used, image correction, image analysis, image interpretation, image classification, and some applications.

b) SAR Imagery concepts

This course explains basic principles and applications of Synthetic Aperture Radar (SAR) imaging radar.

Basic Modules: The topics of this course include the following: Theory of RADAR and SAR imagery, SAR sensors/platforms, SAR geometrical and radiometric effects, basic enhancements of a SAR images, interpretation of SAR imagery, advantages and disadvantages of SAR imagery, Applications.

c) Machine learning applied to RS

The goal of this course is to introduce to the concepts of machine learning in order to process.

Basic Modules: The topics of this course include the following: remotely sensing data, data transformation, supervised and unsupervised learning, features extraction, segmentation and classification, k nearest neighbors, support vectors machine, decision tree, and applications.

d) Image processing using IDL, Matlab or python

The goal of this course is to learn to use a programming language for image processing purposes.

Basic Modules: The topics of this course include the following: Basic concepts of matalab or python, libraries, image manipulation (display, histogram, color mapping), data transformation, segmentation, features extraction, and testing classification approaches.



5. Discussion

The adopted process for defining each North African partner institution needs regarding VET materials was successful in providing SEED4NA with a comprehensive list of possible VET courses and descriptions. During this process, the discussion between North African and European partners exposed the gaps that exist in vocational training in the fields of spatial data infrastructure and earth observation in each NA country. It also helped partners to articulate a list of workgroups that could collaborate in preparing and conducting the capacity building programs.

As depicted in figure (3) three main workgroups were defined. The first workgroup included partners who found the need to prepare VET materials in the fields of earth observation, remote sensing and photogrammetry. Four universities participated in this workgroup and were encouraged to collaborate in exchanging data, building course contents and in disseminating results and case studies.

The second workgroup was concerned with developing knowledge in the fields of geographic information systems and spatial data infrastructure. Four north african partners collaborated under this theme.

The third workgroup cooperated in developing VET materials in other fields of studies such as artificial intelligence, smart water management, machine learning, and spatial decision support systems. Three partner institutions collaborated to develop VET materials under these topics.

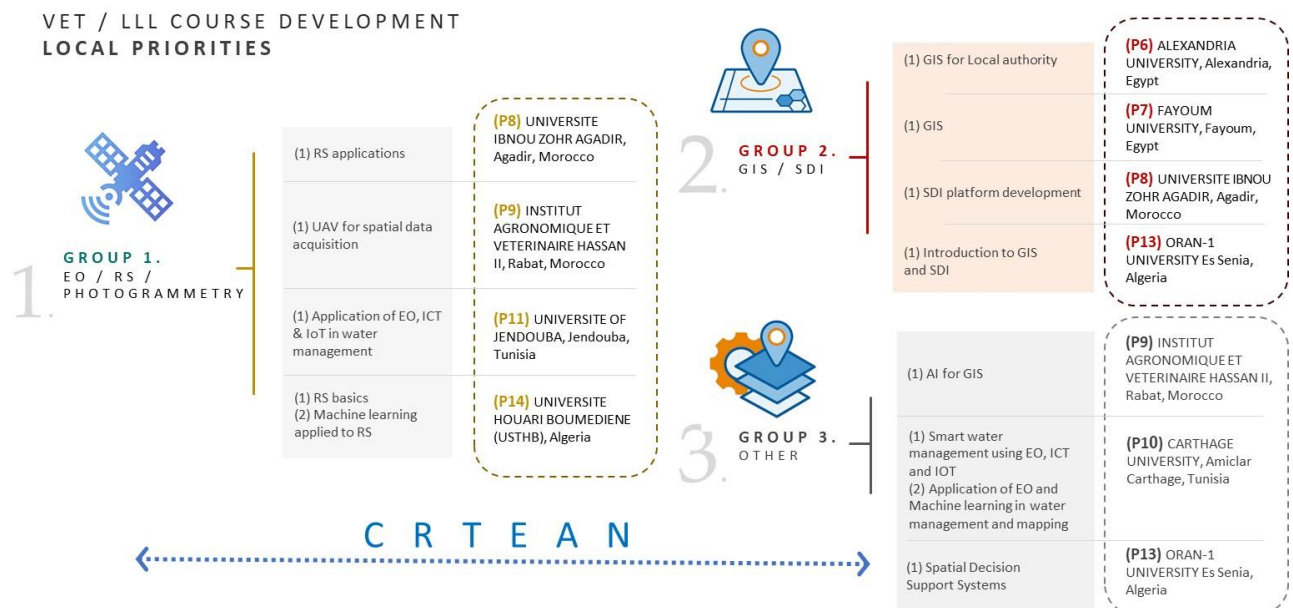


Figure 3. Workgroups classified by topics of specialization.



6. Conclusions

The specific SEED4NA project objectives are to investigate, determine and analyze the needs and requirements for SDI/EO education in North Africa and to develop, test and adapt new curricula, courses, learning material and tools within the field of SDI and EO. Knowledge sharing from high education level to public and private sector is ensured with the establishment of the series of VET and LLL courses described in the previous report sections.

Based on the collaboration experience between all SEED4NA involved institutions, the following is concluded:

- The definition of needs and requirements for VET/LLL education in North Africa depicts several gaps, especially related to spatial data infrastructure (SDI) knowledge and practice among different stakeholders. In addition, the needs assessment reveals that the role of academia in presenting hands-on applications on SDI/EO technologies in engineering and agriculture is crucial to the dissemination of required practical knowledge.
- Various learning sources are available for use in preparing VET/LLL materials. Those sources are detailed in appendix (B), but always need more elaboration by the north african partners in terms of providing case-based local and regional practical exercises and applications.
- The number of VET courses defined by partner institutions are approximately 12 different courses, based on the topics covered by each course. This exceeds the predefined goal of 6 VET courses. The materials could be categorized into three main groups: (1) SDI and GIS, (2) EO and RS, (3) other more advanced topics. The development and implementation of those topics are covered separately under task 4.3.
- The similarities in VET/LLL needs and topics to be covered among north African partners call for mutual future collaboration in the development and implementation of these courses. This collaboration could help in enhancing the teaching experience and in enriching training materials by including case-based practical exercises from different countries, covering different aspects of the training needs.
- If the objective is dissemination based, the reach out as well as reception of key messages should be stated.



Annex I - Needs Assessment Questionnaire for VET/LLL development

Needs assessment of VET/LLL education and training (T2.2) in partner institutions.

GENERAL INFORMATION

1. Partner institution you are affiliated with:

Select 1 of 8 partner institutions from North Africa (NA) region participating in SEED4NA project.

- (P6) ALEXANDRIA UNIVERSITY, Alexandria, Egypt.
- (P7) FAYOUM UNIVERSITY, Fayoum, Egypt.
- (P8) UNIVERSITE IBNOU ZOHR AGADIR, Agadir, Morocco.
- (P9) INSTITUT AGRONOMIQUE ET VETERINAIRE HASSAN II, Rabat, Morocco.
- (10) CARTHAGE UNIVERSITY, Amiclar Carthage, Tunisia.
- (P11) UNIVERSITE OF JENDOUBA, Jendouba, Tunisia.
- (P13) ORAN-1 UNIVERSITY Es Senia, Algeria.
- (P14) UNIVERSITE DES SCIENCES ET LA TECHNOLOGIE HOUARI BOUMEDIENE (USTHB), Algiers, Algeria.

2. Your department:

Give the full name of your Faculty, Department, Institute etc.

3. Contributor and e-mail address:

Name of the person answering this questionnaire and his/her e-mail address.

THE CURRENT STATUS OF VET/LLL EDUCATION AND CERTIFICATION

4. Does the partner institution have experience with VET/LLL training?

- Yes.
- No.

5. What is the status of certification of VET/LLL training offered?

- Certified.
- Not certified.

6. If available, name existing VET/LLL training related to SDI/EO.

Course 1:

Course 2:

Course 3:

FIELDS OF APPLICATION

7. Fields of application:

This section identifies the fields of application related to SDI/EO, select a choice.

- Engineering:
- Agriculture/Forestry:

8. In the case of Engineering, select branches of application related to SDI/EO in your partner institute:

- | | |
|---|---|
| <input type="radio"/> Aerospace Engineering | <input type="radio"/> Electrical Engineering |
| <input type="radio"/> Agricultural Engineering | <input type="radio"/> Energy and Environment |
| <input type="radio"/> Architectural Engineering | <input type="radio"/> Industrial Engineering |
| <input type="radio"/> Automotive Engineering | <input type="radio"/> Infrastructure |
| <input type="radio"/> Chemical Engineering | <input type="radio"/> Manufacturing Engineering |
| <input type="radio"/> Civil Engineering | <input type="radio"/> Mechanical Engineering |
| <input type="radio"/> Computer Engineering | <input type="radio"/> Mechatronics |



- Nuclear Engineering
- Petroleum Engineering
- Structural Engineering
- Transportation
- Urban planning
- Other:

9. In the case of Agriculture/Forestry, select branches of application related to SDI/EO in your partner institute:

- Agricultural Economics
- Agricultural Engineering
- Agriculture Entomology
- Agriculture Genetics
- Agriculture Microbiology
- Agronomy and Crop Science
- Animal husbandry
- Farm and Ranch Management
- Fishery science
- Floriculture
- Forestry
- Horticulture
- Hydroponics
- Plant Breeding
- Soil science and Agri chemistry
- Other:

VET/LLL EDUACTION AND TRAINING NEEDS

10. Select competences/skills you suggest including in VET/LLL training in the field of SDI.

- CONCEPTUAL FOUNDATIONS COMPETENCES. *(The applicant is expected to gain basic knowledge of elements of geographic Information, spatial relationships, imperfections in spatial information, and concepts of data ontology and data sharing)*
- GEOSPATIAL DATA COMPETENCES. *(The applicant is expected to understand Earth geometry, work with land administration systems, use georeferencing systems, understand specific geodetic datums and map projections, assess data quality, learn land surveying, GPS digitizing and collecting field data)*
- EARTH OBSERVATION AND PHOTOGRAMMETRY COMPETENCES. *(The applicant is expected to be familiar with aerial imaging, photogrammetry technologies, satellite remote sensing technologies, and unmanned Aerial Vehicles)*
- CARTOGRAPHY AND VISUALIZATION COMPETENCES. *(The applicant is expected to prepare data for map production and map design, choose adequate graphic representations, use and evaluate maps)*
- ANALYTICAL METHODS COMPETENCES. *(The applicant is expected to be familiar with applying query operations, measuring basic geometric properties, using basic analytical operations, analyzing spatial data and surfaces; additionally, competences as applying spatial statistics and geostatistics, spatial regression, data mining, and analyzing networks)*
- DESIGN ASPECTS COMPETENCES *(The applicant is expected to be aware of defining Geographic information project, planning project resources, applying project management skills, designing databases, system architectures, analysis design, application design, and implementing system)*
- DATA MODELLING COMPETENCES *(The applicant is expected to know about storage and retrieval structures, understand database Management systems, know about tessellation data models, differentiate vector and object data models, 3D modelling, and temporal phenomena)*
- DATA MANIPULATION *(The applicant is expected to learn transforming data representations, generalizing and aggregating data, and know about transaction management)*
- INFRASTRUCTURE & PLATFORMS COMPETENCES *(incl. metadata, standards, services). (The applicant is expected to be familiar with SDI concepts and practices, assessing SDI, implementing and exploiting Mobile GIS, managing metadata, developing web portals and geoportals, understanding relevant web platforms with SDI web services, and SDI service components; additionally, competences as implementing services (discovery, view, download, transformation, web processing), and being familiar with Open-Source software, Cloud computing and Internet of Things, Sensor Web Enablement and Linked Data, key spatial data standards, and exchange specifications and/or transport protocols).*



- SOCIETY, ORGANIZATIONAL & INSTITUTIONAL ASPECTS COMPETENCES. (The applicant is expected to know about legal aspects, and be aware of relevant (national) legislations/regulations; additionally, competences as considering economic and ethical aspects, managing GI in the public sector, disseminating geospatial information, applying use conditions, managing the GI System operations and infrastructure, setting up organizational structures and procedures, connecting institutions, and being aware of crowdsourcing as an alternative way for geospatial data collection and its limitations.

11. Training target groups:

Choose target groups that you need to offer your VET/LLL education and training for.

- Government/administrations.
 - National/regional.
 - Districts and local.
- Education.
 - Academic trainers and assessors.
 - Researchers.
 - Graduated students.
 - Other:
- Industry groups.
 - Natural resources.
 - Manufacturing and construction.
 - Trade and transport.
 - Utilities/infrastructure.
 - Scientific and technical services.
 - Health and human services
 - Other:
- Civil society organizations/Non-governmental organizations.
- Cultural institutions.
- Private business.
- Self-employment/individuals.
- Other:

TEACHING AND LEARNING METHODS OF VET/LLL TRAINING

12. Suggest samples of VET/LLL training needed in your partner institute.

Training Title	Training type	Target group	SDI Competences/skills	Materials	Duration

- **Training type:**
 - Training module
 - Lectures
 - Practical training/exercise
 - Fieldwork
 - Seminar/webinar
 - Summer school
 - Workshop
 - Distance learning (partial/blended, fully)
 - Mentorship
 - E-book
 - Other:
- **Learning materials:**
Provide information about the type and format of learning materials.
 - Presentations (PowerPoint or similar).
 - Scripts (PDF).
 - Slides (PDF).
 - Textbooks.
 - Videos (multimedia).
 - Self-learning materials.
 - e-learning.
 - Other:



Annex II - Data collected for SDI/EO curricula and VET development

Available/ Provided data	Type of data	Use	Link
KU Leuven -SDI courses- KULeuven_M5_AccessServices.pdf	pdf	introduction to the concept of the web only but not webGIS	KULeuven_M5_AccessServices.pdf
UNIZG- 7_lecture_Kliment_WebServices- English.pdf	pdf	webGIS	UNIZG- 7_lecture_Kliment_WebServices- English.pdf
Bochum University of Applied Sciences- Web-based GIS	Link from word file in BOX	webGIS	Bochum University of Applied Sciences- Web-based GIS
KU Leuven -SDI courses- Assignment 2- Geoserver	pdfs + database	info. about Geoserver	Assignment 2- Geoserver
KU Leuven -LINKVIT- INSPIRE_network_services_advanced _exercises.pdf	pdf	useful for the practical application	KU Leuven -LINKVIT- INSPIRE_network_services_advance d_exercises.pdf
KU Leuven -LINKVIT- INSPIRE_network_services_advanced _v2.pdf	pdf	useful for the practical application- Web mapping-Geo- server	KU Leuven -LINKVIT- INSPIRE_network_services_advance d_v2.pdf
KU Leuven -SDI courses- LINKVIT_M11_Network_Services_Adv anced_Exercises_1920.pdf	pdf	useful for the practical application	LINKVIT_M11_Network_Services_Ad vanced_Exercises_1920.pdf
University of Zagreb- GIS in Application	Link from word file in BOX		University of Zagreb- GIS in Application
KU Leuven -SDI courses-Guest lecture_Software tools for SDI and data harmonization(1).pdf	pdf	general information (many titles - little explaining text)	Software tools for SDI and data harmonization(1).pdf
Partner organisation Bochum University of Applied Science-Spatial web and database applications	Link from word file in BOX		Partner organisation Bochum University of Applied Science-Spatial web and database applications
Partner organisation Bochum University of Applied Science- Mobile mapping applications	Link from word file in BOX		Partner organisation Bochum University of Applied Science- Mobile mapping applications
University of Zagreb- Mobile Surveying and GIS	Link from word file in BOX		University of Zagreb- Mobile Surveying and GIS
KU Leuven -SDI courses- KULeuven_M6_Sensor Web Enablement.pdf	pdf	brief info. about real-time web but more about sensors	KULeuven_M6_Sensor Web Enablement.pdf
Partner organisation Bochum University of Applied Science-Enterprise GIS	Link from word file in BOX		Partner organisation Bochum University of Applied Science- Enterprise GIS
KU Leuven -SDI courses- KULeuven_M1_Introduction.pdf	pdf	info. About SDI	KULeuven_M1_Introduction.pdf
KU Leuven -SDI courses- KULeuven_M8_Organisational aspects.pdf	pdf	very usable	KULeuven_M8_Organisational aspects.pdf
EO4GEO-MANAGEMENT VIEW ON SDI	URL	very usable in different modules	EO4GEO-MANAGEMENT VIEW ON SDI -General introduction to Spatial Data Infrastructures



Available/ Provided data	Type of data	Use	Link
-General introduction to Spatial Data Infrastructures			
EO4GEO-MANAGEMENT VIEW ON SDI -SDI performance and assessment	URL		EO4GEO-MANAGEMENT VIEW ON SDI -SDI performance and assessment
EO4GEO-Technical introduction to Spatial Data Infrastructures	URL	1SDI Architecture and SDI components 2 Understanding UML /XML 3 SDI Standards 4 Metadata Catalog Services 5 Data models and specs 6 Web Services to Access Spatial Data	EO4GEO-Technical introduction to Spatial Data Infrastructures
LM1 2of7_BESTSDI barriers to access spatial data LM1 3of7_BESTSDI SDIs to resolve barriers LM1 4of7_BESTSDI Components of SDI LM1 5of7_BESTSDI Types of SDI LM6 2of8_BESTSDI E-government processes	BestSDI word files	info. About SDI introduction to SDI info. About SDI info. About SDI hierarchy related to SDI	
KU Leuven -LINKVIT-introduction_inspire.pdf	pdf	introduction to INSPIRE	KU Leuven -LINKVIT-introduction_inspire.pdf
KU Leuven -LINKVIT-basics_inspire_network_services	pdf	Info about INSPIRE	KU Leuven -LINKVIT-basics_inspire_network_services.pdf
KU Leuven -LINKVIT-basics_of_inspire_data_services_sharing_V2.pdf	pdf	Info about INSPIRE	KU Leuven -LINKVIT-basics_of_inspire_data_services_sharing_V2.pdf
KU Leuven -LINKVIT-Basics_of_INSPIRE_Data_specifications.pdf	pdf	Info about INSPIRE	KU Leuven -LINKVIT-Basics_of_INSPIRE_Data_specifications.pdf
KU Leuven -LINKVIT_Services-LINKVIT_SADL_Basics of INSPIRE Network Services_v4_with_audio_streamlined_aangepast_v2.pptx	pptx +Audio	Info about INSPIRE	KU Leuven -LINKVIT_Services-LINKVIT_SADL_Basics of INSPIRE Network Services_v4_with_audio_streamlined_aangepast_v2.pptx
KU Leuven -LINKVIT_Services-LINKVIT_SADL_INSPIRE network services advanced_v1_Updated_1802_.pptx	pptx +Audio	Info about INSPIRE	KU Leuven -LINKVIT_Services-LINKVIT_SADL_INSPIRE network services advanced_v1_Updated_1802_.pptx
LM9 5of8_BESTSDI The design of usable user interfaces	BestSDI word files	related to user interface but not necessary information	
KU Leuven -LINKVIT-European_Geoportals_en.pdf	pdf	related	KU Leuven -LINKVIT-European_Geoportals_en.pdf
KU Leuven -LINKVIT-Metadata_Catalogue_Services_PLUS.pdf	pdf	info about Metadata Catalogue Services	KU Leuven -LINKVIT-Metadata_Catalogue_Services_PLUS.pdf
KU Leuven -LINKVIT-Procedures_for_Data_and_Metadata_Harmonization_rev01-2018.pdf	pdf	info. about Metadata	KU Leuven -LINKVIT-Procedures_for_Data_and_Metadata_Harmonization_rev01-2018.pdf



Available/ Provided data	Type of data	Use	Link
KU Leuven -SDI courses- KULEuven_M3_Metadatas, Metadata Catalogues and Geospatial Data Quality.pdf	pdf	info. about Metadata	KULEuven_M3_Metadatas, Metadata Catalogues and Geospatial Data Quality.pdf
KU Leuven -SDI courses- LINKVIT_SADL_Introduction_to_linked_data_M19.pdf	pdf	info. about Metadata	KU Leuven -SDI courses- LINKVIT_SADL_Introduction_to_linked_data_M19.pdf
KU Leuven -LINKVIT-2a - L1 XML-UML v 2-1_pptx.pdf	pdf	introduction to XML and UML	introduction to XML and UML
KU Leuven -LINKVIT- Metadata_and_Data_validation_for_INSPiRE_rev01-2018.pdf	pdf	Metadata_and_Data_validation_for_INSPiRE	KU Leuven -LINKVIT- Metadata_and_Data_validation_for_INSPiRE_rev01-2018.pdf
LM2 BESTSDI exercises to search data sets and services LM7 BESTSDI Publish and use geospatial data on the web	BestSDI word files	info. About SDI, Metadata and Geoportal related to Metadata	
KU Leuven -SDI courses- LINKVIT_SADL_Basics of INSPIRE Network Services_v4_with_audio_streamlined_aangepast_v2.pdf	pdf	details about INSPIRE	LINKVIT_SADL_Basics of INSPIRE Network Services_v4_with_audio_streamlined_aangepast_v2.pdf
KU Leuven -Smespire- Smespire_training-pdfs that mention INSPIRE	pdfs	INSPIRE	KU Leuven -Smespire- Smespire_training-pdfs that mention INSPIRE
LM2 6of6 BESTSDI Providing examples of good geoportals and open data portals	BestSDI word files	exercise on geoportals : asked questions	
EO4GEO-MANAGEMENT VIEW ON SDI -SDI and data policies	URL		EO4GEO-MANAGEMENT VIEW ON SDI -SDI and data policies
EO4GEO-MANAGEMENT VIEW ON SDI -SDI governance and allocation of tasks	URL		EO4GEO-MANAGEMENT VIEW ON SDI -SDI governance and allocation of tasks
EO4GEO-MANAGEMENT VIEW ON SDI -SDI and processes	URL		EO4GEO-MANAGEMENT VIEW ON SDI -SDI and processes
University of Twente- Integrated Geospatial Workflows	Link from word file in BOX		University of Twente- Integrated Geospatial Workflows
KU Leuven -LINKVIT- INSPIRE_network_services_advanced_v2.pdf	pdf	sensors	KU Leuven -LINKVIT- INSPIRE_network_services_advanced_v2.pdf
KU Leuven -SDI courses- LINKVIT_SADL_Introduction to sensor web enablement_v2.2.pdf	pdf	info. about sensors	KU Leuven -SDI courses- LINKVIT_SADL_Introduction to sensor web enablement_v2.2.pdf
KU Leuven -Smespire- Smespire_training-pdfs that mention sensors	pdfs	sensors	KU Leuven -Smespire- Smespire_training-pdfs that mention sensors
KU Leuven- Earth observation	Link from word file in BOX		KU Leuven- Earth observation
Partner organisation Bochum University of Applied Science-Spatial data management project	Link from word file in BOX		Partner organisation Bochum University of Applied Science-Spatial data management project



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Available/ Provided data	Type of data	Use	Link
University of Zagreb- Spatial databases	Link from word file in BOX		University of Zagreb- Spatial databases



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