O1-A3: A COMPETENCY FRAMEWORK

DOCUMENT SUBTITLE

VERSION 1.2

Contents

1 A COMPETENCE FRAMEWORK FOR PRECISION AGRICULTURE

This document is intended for discussion and completion by the AgriTeach consortium.

The goal is to construct a Competence Framework for mid-level agricultural workers, guided by, but not necessarily following, the established European e-Competence Framework (e-CF) which provides a reference of 40 competences as required and applied at the Information and Communication Technology (ICT) workplace. The e-CF guide is relevant to AgriTeach as it uses a common language for competences, skills and proficiency levels that can be understood across Europe. That is a goal for this outcome of the project.

The other key influence is the results from the survey of ICT skills demand, in HU and MK, as carried out and analysed in O1-A2 (WRLS).

The three planned AgriTeach modules will be structured as follows.

1. Planned Topics for O3-A2 (ITS) are:
    a. Assessment, learning and digital education
    b. Digital education: strategies and policies.
    c. Understanding learning in an online environment: options and models
    d. Teaching resources and the digital student experience

2. Planned Topics for O3-A3 (GAK) are:
    a. Roles and tasks of Directorate for Agriculture and Rural Development
    b. post-2020 EU Common Agriculture Policy
    c. European Innovation Partnership for Agricultural Productivity and Sustainability
    d. AKIS, Agriculture Knowledge and Information Systems
    e. The European Commission's Digital Single Market strategy
    f. EU 2020 strategy for smart, sustainable and inclusive growth

3. Planned Topics for O3-A4 (AGFT) are:
    a. Connected Agriculture: learning analytics, big data management, IoT.
    b. Precision farming, integrated ICT and automation
    c. Services & applications for Smart Agriculture,
    d. Smart farm management, inventory and traceability systems,
    e. GIS applications, Risk management, forecasts, decision support
    f. e-Government services, knowledge sharing networks

g. Closing the "digital divide" between rural and urban areas.

There is very little detail in the literature about the competencies required by agricultural workers, far less those engaging in Precision Agriculture, so there is merit in trying to establish such a framework. This, in turn, can direct the required Learning Outcomes and Learning Objectives of an EQF levelled course to help develop these competencies in mid-level agricultural workers.

1.1 DIMENSIONS

According to the UK's CIPD (originally the *Chartered Institute of Personnel and Development*), the terms 'competency' and 'competencies' focus on the personal attributes or inputs of an individual, and are defined as the behaviours that individuals must have, or must acquire, to perform effectively at work.

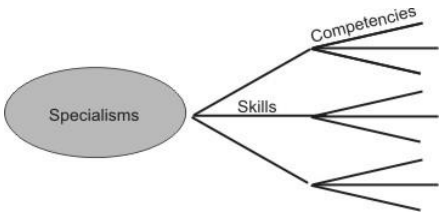
However, 'competence' and 'competences' are broader concepts that encompass demonstrable performance outputs as well as behaviour inputs, and may relate to a system or set of minimum standards required for effective performance at work.

A Competence Framework is therefore a structure that sets out and defines each individual competency (such as problem-solving or people management) required by individuals working in an organisation.

The European e-Competence Framework has four dimensions, reflecting the different levels of business and HR requirements plus work proficiency guidelines:

- Dimension 1: 5 e-Competence areas, derived from the ICT business processes
- Dimension 2: A set of reference e-Competences for each area, with a generic description for each competence
- Dimension 3: Proficiency levels of each e-Competence - on an e-1 to e-5 scale relating to EQF levels 3-8.
- Dimension 4: Samples of knowledge and skills relate to e-Competences in dimension 2.

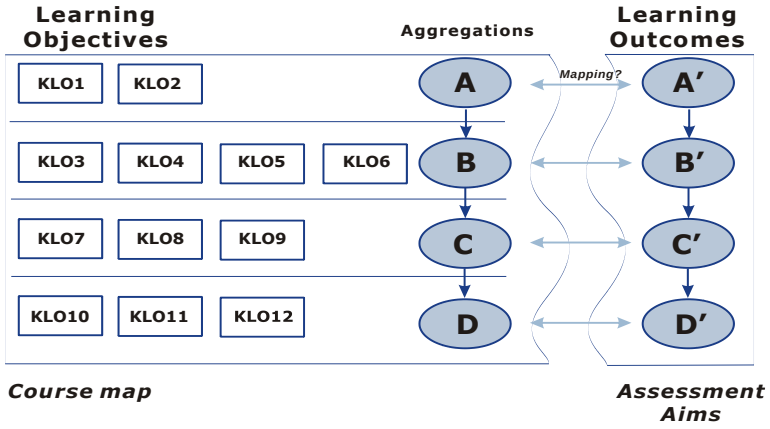
The last dimension is really a set of samples, so the framework has a structure for each Dimension 1 area as follows:



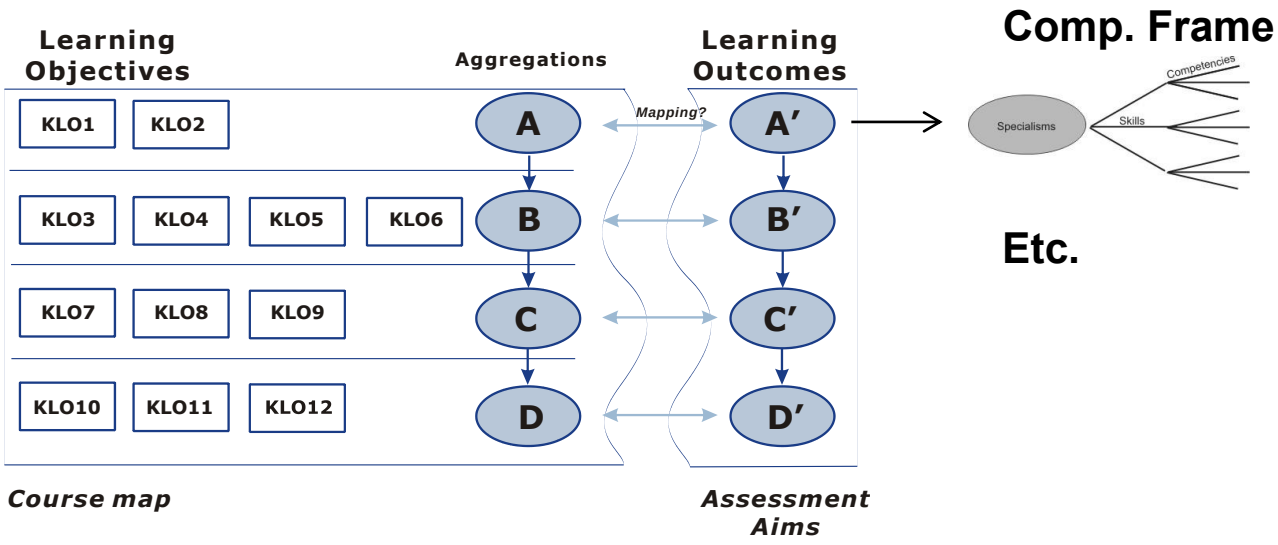
Note that the three levels could read: Area, Competencies, Proficiency!

1.2 MAPPING TO CONTENT

These Dimension 1 Areas can be directly mapped to the Learning Outcomes that would be the focus of the assessment of a course. These, in turn, should be the focus of the Learning Objectives of the course materials and course structure.



This structure, then, can act as a guide for the development of a course and content that relates directly to the required set of competencies for developing the precision agriculture worker.



A course and content developed in this manner should enable analytics to be gathered at all stages of learning, and offering feedback and a measure of competence development

As a guide to developers of e-CF applications, the following principles have been adopted in the specification of the e-CF. They are generic principles, so apply to AgriTeach too.

- **The framework is an enabler; it is designed to be a tool to empower users, not to restrict them.** The framework provides a structure and content for application by many types of teacher and teaching institution. It is intended to have a broad application context, and to support common understanding. It is not a prescription.

- **Competence** is defined as: 'Competence is a demonstrated ability to apply knowledge, skills and attitudes for achieving observable results'.

- **A competence can be a component of a job role, but it cannot be used as a substitute for similarly named job titles.** Competences can be aggregated, as required, to represent the essential content of a role or profile. Similarly, a single competence may be assigned to a number of different roles and job profiles.

- **Competence is not to be confused with processes or technology concepts**. These descriptions may represent evolving technologies, and in the context of the framework they may be integrated as elements within knowledge and skill examples.

- **The framework does not attempt to cover every possible competence deployed by teachers.** The framework articulates competences associated with teaching roles, including some that may be found in other professions but which are equally important in a teaching context. The framework avoids generic and transversal competences are comprehensively articulated in other structures.

- **The framework is structured within four dimensions.** e-competences in dimension 1 and 2 are presented from the organisational perspective as opposed to from an individual's perspective. Dimension 3 defines e-competence levels related to the European Qualifications Framework (EQF), and bridge between

organisational and individual competences.

- **The framework has a sector specific relationship to the EQF**; competence levels within the framework provide a consistent and rational relationship to levels defined within the EQF. The relationships between EQF learning levels and e-CF competence levels should be systematically developed to enable consistent interpretation of the EQF within the 'Flipped' framework.

- **Continuity of the framework is essential;** users should invest time and resources to align processes or procedures with the framework. Organisations using the framework need to be confident of the continued sustainability of their processes.

A competency framework should only include measurable components, and should contain definitions and/or examples of each competency

A critical aspect of a framework is the degree of detail. However, while a framework that is too broad (i.e. one that contains only general statements about individual competencies) will fail to provide adequate guidance either for:

- employees - as to what is expected of them, or
- managers - who have to assess their staff against these terms

one that is too detailed can be bureaucratic and time-consuming, hence not used.

Competency frameworks may include different types of competence:

- Core competencies – those that apply to all jobs.

- Common competencies – those that relate to specific jobs.

- Technical or job specific competencies – those that apply to certain roles or a 'family' or 'group', outlining any technical expertise required.

AgriTech is targeted at mid-level agricultural workers, but at higher levels other types of competences exist, though apply more to jobs within organisations:

- Leadership competencies - skills and behaviours that contribute to leadership performance.

- 'Meta' competencies - relate to, and characterise, competencies required in possible future roles.

Agriteach is using a competency framework to guide the development of its training modules – which is a departure from the traditional use of such frameworks. Normally when frameworks are used to assess competence in a job, they should recognise an individual's potential to develop in the future, and not just be used to collect evidence of certain past behaviours.

2 OTHER FRAMEWORK STRUCTURES

The e-CF is but one possible structure, but other sector and industry frameworks exist. This is a Competency Framework Structure example from the Microsoft Domain.

Of particular interest are levels 4 – 6 that broadly map to Dimensions 1 – 3 of the EU e-CF. Note that in this Microsoft domain the three CF hierarchy levels are termed:

1. Specialisation
2. Skill
3. Competence

While these are merely terms (and possibly slightly confusing ones given that Competence is at the lowest, not highest, level) the examples and description are perhaps easier to understand and relate to than the dimensions of the EU e-CF.

What is particularly useful is that Microsoft can relate their identified levels to specific areas of their training content and courses.

Level	**Name**	**Example**	**Description**
1	Environment	Microsoft, Unix, Linux	A competency framework set from a choice within an environment.
2	Competency Framework Set	Microsoft Desktop Support Technician MCSE, MCSA, MCDBA	Each competency framework set will be subdivided into a number of competency frameworks.
3	**Competency Framework** (or Skill Set)	MCDST (1) MCDST (2)	Each competency framework has an associated skill set from which the user can select one or more specialisations against which to self-assess.
4	**Specialisation**	Installing Windows XP Installing and Managing Hardware Supporting Network Connectivity	Specialisations are sub-divided into skills, which in turn are sub-divided into competencies.

5	**Skill**	Installing Hardware in Windows XP Using Windows Troubleshooters Troubleshooting Network Connectivity Managing Disks Remotely Understanding Removable Storage	Individual experience (No of months) is specified at the Skill Level. Competence, Ability and Expertise Points can be accumulated at the Skill Level. Competence Points give an overall view of capability in the Skill Ability Points are indicative of the spread of capability across the competences defining the skill Expertise Points reflect capability and experience.
6	**Competence**	Understanding Plug and Play Devices Troubleshooting Networking Hardware End Users Level of Expertise Traits of a qualified DST	Users assess competence at a rating of 0-3 against the lower level competence definitions.

3 A PRECISION AGRICULTURE COMPETENCY FRAMEWORK

This is perhaps a clearer and more logical framework to develop within.

Specialism	Skill	Competencies
A. FAMILIARITY	A1. Digital Transformations	A1.1. Single Digital Market
		A1.2. Standards & Interoperability
		A1.3. Regulatory Barriers
	A2. Equipment	A2.1. Spatial Positioning
		A2.2. Sensors
		A2.3. Mobile Computing
	A3. Tools	A3.1. GIS & Spatial Mapping
		A3.2. Proximal Sensors
		A3.3. Remote Sensing & UAVs
		A3.4. Variable Rate Technology
	A4. Skills	A4.1. Reliable Data Sources
		A4.2. Information Processing
		A4.3. Quantifying Benefits
B. ASSESSING	B1. Assessment Factors	B1.1. Yield Maps
		B1.2. Causes
		B1.3. Soil Variability

		B1.4. Water & Nutrients
	B2. Economic and Resource Benefits	B2.1. Precision Seeding & Planting Density
		B2.2. Reduced Environmental Impact
		B2.3. Site Specific Crop Management
	B3. Adoption Drawbacks	B3.1. Cost & Timescale
		B3.2. Data Collection
		B3.3. Systems Incompatibility
C. INVESTMENT	C1. Appraisals	C1.1. Aggregations of Technology
		C1.2. Data Collection
		C1.3. Time Scales
	C2. Adoption Factors	C2.1. Soils & Growing Conditions
		C2.2. Agrochemical Overuse
		C2.3. Environmental Legislation
	C3. Usage & Systems Integration	C3.1. Systems Approach
		C3.2. Services & Applications
		C3.3. Knowledge Sharing (AKIS)
	C4. Return on Investment	C4.1. Environmental & Economic Benefits
		C4.2. Agronomics & Ecological Principles
		C4.3. Economics & Resources

D. UNDERSTANDING	D1. Precision Technologies	D1.1. Information
		D1.2. Spatial Data
		D1.3. Yield Monitoring & Mapping
	D2. Understanding Measurements	D2.1. Sensors
		D2.2. Data Processing
	D3. Data & Information Integration	D3.1. Compatibility & ISOBUS
		D3.2. Weather Forecasting
		D3.3. IoT & Big Data
	D4. Agronomic Decision-making	D4.1. Yield Variability
		D4.2. Data Management & Interpretation
		D4.3. Management Plans
E. DECISION MAKING	E1.Optimal Resource Management	E1.1. Experimentation
		E1.2. Data Collection
	E2. Analysis & Evaluation	E2.1. Management Information
		E2.2. Knowledge
		E2.3. Consultation
	E3. Evaluation	E3.1. Wisdom & Experience
		E3.2. Implementation

3.1 KNOWLEDGE & SKILLS - SAMPLES

Each competence should include samples, or examples, of Knowledge and Skills. The table below begins to detail what these might include.

The course to be developed should cover the Knowledge to be learned and develop the Skills identified within each Competence. The hierarchy of:

Specialisms | Skills | Competencies

Can be used to shape the structure of the course modules, but the Knowledge & Skills identified should begin to govern what the content should include. These samples are therefore provided to add value and context but are not intended to be exhaustive or restrictive.

Here are possible examples. To be completed.

Competence	Knowledge	Skills
A1.1. Single Digital Market	• Digital agenda • Interoperability • Cross border services	• Digital literacy • Secure e-commerce • Shared community practices
A1.2. Standards & Interoperability	• Data exchanges • Data and information structures • ISOBUS	• Device compatibility • Information integration • Semantics and codification
A1.3. Regulatory Barriers	• Proliferation of drones • EU policy and regulations • Agricultural subsidies – a shift	• Diversity of farms • Evaluating programmes and measures
A2.1. Spatial Positioning	• Controlled traffic farming • Auto-guiding systems	• Recording farm machinery movement
A2.2. Sensors	• Linking variables to practice • Quantifying the physiological status of plants	• Multiple parameters and data fusion • Linking to decision making
A2.3. Mobile Computing	• User terminals for PA applications	
A3.1. GIS & Spatial Mapping	• An enabler of precision	
A3.2. Proximal Sensors	• Location sampling • Biomass monitoring	• Relating to optimal management • Compliance with regulation

A3.3. Remote Sensing & UAVs	• Vegetation indices	
A3.4. Variable Rate Technology	• How to apply to farming operation • Rates of delivery of inputs • Soil types	• Extrapolating information • Controlling application rates • Knowing where to apply
A4.1. Reliable Data Sources	• Ownership of information	• Objectivity & tools
A4.2. Information Processing	• Storage systems • Information sharing • Developing management plans	• Transforming data into maps • Interpreting from large data sets
A4.3. Quantifying Benefits	• Increased yields & profits • Fertiliser reduction • Guidance system costs	• Social and working conditions • Reduced labour needs • Increased animal welfare
B1.1. Yield Maps	• Relating images to yield	• Understanding yield maps • Localised harvesting information
B1.2. Causes		
B1.3. Soil Variability		
B1.4. Water & Nutrients		
B2.1. Precision Seeding & Planting Density	• Seeding via mappings of soil and plant information	• Targeted treatments
B2.2. Reduced Environmental Impact	• Sustainable use of resources • Guaranteeing the safety and security of food.	• Site-specific sensors & control • Frequent observations
B2.3. Site Specific Crop Management	• Collecting data • Scale and timing of data collection • Interpreting data	• Analysing data for decision making • Implementing management responses
B3.1. Cost & Timescale	• Low economic margins • Conservative investment	
B3.2. Data Collection	• Simple displays; more control	
B3.3. Systems Incompatibility	• Lack of independent field tests	
C1.1. Aggregations of Technology	• Complexity • Incompatibility of components	
C1.2. Data Collection		

C1.3. Time Scales		
C2.1. Soils & Growing Conditions		
C2.2. Agrochemical Overuse		
C2.3. Environmental Legislation	• Compliance with legal regulations	• Compatibility with the CAP
C3.1. Systems Approach		
C3.2. Services & Applications	• Models of causality	
C3.3. Knowledge Sharing (AKIS)	• Innovations as a social process	
C4.1. Environmental & Economic Benefits	• Minimizing over-application	
C4.2. Agronomics & Ecological Principles	• Biodiversity and environmental factors	
C4.3. Economics & Resources	• Minimum farm size • Crop management	
D1.1. Information		
D1.2. Spatial Data		
D1.3. Yield Monitoring & Mapping	• Spatial applications	
D2.1. Sensors		
D2.2. Data Processing		
D3.1. Compatibility & ISOBUS		
D3.2. Weather Forecasting		
D3.3. IoT & Big Data		

D4.1. Yield Variability		
D4.2. Data Management & Interpretation	• Cost benefit approaches & decision making • Field status maps	
D4.3. Management Plans	• Models of causality and interrelations	
E1.1. Experimentation	• Research and development • Research to on-farm practice	
E1.2. Data Collection	• Quality assurance	
E2.1. Management Information	• Cost benefit approaches • From maps and input costs to outputs	• Cost analysis
E2.2. Knowledge	• Farm advisory services • Innovation partnerships	• Causalities and determinants of yield • Heterogeneous or homogeneous environment • Specialist advisors
E2.3. Consultation	• Independent consultancy	
E3.1. Wisdom & Experience	• Support to the farmer • Success & unsuccessful stories	• Lack of standards & data exchange • Lack of advisory services
E3.2. Implementation	• Software systems and services • Farm type and size • Business approach	• Solutions from manufacturers and service providers • Costs (information, learning, tools)

4 COMPETENCY FRAMEWORK CHECKS

The UK CIPD offer the following simple steps to check whether a competency framework is fit for purpose:

- **Communicate the purpose** – The first step is to find out if those who are the target of the CF understand what the purpose is. If they don't understand how behaviours contribute to personal and organisational success, there is little point in updating or developing the framework.

- **Identify key themes** – Even if people are clear about the purpose of the framework, it still needs to support the organisation's aspirations (goals, values, business plans, and so on). If people aren't all working towards these aspirations then some individual efforts are likely to be diversions from organisational success.

- **Get conditions right** – The organisation's procedures need to support the framework, and the culture, resourcing and management structures must be supportive too. Be realistic: if conditions inhibit behaviours then change the conditions or change the behaviours.

- **Tackle the root cause** – As well as goals and conditions, behaviour is also influenced by underpinning characteristics (knowledge, skills and attitude). One underdeveloped characteristic, such as communication skills, can affect many different behaviours. If managers don't understand this distinction they may focus on trying to improve the behaviour without tackling the root cause.

- **Keep it simple** – There are two key elements to ease of use – language and structure. However 'perfect' the framework, if it's too complicated, long or detailed it won't be used. The language has to be meaningful to the people who use it.

- **Train, don't blame** – Once the structure has been tidied up, make sure that everyone who uses the framework is trained in how to use it. A framework is a tool and, as with any tool, if users don't know how to use it, it will fall into disuse or fail to meet its full potential.