INNOVATION IN THE CLOUD
BRIDGING UNIVERSITIES AND BUSINESS

IN-CLOUD

Erasmus+

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INNOVATION IN THE CLOUD BRIDGING UNIVERSITIES AND BUSINESSES

Project Number: 2015-1-IT01-KA202-004733

IN-CLOUD Qualifications
Full version

Legal notice: With the support of the Erasmus+ Programme of the European Union.
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Document Metadata

Project	IN-CLOUD – INNOVATION IN THE CLOUD BRIDGING UNIVERSITIES AND BUSINESSES ERASMUS+ – KA2 STRATEGIC PARTNERSHIP VET Project Number: 2015-1-IT01-KA202-004733
Title of the document	IN-CLOUD Qualifications – Full version
Elaborated by	EFFEBI
Intellectual Output / Activity	O2/A1 Qualification Design
Deliverable number	D2.2
Dissemination level	Public
Date of the document	November 2016
File name	IN-CLOUD_Qualifications_Full.pdf

Document reviews	
Release date	**Relevant modification**
November 2016	Full description of the qualifications according to the ECVET instrument.

Contents

IN-CLOUD Qualifications

The IN-CLOUD project[1] aims to pursue the objectives of the European Cloud Computing Strategy, with the general objective of boosting the competitiveness of European companies by means of the Cloud technologies. This is achieved by raising awareness of the potentialities of the Cloud and by creating professionals able to use these technologies.
Therefore, a specific objective of the IN-CLOUD project is to create "*VET qualifications for professionals inside European Companies and Public Administrations, training them to introduce and manage cloud computing technologies and services inside their systems*". The qualifications are designed according to the European lifelong learning instruments (EQF[2], ECVET[3] and EQAVET[4]), in order to ensure the recognition at European level and the transferability of the qualification units.
The Intellectual Output 2 of the project includes the design of the qualifications, of the validation methodologies and of the accumulation and transfer instruments.
In particular, this document describes the first design of the IN-CLOUD Qualifications in terms of contexts, contents, didactic units, pre-requisites and minimum suggested EQF. This document is the basis for the detailed description of the IN-CLOUD Qualifications in terms of Learning Outcomes.

1. Methodology

In order to approach to design of the qualifications, the IN-CLOUD partnership has taken into account:

- the analysis of the survey carried out at European level by the partnership in the Intellectual Output 1, described in the IN-CLOUD report "Analysis of the training needs and the labour market with relation to the Cloud technologies and services"
- the existing Cloud services and technologies available at European level, as analysed in the Intellectual Output 1 and described in the IN-CLOUD report "Cloud services and technologies at European level: national studies";
- existing national and international studies, surveys and reports on the use of Cloud computing technologies and services, on the impact on the business sector and on the foreseen potentialities;
- the project proposal, the declared objectives and target groups.

As results of these studies, the partnership has identifies three main target sectors:

- the business sector, being the main target of the project. Due to the high number of professionals potentially interested to the qualifications, it is reasonable to propose several qualifications with different degrees of complexities and different levels of deepening of the Cloud concepts;

[1] http://www.learn-in-cloud.eu/
[2] https://ec.europa.eu/ploteus/documentation#documentation_76
[3] http://www.ecvet-team.eu/
[4] http://www.eqavet.eu/gns/home.aspx

- the public administration sector, due to the high impact that the Cloud services and technologies can have both in the management of the public administrations and as benefits for the citizenship, and due to the widespread need for employees of public administrations to acquire digital skills;
- the education sector, due to the potentiality of the Cloud to enhance the common teaching and learning methodologies and the need for teachers at all levels to improve their digital skills.

For this reason, four valuable qualifications have been identified:

- Certified Cloud Professional for Business: it is a basic qualification for all the operators in the business sector. It provides the basics of Cloud computing and an entry-level knowledge of the main applications for business. The certified professional, even without advanced ICT competences and skills, is able to use the most common Cloud technologies and services, is able to evaluate their utility for the company and their cost-effectiveness.
- Certified Cloud Professional for Public Administrations: it is a basic qualification for all the operators in the public administration. It provides the basics of Cloud computing and an outline of the main Cloud applications for the public administration and the citizens. The certified operator is able to adopt (or suggest the adoption) of Cloud services and technologies both for the internal management of the public administration and for the services to the citizenship, evaluating their utility and their cost-effectiveness.
- Certified Cloud Professional for Education: it is a basic qualification for teachers and instructors operating in schools, Universities and training centres. It provides the basics of Cloud computing and an outline of the main Cloud applications for teaching and learning. The certified operator is able to adopt Cloud services and technologies for managing, creating and delivering didactic contents and to organize new Cloud-based didactic activities, evaluating the utility and the cost-effectiveness of the solutions.
- Certified Cloud Technology Professional: it is an advanced qualification for all the operators in the business sector. It provides advanced concepts of Cloud security, Cloud infrastructures and architectures, Cloud virtualization, Cloud storage services. The certified professional is able to introduce and manage advanced Cloud technologies and services, is able to evaluate their utility for the company and their cost-effectiveness.

A short version of the qualifications' description, agreed among partners, has been defined previously.
In the following sections, after minor modifications, a complete version of each qualification is provided in terms of sectors of applications, contents, didactic units, performance description, key activities and related learning outcomes (Knowledge, Skills and Competences).

2. Certified Cloud Professional for Business

Title	Certified Cloud Professional for Business
Label	
EQF LEVEL (Recommended)	EQF LEVEL 4

CORE UNITS OF LEARNING OUTCOMES	ECVET POINTS
Unit 1 Introduction to cloud computing	0,75
Unit 2 Security basics	1,25
Unit 3 Cloud models	1,00
Unit 4 Cloud business services and applications	1,50
Unit 5 Legal and technical aspects of cloud computing for business	0,50
TOTAL ECVET POINTS	**5**

Update requirements for the overall qualification: **every 2 years**
(CPD – Continuous Professional Development)

Qualification update: **every 2 years**

Unit 1 of Learning Outcomes: **Introduction to cloud computing**
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RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD

Key activities supported by the learning outcomes:

Define basic terms and principles in cloud computing.

Implement virtualization techniques and management approaches.

Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing.

Analyze components and services related to cloud computing implementation mediums and apply testing methodologies.

Describe and implement cloud storage services and technologies through both non-relational and relational models.

Illustrate the main providers for cloud-based services and solutions at international level.

Identify and describe the main national providers of cloud computing.

Analyse and demonstrate the main commonalities and differences among the different cloud providers.

Key performance indicators:

Identify and set-up cloud computing extended services.

Monitor the correct implementation of a cloud storage service.

Demonstrate comprehensive knowledge of both national and international cloud computing providers and the services they provide.

Behaviours underpinning effective performance:

Be impartial in illustrating benefits and risks regarding the application of cloud computing.

Demonstrate a fair approach in proposing different cloud providers and the services offered.

TOTAL ECVET POINTS: 0,5

Key activities:	Knowledge	Skills	Competencies
Define basic terms and principles in cloud computing	Has factual and theoretical knowledge on the following topics: 1. Cloud 2. IT resource 3. ON-premise 4. Scaling	Illustrate the contents and the relations between specific concepts related to cloud computing. Describe cloud characteristics and models showing the	Take responsibility, within regulatory requirements, to implement generic characteristics of cloud computing.

	5. Cloud characteristics, such as: Broad Network Access, Measured Service, Multi-tenancy, On-demand self-service, Rapid elasticity and scalability, Resource pooling 6. Cloud Models	possible impact of cloud services can have on organization's development.	
Implement virtualization techniques and management approaches	Has factual and theoretical knowledge on the following topics: 1. Full virtualization 2. OS-level virtualization 3. Partial virtualization 4. Para-virtualization 5. Hardware assessed virtualization 6. Virtual server 7. Fail-safe resilient architectures 8. No-setup hosts 9. Pay-for-use systems	Analyze and illustrate the differences and commonalities between the different methods of virtualization and cloud computing. Support the creation of virtual servers for providing appropriate cloud services. Use fail-resilient architectural and no-setup hosts models of cloud services. Apply and monitor pay-for-use systems for measuring the usage level of cloud services within the organziation.	Demonstrate autonomy in identifying appropriate virtualization techniques. Supervise the routine work of the personnel for ensuring the efficient implementation and monitoring of cloud services within the organization.
Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing	Has factual and theoretical knowledge on the following topics: 1. Cloud services users: owners, administrators and consumers 2. Cloud computing power sharing characteristics 3. Cloud storage sharing characteristics 4. Differences and commonalities between on-demand computing power and data storage 5. Methods and instruments for implementing adaptive computing power and data storage	Analyze characteristics and implement different roles of the cloud service users. Analyze and explain the different benefits and challenges of cloud computing power sharing and of cloud storage sharing. Put into practice methods for implementing on-demand computing power and data storage services.	Supervise the routine work of the personnel for ensuring the efficient accomplishment of the specific role attributed. Based on internal standards and requirements, supports the implementation of on-demand computing power. Take the responsibility, within regulatory requirements, to identify the type of cloud computing service is needed within the organization: adaptive cloud computing power sharing or cloud storage sharing.
Analyze components and services related to cloud computing	Has factual and theoretical knowledge on the following topics: 1. Implementation mediums: web services,	Illustrate specific characteristics and components of the different implementation mediums.	Based on internal standards and requirements, supports the implementation of

implementation mediums and apply testing methodologies.	REST services, components 2. Methods and instruments for service testing (in traditional, mobile, hybrid environments)	Describe and support the application of service testing methods within organizations.	specific service testing methods and instruments.
Describe and implement cloud storage services and technologies through both non-relational and relational models.	Has factual and theoretical knowledge on the following topics: 1. Types of cloud storage services and technologies 2. Data storage models: relational (SQL) and non-relational (NoSQL)	Explain to the organization's representatives existing cloud storage services and technologies that could be implemented according with the organization's needs and performance objectives. Illustrate the two data storage models and support their implementation in line with the organization's context.	Supervise the routine work of the personnel for ensuring the efficient implementation of the chosen cloud service. Take the responsibility, within regulatory requirements, to advice on the type of data storage model needed within the organization: SQL or NoSQL.
Illustrate the main providers for cloud-based services and solutions at international level.	Has factual and theoretical knowledge on the different services offered by the main cloud providers at international level (e.g. Google, Parallels, Virtustream, HubSpot, AppDirect, Mirantis, MuleSoft, Zenoss, Open DNS, etc.)	Analyze and illustrate the services offered by the most relevant cloud providers at international level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and advice cloud users on the most appropriate cloud providers, based on their needs and performance objectives.
Identify and describe the main national providers of cloud computing.	Is aware of the different services offered by the main cloud providers at national level.	Analyze and illustrate the services offered by the most relevant cloud providers at national level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and cloud consumers the most appropriate national cloud provider, based on their needs and performance objectives.
Analyse and demonstrate the main characteristics of the services offered by the different cloud providers.	Has factual and theoretical knowledge on methods and instruments for analysing the strengths and weaknesses of the different cloud providers.	Has the ability to identify and demonstrate the strengths and weaknesses of the different cloud providers, specific for each cloud component.	Capable of illustrating the strong and weak characteristics of the different cloud providers, related to each cloud component. Demonstrate autonomy in providing advice to cloud consumers, based on the analysis conducted.

	Unit 2 of Learning Outcomes**: Security basics**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging. Perform technical interventions for developing and monitoring network security groups and virtual server images. Support the implementation of risk analysis related to cloud computing services provided to organizations. Apply appropriate security strategies and methods for guaranteeing secure cloud computing.
	Key performance indicators: Monitor the correct use of authentication, authorization and accounting in a cloud environment. Supervise the appropriate monitoring, auditing and logging of cloud services. Support full securitization of cloud computing services.
	Behaviours underpinning effective performance: Demonstrate a fair and ethical behaviour in tackling both organizations' goals and security challenges in cloud computing. Promote the organization's values and principles in the field of confidentiality and data security.

TOTAL ECVET POINTS: 1,25			
Key activities:	**Knowledge**	**Skills**	**Competences**
Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging.	Has factual and theoretical knowledge on the following topics: 1. Authentication procedures and methods 2. Authorization methods 3. Accounting and logging systems 4. Monitoring approaches and instruments 5. Auditing systems for cloud activity	Develop and implement AAA methods and procedures in line with the organization's requirements and performance objectives. Select and perform monitoring and logging activities for cloud services implemented within an organization.	Take initiative and responsibility, within regulatory requirements, to apply specific AAA methods and procedures. Is committed to propose and implement customized monitoring and logging actions related to cloud services.

		Illustrate and support auditing actions for cloud services.	Take the responsibility to conduct preliminary audit actions for cloud services.
Perform technical interventions for developing and monitoring network security groups and virtual server images.	Has factual and theoretical knowledge on the following topics: 1. Network security groups characteristics and challenges 2. Virtual server images	Design and implement network security groups for virtual networks. Analyze network traffic to enhance the effective use of the virtual network. Create virtual server images for developing virtual machines.	Demonstrate autonomy in identifying appropriate network security groups for virtual networks. Capable to monitor and to interpret the network traffic and to provide appropriate advice for an effective utilization of virtual networks. Take the responsibility to provide specific support for the creation of images of virtual servers for facilitating the development of virtual machines, in line with the strategic objectives of the organization.
Support the implementation of risk analysis related to cloud computing services provided to organizations.	Has factual and theoretical knowledge on: 1. Cloud-based services 2. Cloud hosted solutions 3. Security risks regarding the implementation of both cloud-based services and cloud-hosted solutions. Has factual and theoretical knowledge on approaches and instruments for conducting risk analysis related to cloud computing.	Analyze and explain the commonalities and differences between cloud-based services and cloud hosted solutions. Identify and analyze the common security risks of cloud-based services and cloud hosted solutions. Illustrate approaches and instruments for performing analysis to indentify the concrete risks related to cloud services.	Support the coordination of the risk analysis for cloud services, according with the organization's guidelines. Take the responsibility to provide advice for addressing the risks identified.

Apply appropriate security strategies and methods for guaranteeing secure cloud computing.	Has factual and theoretical knowledge on: 1. Key security issues in cloud computing, such as: confidentiality, integrity, availability, security, accountability, usability, reliability and auditability. 2. Types of active and passive attacks both for data in transit and in cloud. 3. Counter-attacks strategies and methods for cloud computing security.	Illustrates characteristics of the key security issues and their relevance for the cloud service effective functionality with an organization. Analyze existing types of passive and active attacks for data in transit and in cloud. Implement appropriate security strategies and methods for guaranteeing cloud computing secure functioning. Provide the organization with the basic know how to facilitate the management of security in cloud computing services.	Capable of identifying and explaining to cloud administrators and consumers the different key security issues in cloud computing that need to be addressed. Monitor, evaluate and provide advice regarding the types of attacks to be addressed in cloud services within the organization. Demonstrate autonomy in implementing customized security strategies and methods in line with the organization's needs and objectives. Provide basic know how to organization's staff for enhancing a secure use of cloud services. Supervise the routine work of others in implementing cloud services, taking some responsibility for the evaluation and improvement of work.

	Unit 3 of Learning Outcomes**: Cloud models**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community. Support the definition and implementation of Service Level Agreements (SLAs).
	Key performance indicators: Monitor appropriate understanding and implementation of Saas, Paas and IaaS applied to the different deployment models for cloud computing. Analyse local / national / European / international scope of the SLAs and check its proper understanding.
	Behaviours underpinning effective performance: Accuracy and precision in analysing and proposing cloud models to specific organizational environment. Show an ethical approach to the definition and implementation of the SLAs requirements.

TOTAL ECVET POINTS: 1,25

Key activities:	Knowledge	Skills	Competences
Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).	Has factual and theoretical knowledge on characteristics of: 1. Software as a Service (SaaS) 2. Platform as a Service (PaaS) 3. Infrastructure as a Service (IaaS)	Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model. Analyze and select the most appropriate cloud computing model for the organization.	Take the responsibility, within internal regulatory framework, to advice the organization on which of cloud computing model fits better for their needs and objectives. Supervise the work of the others and take some responsibility for the evaluation and for enhancing the implementation of the delivery models.

Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community.	Has factual and theoretical knowledge on characteristics of: 1. Private cloud 2. Public cloud 3. Hybrid cloud 4. Community cloud	Has the ability to implement each of the four deployment models for cloud computing. Provide support to cloud users for concrete utilization and monitoring of the cloud services delivered through each of the four delivery models.	Take the responsibility to propose the selection of the most suitable model for the organization in line with its needs and objectives. Provide basic know how for cloud consumers in order to support them in the concrete application of the selected model.
Support the definition and implementation of Service Level Agreements (SLAs).	Has factual and theoretical knowledge on the provisions of Service Level Agreements regarding: principles for development, performance service, security service, data management services, personal data protection service. Is aware of the relevance and impact of the SLA provisions for the cloud users.	Analyze and implement the requirements of SLA for organizations. Monitor and provide support for auditing the accurate application of SLA.	Take the responsibility, within internal regulatory framework, to advice cloud users on the contents of the SLA, based on organization's needs and objectives in implementing cloud computing.

	Unit 4 of Learning Outcomes**: Cloud business services and applications**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and perform cloud-based business services for enhancing competitiveness and internationalization. Support the cost-benefits analysis for the implementation of cloud computing in SMEs. Analyze and promote good practices in the field of cloud applications for SMEs.
	Key performance indicators: Is able to link cloud services with the business goals of the company and the context. Develop an action plan for the roll-out of cloud computing within the business. Analyze risks and monitor the appropriate implementation of cloud based business models. Support the implementation of cost-benefit analysis for various learning models based on cloud computing.
	Behaviours underpinning effective performance: Consider company's vision and goals when selecting, planning and implementing specific cloud services. Demonstrate an equilibrate approach in supporting the cost-benefits analysis related to the implementation of cloud computing in the company.

TOTAL ECVET POINTS: 1,50			
Key activities:	**Knowledge**	**Skills**	**Competences**
Illustrate and perform cloud-based business services for enhancing competitiveness and internationalization.	Has factual and theoretical knowledge on: 1. Cloud based business solutions for SMEs 2. Storage services 3. Virtual resources 4. Databases Has accurate and theoretical knowledge on cloud based services and applications for marketing activities and e-commerce.	Illustrate the main characteristics of cloud-based solutions. Analyse and support the implementation of cloud storage services for SMEs. Support the design and share of virtual resources within cloud computing consumer organizations.	Take the responsibility to implement customized cloud business services and solutions to SMEs. Supervise the work of the others and take some responsibility for the evaluation and for enhancing the implementation of marketing and e-commerce solutions.

		Assist data management as part of cloud computing services for SMEs. Is able to implement cloud based marketing actions. Illustrate and implement cloud based e-commerce solutions for SMEs.	
Support the cost-benefits analysis for the implementation of cloud computing in SMEs.	Has factual and theoretical knowledge on specific approaches and instruments for conducting cost-benefit analysis for cloud computing in SMEs.	Apply specific methods and instruments for analysing the cost-benefit ratio related to the implementation of cloud business services in SMEs. Interpret and present the results of cost-benefit analysis to the organization representatives.	Take the responsibility, within internal regulatory framework, to advice appropriate measures based on the results of the cost-benefit analysis.
Analyze and promote good practices in the field of cloud applications for SMEs.	Has accurate and theoretical knowledge on the impact of cloud computing in SMEs. Is aware of specific criteria for selecting the showcases relevant for cloud computing users.	Is able to identify good practices in the field of cloud business services, based on specific quality criteria.	Demonstrate autonomy in analysing and selecting the most relevant showcases in the field of cloud business services for SMEs.

	Unit 5 of Learning Outcomes**: Legal and technical aspects of cloud computing for business**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement legal and technical requirements related to the need for fair competition on the market. Apply national and international provisions for the recognition and protection of intellectual property rights regarding innovative products/services. Describe and put into practice methods and tools for personal data management in line with national and international requirements.
	Key performance indicators: Analyse the national/international scope and requisites of the SLAs regarding private business. Identify the main intellectual property rights issues in the SLAs.
	Behaviours underpinning effective performance: Demonstrate ethical and legally correct approach in planning and implementing cloud computing in the business environment. Recognize data confidentiality when implementing cloud based business models.

TOTAL ECVET POINTS: 0,50			
Key activities:	**Knowledge**	**Skills**	**Competences**
Illustrate and implement legal and technical requirements related to the need for fair competition on the market.	Has factual and theoretical knowledge on national and international general requirements for fair competition and antitrust.	Apply generic requirements regarding fair competition when selecting and implementing cloud based business models	Supervise the work of the others in implementing cloud services in line with legal requirements for fair competition and antitrust.
Apply national and international provisions for the recognition and protection of intellectual property rights regarding innovative products/services	Has factual and theoretical knowledge on national and international provisions regarding the recognition of intellectual property rights.	Support the company in implementing innovative products and services respecting the intellectual property rights regulations.	Take the responsibility, within internal regulatory framework, to advice appropriate actions for the recognition of intellectual property rights.

Describe and put into practice methods and tools for personal data management in line with national and international requirements.	Has factual and theoretical knowledge on national and international general rules in the field of personal data protection and management.	Illustrate and support the implementation of national and international regulations regarding personal data management.	Demonstrate autonomy in implementing cloud based methods in line with national and international provisions in the field of persona data management and protection.

3. Certified Cloud Professional for Public Administrations

Title	Certified Cloud Professional for Public Administrations
Label	
EQF LEVEL (Recommended)	EQF LEVEL 4

CORE UNITS OF LEARNING OUTCOMES	ECVET POINTS
Unit 1 Introduction to cloud computing	0,75
Unit 2 Security basics	1,25
Unit 3 Cloud models	1,00
Unit 4 Cloud services and applications for public administrations and for citizens/community	1,50
Unit 5 Legal and technical aspects of cloud computing for public administration and for citizens/community	0,50
TOTAL ECVET POINTS	**5**

Update requirements for the overall qualification: **every 2 years**
(CPD – Continuous Professional Development)

Qualification update: **every 2 years**

	Unit 1 of Learning Outcomes: **Introduction to cloud computing**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Define basic terms and principles in cloud computing. Implement virtualization techniques and management approaches. Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing. Analyze components and services related to cloud computing implementation mediums and apply testing methodologies. Describe and implement cloud storage services and technologies through both non-relational and relational models. Illustrate the main providers for cloud-based services and solutions at international level. Identify and describe the main national providers of cloud computing. Analyse and demonstrate the main commonalities and differences among the different cloud providers.
	Key performance indicators: Identify and set-up cloud computing extended services. Monitor the correct implementation of a cloud storage service. Demonstrate comprehensive knowledge of both national and international cloud computing providers and the services they provide.
	Behaviours underpinning effective performance: Be impartial in illustrating benefits and risks regarding the application of cloud computing. Demonstrate a fair approach in proposing different cloud providers and the services offered.

TOTAL ECVET POINTS: 0,5			
Key activities:	**Knowledge**	**Skills**	**Competencies**
Define basic terms and principles in cloud computing	Has factual and theoretical knowledge on the following topics: 7. Cloud 8. IT resource 9. ON-premise 10. Scaling	Illustrate the contents and the relations between specific concepts related to cloud computing.	Take responsibility, within regulatory requirements, to implement generic characteristics of cloud computing.

	11. Cloud characteristics, such as: Broad Network Access, Measured Service, Multi-tenancy, On-demand self-service, Rapid elasticity and scalability, Resource pooling 12. Cloud Models	Describe cloud characteristics and models showing the possible impact of cloud services can have on organization's development.	
Implement virtualization techniques and management approaches	Has factual and theoretical knowledge on the following topics: 10. Full virtualization 11. OS-level virtualization 12. Partial virtualization 13. Para-virtualization 14. Hardware assessed virtualization 15. Virtual server 16. Fail-safe resilient architectures 17. No-setup hosts 18. Pay-for-use systems	Analyze and illustrate the differences and commonalities between the different methods of virtualization and cloud computing. Support the creation of virtual servers for providing appropriate cloud services. Use fail-resilient architectural and no-setup hosts models of cloud services. Apply and monitor pay-for-use systems for measuring the usage level of cloud services within the organziation.	Demonstrate autonomy in identifying appropriate virtualization techniques. Supervise the routine work of the personnel for ensuring the efficient implementation and monitoring of cloud services within the organization.
Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing	Has factual and theoretical knowledge on the following topics: 6. Cloud services users: owners, administrators and consumers 7. Cloud computing power sharing characteristics 8. Cloud storage sharing characteristics 9. Differences and commonalities between on-demand computing power and data storage 10. Methods and instruments for implementing adaptive computing power and data storage	Analyze characteristics and implement different roles of the cloud service users. Analyze and explain the different benefits and challenges of cloud computing power sharing and of cloud storage sharing. Put into practice methods for implementing on-demand computing power and data storage services.	Supervise the routine work of the personnel for ensuring the efficient accomplishment of the specific role attributed. Based on internal standards and requirements, supports the implementation of on-demand computing power. Take the responsibility, within regulatory requirements, to identify the type of cloud computing service is needed within the organization: adaptive cloud computing power sharing or cloud storage sharing.
Analyze components and services	Has factual and theoretical knowledge on the following topics:	Illustrate specific characteristics and	

related to cloud computing implementation mediums and apply testing methodologies.	3. Implementation mediums: web services, REST services, components 4. Methods and instruments for service testing (in traditional, mobile, hybrid environments)	components of the different implementation mediums. Describe and support the application of service testing methods within organizations.	Based on internal standards and requirements, supports the implementation of specific service testing methods and instruments.
Describe and implement cloud storage services and technologies through both non-relational and relational models.	Has factual and theoretical knowledge on the following topics: 3. Types of cloud storage services and technologies 4. Data storage models: relational (SQL) and non-relational (NoSQL)	Explain to the organization's representatives existing cloud storage services and technologies that could be implemented according with the organization's needs and performance objectives. Illustrate the two data storage models and support their implementation in line with the organization's context.	Supervise the routine work of the personnel for ensuring the efficient implementation of the chosen cloud service. Take the responsibility, within regulatory requirements, to advice on the type of data storage model needed within the organization: SQL or NoSQL.
Illustrate the main providers for cloud-based services and solutions at international level.	Has factual and theoretical knowledge on the different services offered by the main cloud providers at international level (e.g. Google, Parallels, Virtustream, HubSpot, AppDirect, Mirantis, MuleSoft, Zenoss, Open DNS, etc.)	Analyze and illustrate the services offered by the most relevant cloud providers at international level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and advice cloud users on the most appropriate cloud providers, based on their needs and performance objectives.
Identify and describe the main national providers of cloud computing.	Is aware of the different services offered by the main cloud providers at national level.	Analyze and illustrate the services offered by the most relevant cloud providers at national level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and cloud consumers the most appropriate national cloud provider, based on their needs and performance objectives.
Analyse and demonstrate the main characteristics of the services offered by the different cloud providers.	Has factual and theoretical knowledge on methods and instruments for analysing the strengths and weaknesses of the different cloud providers.	Has the ability to identify and demonstrate the strengths and weaknesses of the different cloud providers, specific for each cloud component.	Capable of illustrating the strong and weak characteristics of the different cloud providers, related to each cloud component. Demonstrate autonomy in providing advice to cloud consumers, based on the analysis conducted.

	Unit 2 of Learning Outcomes**: Security basics**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging. Perform technical interventions for developing and monitoring network security groups and virtual server images. Support the implementation of risk analysis related to cloud computing services provided to organizations. Apply appropriate security strategies and methods for guaranteeing secure cloud computing.
	Key performance indicators: Monitor the correct use of authentication, authorization and accounting in a cloud environment. Supervise the appropriate monitoring, auditing and logging of cloud services. Support full securitization of cloud computing services.
	Behaviours underpinning effective performance: Demonstrate a fair and ethical behaviour in tackling both organizations' goals and security challenges in cloud computing. Promote the organization's values and principles in the field of confidentiality and data security.

TOTAL ECVET POINTS: 1,25			
Key activities:	**Knowledge**	**Skills**	**Competences**
Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging.	Has factual and theoretical knowledge on the following topics: 6. Authentication procedures and methods 7. Authorization methods 8. Accounting and logging systems 9. Monitoring approaches and instruments 10. Auditing systems for cloud activity	Develop and implement AAA methods and procedures in line with the organization's requirements and performance objectives. Select and perform monitoring and logging activities for cloud services implemented within an organization.	Take initiative and responsibility, within regulatory requirements, to apply specific AAA methods and procedures. Is committed to propose and implement customized monitoring and logging actions related to cloud services. Take the responsibility to conduct preliminary audit actions for cloud services.

		Illustrate and support auditing actions for cloud services.	
Perform technical interventions for developing and monitoring network security groups and virtual server images.	Has factual and theoretical knowledge on the following topics: 3. Network security groups characteristics and challenges 4. Virtual server images	Design and implement network security groups for virtual networks. Analyze network traffic to enhance the effective use of the virtual network. Create virtual server images for developing virtual machines.	Demonstrate autonomy in identifying appropriate network security groups for virtual networks. Capable to monitor and to interpret the network traffic and to provide appropriate advice for an effective utilization of virtual networks. Take the responsibility to provide specific support for the creation of images of virtual servers for facilitating the development of virtual machines, in line with the strategic objectives of the organization.
Support the implementation of risk analysis related to cloud computing services provided to organizations.	Has factual and theoretical knowledge on: 4. Cloud-based services 5. Cloud hosted solutions 6. Security risks regarding the implementation of both cloud-based services and cloud-hosted solutions. Has factual and theoretical knowledge on approaches and instruments for conducting risk analysis related to cloud computing.	Analyze and explain the commonalities and differences between cloud-based services and cloud hosted solutions. Identify and analyze the common security risks of cloud-based services and cloud hosted solutions. Illustrate approaches and instruments for performing analysis to indentify the concrete risks related to cloud services.	Support the coordination of the risk analysis for cloud services, according with the organization's guidelines. Take the responsibility to provide advice for addressing the risks identified.
Apply appropriate security strategies and methods for guaranteeing secure cloud computing.	Has factual and theoretical knowledge on: 4. Key security issues in cloud computing, such as: confidentiality, integrity, availability, security, accountability, usability, reliability and auditability.	Illustrates characteristics of the key security issues and their relevance for the cloud service effective functionality with an organization. Analyze existing types of passive and active attacks for data in transit and in cloud.	Capable of identifying and explaining to cloud administrators and consumers the different key security issues in cloud computing that need to be addressed. Monitor, evaluate and provide advice regarding the types of

	5. Types of active and passive attacks both for data in transit and in cloud. 6. Counter-attacks strategies and methods for cloud computing security.	Implement appropriate security strategies and methods for guaranteeing cloud computing secure functioning. Provide the organization with the basic know how to facilitate the management of security in cloud computing services.	attacks to be addressed in cloud services within the organization. Demonstrate autonomy in implementing customized security strategies and methods in line with the organization's needs and objectives. Provide basic know how to organization's staff for enhancing a secure use of cloud services. Supervise the routine work of others in implementing cloud services, taking some responsibility for the evaluation and improvement of work.

	Unit 3 of Learning Outcomes**: Cloud models**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community. Support the definition and implementation of Service Level Agreements (SLAs).
	Key performance indicators: Monitor appropriate understanding and implementation of Saas, Paas and IaaS applied to the different deployment models for cloud computing. Analyse local / national / European / international scope of the SLAs and check its proper understanding.
	Behaviours underpinning effective performance: Accuracy and precision in analysing and proposing cloud models to specific organizational environment. Show an ethical approach to the definition and implementation of the SLAs requirements.

TOTAL ECVET POINTS: 1,25

Key activities:	Knowledge	Skills	Competences
Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS)	Has factual and theoretical knowledge on characteristics of: 4. Software as a Service (SaaS) 5. Platform as a Service (PaaS) 6. Infrastructure as a Service (IaaS)	Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model. Analyze and select the most appropriate cloud computing model for the organization.	Take the responsibility, within internal regulatory framework, to advice the organization on which of cloud computing model fits better for their needs and objectives. Supervise the work of the others and take some responsibility for the evaluation and for enhancing the implementation of the delivery models.

Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community.	Has factual and theoretical knowledge on characteristics of: 5. Private cloud 6. Public cloud 7. Hybrid cloud 8. Community cloud	Has the ability to implement each of the four deployment models for cloud computing. Provide support to cloud users for concrete utilization and monitoring of the cloud services delivered through each of the four delivery models.	Take the responsibility to propose the selection of the most suitable model for the organization in line with its needs and objectives. Provide basic know how for cloud consumers in order to support them in the concrete application of the selected model.
Support the definition and implementation of Service Level Agreements (SLAs).	Has factual and theoretical knowledge on the provisions of Service Level Agreements regarding: principles for development, performance service, security service, data management services, personal data protection service. Is aware of the relevance and impact of the SLA provisions for the cloud users.	Analyze and implement the requirements of SLA for organizations. Monitor and provide support for auditing the accurate application of SLA.	Take the responsibility, within internal regulatory framework, to advice cloud users on the contents of the SLA, based on organization's needs and objectives in implementing cloud computing.

Unit 4 of Learning Outcomes**: Cloud services and applications for public administrations and for citizens/community**

RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD

Key activities supported by the learning outcomes:

Illustrate and perform cloud services for enhancing the public administration's activity.

Develop and implement cloud solutions for supporting the delivery of public services to citizens.

Conduct cost-benefits analysis for the implementation of cloud computing in public administrations and for public services.

Analyze and promote good practices in the field of cloud applications for public administrations and citizens.

Key performance indicators:

Is able to link cloud services with the public organizations' scope and services offered to citizens/community.

Develop an action plan for the roll-out of cloud computing within the public institution and in relation with the services offered.

Analyze risks and monitor the appropriate implementation of cloud models for public institutions and services.

Support the implementation of cost-benefit analysis for various cloud models applied in public administrations and services.

Behaviours underpinning effective performance:

Consider the public institutions' role and functions for communities when selecting, planning and implementing specific cloud services.

Show an equilibrate approach in supporting the cost-benefits analysis related to the implementation of cloud computing in the public institution and services.

TOTAL ECVET POINTS: 1,50

Key activities:	Knowledge	Skills	Competences
Illustrate and perform cloud services for enhancing the public administration's activity.	Has factual and theoretical knowledge on: 1. Cloud solutions for public institutions 2. Collaborative resources, online tools and document sharing for public administrations	Illustrate the main characteristics of cloud-based solutions for public institutions. Analyse and support the implementation of cloud	Take the responsibility to propose customized cloud services and solutions to public institutions, according to their needs and type of services they offer.

	3. Storage services 4. Virtual resources 5. Interoperability among institutions	storage services for public institutions. Support the design and share of virtual resources within public institutions. Develop and monitor the implementation of interoperability solutions for public institutions.	Supervise the work of the others and take some responsibility for the evaluation and for enhancing the implementation of interoperability solutions for public institutions.
Develop and implement cloud solutions for supporting the delivery of public services to citizens.	Has factual and theoretical knowledge on: 1. Organization of public institutions 2. Type of public services for citizens 3. Principles and examples in the field of e-administration	Is able to illustrate the general models of internal organization and communication processes of public institutions. Analyse the different types of public services for citizens. Interpret and illustrate the main principles and examples of e-administration.	Take the responsibility, within the internal regulatory framework, to advice public administration on most appropriate cloud solutions considering their needs and type of services they offer. Demonstrate autonomy in monitoring and evaluating the implementation of cloud solutions for services addressed to citizens.
Conduct cost-benefits analysis for the implementation of cloud computing in public administrations and for public services.	Has factual and theoretical knowledge on specific approaches and instruments for conducting cost-benefit analysis for cloud computing in public institutions.	Apply specific methods and instruments for analysing the cost-benefit ratio related to the implementation of cloud services in public institutions. Interpret and present the results of cost-benefit analysis to cloud computing users.	Take the responsibility within internal regulatory framework, to advice appropriate measures based on the results of the cost-benefit analysis.
Analyze and promote good practices in the field of cloud applications for public administrations and citizens.	Has accurate and theoretical knowledge on the impact of cloud computing in public institutions. Is aware of specific criteria for selecting the showcases relevant for cloud computing users.	Is able to identify good practices in the field of cloud services, based on specific quality criteria.	Demonstrate autonomy in analysing and selecting the most relevant showcases in the field of cloud services for public institutions.

	Unit 5 of Learning Outcomes**: Legal and technical aspects of cloud computing for public administration and for citizens/community**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement legal and technical requirements related to financial flows and procurement procedures in public administration, to be integrated in cloud services. Describe and put into practice methods and tools for personal data management in line with national and international requirements for public administrations and services. Apply national and international provisions for the recognition and protection of intellectual property rights regarding products/services.
	Key performance indicators: Analyse the national/international scope and requisites of the SLAs. regarding public institutions. Identify the main intellectual property rights issues in the SLAs.
	Behaviours underpinning effective performance: Demonstrate ethical and legally correct approach in planning and implementing cloud computing in the public organization environment. Recognize data confidentiality when implementing cloud models for public institutions and services.

TOTAL ECVET POINTS: 0,50			
Key activities:	**Knowledge**	**Skills**	**Competences**
Illustrate and implement legal and technical requirements related to financial flows and procurement procedures in public administration, to be integrated in cloud services.	Has factual and theoretical knowledge on: 1. The legal requirements regarding the economic and financial flows in public institutions. 2. Public procurement regulations for public institutions.	Support the selection and implementation of cloud services based on the specific characteristics of economic and financial flows registered in public institutions. Illustrate methods of integrating cloud services with specific procurement	Supervise the work of the others in implementing cloud services in line with legal requirements regarding economic and financial flows and procurement procedures.

		regulations in public institutions.	
Describe and put into practice methods and tools for personal data management in line with national and international requirements for public administrations.	Has factual and theoretical knowledge on national and international rules in the field of personal data protection and management, to be applied by public institutions in particular.	Illustrate and support the implementation of national and international regulations regarding personal data management in public institutions.	Demonstrate autonomy in implementing cloud based methods in line with national and international provisions in the field of persona data management and protection, in public institutions.
Apply national and international provisions for the recognition and protection of intellectual property rights regarding innovative products/services.	Has factual and theoretical knowledge on national and international provisions regarding the recognition of intellectual property rights.	Support the public institution in implementing innovative products and services respecting the intellectual property rights regulations.	Take the responsibility, within internal regulatory framework, to advice appropriate actions for the recognition of intellectual property rights.

4. Certified Cloud Professional for Education and Training

Title	Certified Cloud Professional for Education and Training
Label	
EQF LEVEL (Recommended)	EQF LEVEL 4

CORE UNITS OF LEARNING OUTCOMES	ECVET POINTS
Unit 1 Introduction to cloud computing	0,75
Unit 2 Security basics	1,25
Unit 3 Cloud models	1,00
Unit 4 Cloud services and applications for education and training (ET)	1,50
Unit 5 Legal and technical aspects of cloud computing for education and training	0,50
TOTAL ECVET POINTS	**5**

Update requirements for the overall qualification: **every 2 years**
(CPD – Continuous Professional Development)

Qualification update: **every 2 years**

	Unit 1 of Learning Outcomes: **Introduction to cloud computing**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Define basic terms and principles in cloud computing. Implement virtualization techniques and management approaches. Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing. Analyze components and services related to cloud computing implementation mediums and apply testing methodologies. Describe and implement cloud storage services and technologies through both non-relational and relational models. Illustrate the main providers for cloud-based services and solutions at international level. Identify and describe the main national providers of cloud computing. Analyse and demonstrate the main commonalities and differences among the different cloud providers.
	Key performance indicators: Identify and set-up cloud computing extended services. Monitor the correct implementation of a cloud storage service. Demonstrate comprehensive knowledge of both national and international cloud computing providers and the services they provide.
	Behaviours underpinning effective performance: Be impartial in illustrating benefits and risks regarding the application of cloud computing. Demonstrate a fair approach in proposing different cloud providers and the services offered.

TOTAL ECVET POINTS: 0,5			
Key activities:	**Knowledge**	**Skills**	**Competencies**
Define basic terms and principles in cloud computing	Has factual and theoretical knowledge on the following topics: 13. Cloud 14. IT resource 15. ON-premise	Illustrate the contents and the relations between specific concepts related to cloud computing.	Take responsibility, within regulatory requirements, to implement generic characteristics of cloud computing.

	16. Scaling 17. Cloud characteristics, such as: Broad Network Access, Measured Service, Multi-tenancy, On-demand self-service, Rapid elasticity and scalability, Resource pooling 18. Cloud Models	Describe cloud characteristics and models showing the possible impact of cloud services can have on organization's development.	
Implement virtualization techniques and management approaches	Has factual and theoretical knowledge on the following topics: 19. Full virtualization 20. OS-level virtualization 21. Partial virtualization 22. Para-virtualization 23. Hardware assessed virtualization 24. Virtual server 25. Fail-safe resilient architectures 26. No-setup hosts 27. Pay-for-use systems	Analyze and illustrate the differences and commonalities between the different methods of virtualization and cloud computing. Support the creation of virtual servers for providing appropriate cloud services. Use fail-resilient architectural and no-setup hosts models of cloud services. Apply and monitor pay-for-use systems for measuring the usage level of cloud services within the organziation.	Demonstrate autonomy in identifying appropriate virtualization techniques. Supervise the routine work of the personnel for ensuring the efficient implementation and monitoring of cloud services within the organization.
Illustrate and analyze characteristics, advantages and challenges related to cloud computing power sharing and cloud storage sharing	Has factual and theoretical knowledge on the following topics: 11. Cloud services users: owners, administrators and consumers 12. Cloud computing power sharing characteristics 13. Cloud storage sharing characteristics 14. Differences and commonalities between on-demand computing power and data storage 15. Methods and instruments for implementing adaptive computing power and data storage	Analyze characteristics and implement different roles of the cloud service users. Analyze and explain the different benefits and challenges of cloud computing power sharing and of cloud storage sharing. Put into practice methods for implementing on-demand computing power and data storage services.	Supervise the routine work of the personnel for ensuring the efficient accomplishment of the specific role attributed. Based on internal standards and requirements, supports the implementation of on-demand computing power. Take the responsibility, within regulatory requirements, to identify the type of cloud computing service is needed within the organization: adaptive cloud computing power sharing or cloud storage sharing.
Analyze components and services related to cloud	Has factual and theoretical knowledge on the following topics:	Illustrate specific characteristics and	Based on internal standards and requirements, supports

computing implementation mediums and apply testing methodologies.	5. Implementation mediums: web services, REST services, components 6. Methods and instruments for service testing (in traditional, mobile, hybrid environments)	components of the different implementation mediums. Describe and support the application of service testing methods within organizations.	the implementation of specific service testing methods and instruments.
Describe and implement cloud storage services and technologies through both non-relational and relational models.	Has factual and theoretical knowledge on the following topics: 5. Types of cloud storage services and technologies 6. Data storage models: relational (SQL) and non-relational (NoSQL)	Explain to the organization's representatives existing cloud storage services and technologies that could be implemented according with the organization's needs and performance objectives. Illustrate the two data storage models and support their implementation in line with the organization's context.	Supervise the routine work of the personnel for ensuring the efficient implementation of the chosen cloud service. Take the responsibility, within regulatory requirements, to advice on the type of data storage model needed within the organization: SQL or NoSQL.
Illustrate the main providers for cloud-based services and solutions at international level.	Has factual and theoretical knowledge on the different services offered by the main cloud providers at international level (e.g. Google, Parallels, Virtustream, HubSpot, AppDirect, Mirantis, MuleSoft, Zenoss, Open DNS, etc.)	Analyze and illustrate the services offered by the most relevant cloud providers at international level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and advice cloud users on the most appropriate cloud providers, based on their needs and performance objectives.
Identify and describe the main national providers of cloud computing.	Is aware of the different services offered by the main cloud providers at national level.	Analyze and illustrate the services offered by the most relevant cloud providers at national level, for each cloud component: infrastructure, platform& development, software, storage and security.	Take the responsibility, within internal regulatory framework, to select and cloud consumers the most appropriate national cloud provider, based on their needs and performance objectives.
Analyse and demonstrate the main characteristics of the services offered by the different cloud providers.	Has factual and theoretical knowledge on methods and instruments for analysing the strengths and weaknesses of the different cloud providers.	Has the ability to identify and demonstrate the strengths and weaknesses of the different cloud providers, specific for each cloud component.	Capable of illustrating the strong and weak characteristics of the different cloud providers, related to each cloud component. Demonstrate autonomy in providing advice to cloud consumers, based on the analysis conducted.

	Unit 2 of Learning Outcomes**: Security basics**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging. Perform technical interventions for developing and monitoring network security groups and virtual server images. Support the implementation of risk analysis related to cloud computing services provided to organizations. Apply appropriate security strategies and methods for guaranteeing secure cloud computing.
	Key performance indicators: Monitor the correct use of authentication, authorization and accounting in a cloud environment. Supervise the appropriate monitoring, auditing and logging of cloud services. Support full securitization of cloud computing services.
	Behaviours underpinning effective performance: Demonstrate a fair and ethical behaviour in tackling both organizations' goals and security challenges in cloud computing. Promote the organization's values and principles in the field of confidentiality and data security.

TOTAL ECVET POINTS: 1,25

Key activities:	Knowledge	Skills	Competences
Implement specific activities regarding the authentication, authorization and accounting (AAA), as well as monitoring, auditing and logging.	Has factual and theoretical knowledge on the following topics: 11. Authentication procedures and methods 12. Authorization methods 13. Accounting and logging systems 14. Monitoring approaches and instruments	Develop and implement AAA methods and procedures in line with the organization's requirements and performance objectives. Select and perform monitoring and logging activities for cloud services implemented within an organization.	Take initiative and responsibility, within regulatory requirements, to apply specific AAA methods and procedures. Is committed to propose and implement customized monitoring and logging actions related to cloud services.

	15. Auditing systems for cloud activity	Illustrate and support auditing actions for cloud services.	Take the responsibility to conduct preliminary audit actions for cloud services.
Perform technical interventions for developing and monitoring network security groups and virtual server images.	Has factual and theoretical knowledge on the following topics: 5. Network security groups characteristics and challenges 6. Virtual server images	Design and implement network security groups for virtual networks. Analyze network traffic to enhance the effective use of the virtual network. Create virtual server images for developing virtual machines.	Demonstrate autonomy in identifying appropriate network security groups for virtual networks. Capable to monitor and to interpret the network traffic and to provide appropriate advice for an effective utilization of virtual networks. Take the responsibility to provide specific support for the creation of images of virtual servers for facilitating the development of virtual machines, in line with the strategic objectives of the organization.
Support the implementation of risk analysis related to cloud computing services provided to organizations.	Has factual and theoretical knowledge on: 7. Cloud-based services 8. Cloud hosted solutions 9. Security risks regarding the implementation of both cloud-based services and cloud-hosted solutions. Has factual and theoretical knowledge on approaches and instruments for conducting risk analysis related to cloud computing.	Analyze and explain the commonalities and differences between cloud-based services and cloud hosted solutions. Identify and analyze the common security risks of cloud-based services and cloud hosted solutions. Illustrate approaches and instruments for performing analysis to indentify the concrete risks related to cloud services.	Support the coordination of the risk analysis for cloud services, according with the organization's guidelines. Take the responsibility to provide advice for addressing the risks identified.
Apply appropriate security strategies and methods for guaranteeing secure cloud computing.	Has factual and theoretical knowledge on: 7. Key security issues in cloud computing, such as: confidentiality, integrity, availability, security, accountability, usability, reliability and auditability.	Illustrates characteristics of the key security issues and their relevance for the cloud service effective functionality with an organization. Analyze existing types of passive and active attacks for data in transit and in cloud.	Capable of identifying and explaining to cloud administrators and consumers the different key security issues in cloud computing that need to be addressed. Monitor, evaluate and provide advice regarding the types of

	8. Types of active and passive attacks both for data in transit and in cloud. 9. Counter-attacks strategies and methods for cloud computing security.	Implement appropriate security strategies and methods for guaranteeing cloud computing secure functioning. Provide the organization with the basic know how to facilitate the management of security in cloud computing services.	attacks to be addressed in cloud services within the organization. Demonstrate autonomy in implementing customized security strategies and methods in line with the organization's needs and objectives. Provide basic know how to organization's staff for enhancing a secure use of cloud services. Supervise the routine work of others in implementing cloud services, taking some responsibility for the evaluation and improvement of work.

	Unit 3 of Learning Outcomes**: Cloud models**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community. Support the definition and implementation of Service Level Agreements (SLAs).
	Key performance indicators: Monitor appropriate understanding and implementation of Saas, Paas and IaaS applied to the different deployment models for cloud computing. Analyse local / national / European / international scope of the SLAs and check its proper understanding.
	Behaviours underpinning effective performance: Accuracy and precision in analysing and proposing cloud models to specific organizational environment. Show an ethical approach to the definition and implementation of the SLAs requirements.

TOTAL ECVET POINTS: 1,25			
Key activities:	**Knowledge**	**Skills**	**Competences**
Illustrate and implement the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).	Has factual and theoretical knowledge on characteristics of: 7. Software as a Service (SaaS) 8. Platform as a Service (PaaS) 9. Infrastructure as a Service (IaaS)	Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model. Perform the practical application of the SaaS delivery model.	Take the responsibility, within internal regulatory framework, to advice the organization on which of cloud computing model fits better for their needs and objectives. Supervise the work of the others and take some responsibility for

		Analyze and select the most appropriate cloud computing model for the organization.	the evaluation and for enhancing the implementation of the delivery models.
Develop and apply the four deployment models for cloud computing: Public/private/hybrid/community.	Has factual and theoretical knowledge on characteristics of: 9. Private cloud 10. Public cloud 11. Hybrid cloud 12. Community cloud	Has the ability to implement each of the four deployment models for cloud computing. Provide support to cloud users for concrete utilization and monitoring of the cloud services delivered through each of the four delivery models.	Take the responsibility to propose the selection of the most suitable model for the organization in line with its needs and objectives. Provide basic know how for cloud consumers in order to support them in the concrete application of the selected model.
Support the definition and implementation of Service Level Agreements (SLAs).	Has factual and theoretical knowledge on the provisions of Service Level Agreements regarding: principles for development, performance service, security service, data management services, personal data protection service. Is aware of the relevance and impact of the SLA provisions for the cloud users.	Analyze and implement the requirements of SLA for organizations. Monitor and provide support for auditing the accurate application of SLA.	Take the responsibility, within internal regulatory framework, to advice cloud users on the contents of the SLA, based on organization's needs and objectives in implementing cloud computing.

	Unit 4 of Learning Outcomes**: Cloud services and applications for education and training (ET)**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and manage cloud services for enhancing the ET offer. Develop and implement cloud-based collaborative methods and instruments for supporting the application of technology enhance learning in education and training. Design and implement cloud-based training resources and methodologies. Analyze and promote good practices in the field of cloud applications for ET programmes.
	Key performance indicators: Present a range of learning strategies within cloud computing. Illustrate techniques of integrating cloud computing methods with other learning methods. Support the implementation of cost-benefit analysis for various learning models based on cloud computing. Identify and manage ET cloud service providers.
	Behaviours underpinning effective performance: Consider the ET institutions' role and educational objectives when selecting, planning and implementing specific cloud services. Show an equilibrate approach in supporting the cost-benefit analysis related to the implementation of cloud computing in the ET institution.

TOTAL ECVET POINTS: 1,50

Key activities:	Knowledge	Skills	Competences
Illustrate and manage cloud services for enhancing the ET offer.	Has factual and theoretical knowledge on: 1. Cloud services and solutions for education institutions. 2. Storage services 3. Virtual machines	Illustrate the main characteristics of cloud-based services and solutions for ET institutions. Analyze and support the implementation of cloud storage services for ET institutions. Assist the creation of virtual machines and monitor their	Take the responsibility to propose customized cloud services and solutions to ETinstitutions, according to their needs and type of programmes they offer. Supervise the work of the others and take some responsibility for the evaluation and for enhancing

		activity in education programmes.	the use of virtual machines in education and training.
Develop and implement cloud-based collaborative methods and instruments for supporting the application of technology enhance learning in education and training.	Has factual and theoretical knowledge on: 4. Technology enhance learning (TEL) principles and instruments 5. Methods of implementing TEL in education systems 6. Collaborative resources and tools 7. Methods and instruments for document sharing 8. Collaborative editing methods and instruments	Analyze and implement the TEL principles and approaches in ET systems. Select and apply models and instruments for collaborative working in education and training.	Take the responsibility, within the internal regulatory framework, to advice ET institution on most appropriate methods and instruments to be applied for enhancing collaborative work environment. Demonstrate autonomy in monitoring and evaluating the implementation of collaborative models for supporting the integration of TEL in education and training.
Design and implement cloud-based training resources and methodologies.	Has factual and theoretical knowledge on: 1. Methods and instruments for design and delivery of cloud-based training. 2. Methodologies for assessing cloud-based training results.	Apply specific methods and instruments for developing cloud-based training contents and materials. Develop blended learning strategies including cloud based learning. Support the design and implementation of delivery modules for cloud-based training. Assist the assessment of cloud-based training results.	Take the responsibility within internal regulatory framework, to provide advice to ET institutions to include cloud-based learning in curriculum design, delivery and assessment.
Analyze and promote good practices in the field of cloud applications for ET programmes.	Has accurate and theoretical knowledge on the impact of cloud computing in education systems. Is aware of specific criteria for selecting the showcases relevant for cloud computing users.	Is able to identify good practices in the field of cloud services for ET, based on specific quality criteria.	Demonstrate autonomy in analysing and selecting the most relevant showcases in the field of cloud services for education and training institutions.

	Unit 5 of Learning Outcomes**: Legal and technical aspects of cloud computing for education and training**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Illustrate and implement legal and technical requirements related to financial flows and procurement procedures in ET institutions, to be integrated in cloud services. Describe and put into practice methods and tools for personal data management in line with national and international requirements for ET institutions. Apply national and international provisions for the recognition and protection of intellectual property rights regarding products/services.
	Key performance indicators: Analyse the national/international scope and requisites of the SLAs. regarding ET. Identify the main intellectual property rights issues in the SLAs.
	Behaviours underpinning effective performance: Demonstrate ethical and legally correct approach in planning and implementing cloud computing in the ET environment. Recognize data confidentiality when implementing cloud based models.

TOTAL ECVET POINTS: 0,50			
Key activities:	**Knowledge**	**Skills**	**Competences**
Illustrate and implement legal and technical requirements related to financial flows and procurement procedures in ET institutions, to be integrated in cloud services.	Has factual and theoretical knowledge on: 3. The legal requirements regarding the economic and financial flows in ET institutions. 4. Public procurement regulations for ET institutions.	Support the selection and implementation of cloud services based on the specific characteristics of economic and financial flows registered in ET institutions. Illustrate methods of integrating cloud services with specific procurement regulations in ET institutions.	Supervise the work of the others in implementing cloud services in line with legal requirements regarding economic and financial flows and procurement procedures.
Describe and put into practice	Has factual and theoretical knowledge on national and	Illustrate and support the implementation of national	Demonstrate autonomy in implementing cloud based

methods and tools for personal data management in line with national and international requirements for ET institutions.	international rules in the field of personal data protection and management, to be applied by ET institutions in particular.	and international regulations regarding personal data management in ET institutions.	methods in line with national and international provisions in the field of persona data management and protection, in ET institutions.
Apply national and international provisions for the recognition and protection of intellectual property rights regarding innovative products/services.	Has factual and theoretical knowledge on national and international provisions regarding the recognition of intellectual property rights.	Support the ET institution in implementing innovative products and services respecting the intellectual property rights regulations.	Take the responsibility, within internal regulatory framework, to advice appropriate actions for the recognition of intellectual property rights.

5. Certified Cloud Technology Professional

Title	Certified Cloud Technology Professional
Label	
EQF LEVEL (Recommended)	EQF LEVEL 5

CORE UNITS OF LEARNING OUTCOMES	ECVET POINTS
Unit 1 Cloud security	1,25
Unit 2 Cloud models and providers	1
Unit 3 Cloud architecture	1
Unit 4 Cloud virtualization	1,25
Unit 5 Cloud service and application development and implementation	1,50
TOTAL ECVET POINTS	**6**

Update requirements for the overall qualification: **every 2 years**
(CPD – Continuous Professional Development)

Qualification update: **every 2 years**

	Unit 1 of Learning Outcomes: **Cloud security**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Propose customized solutions for authentication, authorization and accounting (AAA), as well as monitoring and auditing activities, in particular for enhancing network security in cloud computing. Design approaches and propose specific technologies to protect data, applications, associated infrastructure of cloud computing and to enhance the security of virtual machine platforms. Provide advice to cloud users on appropriate trusted cloud resources to implement within their organizational context. Is able to perform risk analysis and to develop and implement proactive mitigation methods and tools regarding the whole security lifecycle in cloud computing.
	Key performance indicators: Propose innovative solutions for AAA and for auditing activities aimed at enhancing network security in cloud computing. Define customized approaches for guaranteeing high levels of security in cloud services implemented within the organization. Manage the securitization of cloud computing services with comprehensive approach.
	Behaviours underpinning effective performance: Demonstrate a fair and ethical behaviour in tackling both organizations' goals and security challenges in cloud computing. Consider the organization's values and principles in the field of confidentiality and data security.

TOTAL ECVET POINTS: 1,25			
Key activities:	**Knowledge**	**Skills**	**Competencies**
Propose customized customized solutions for authentication, authorization and accounting (AAA), as well as monitoring and auditing	Has comprehensive, specialised, factual and theoretical knowledge on: 16. Authentication procedures and methods 17. Authorization methods 18. Accounting and logging systems	Design and apply AAA approaches and methodologies for enhancing cloud computing efficiency in reaching organizational requirements and business objectives. Propose and advice on the implementation of monitoring	Manage and supervise the practical application of AAA methods. Monitor the design and implementation of customized monitoring actions related to cloud services and provide advice

activities, in particular for enhancing network security in cloud computing.	19. Monitoring approaches and instruments 20. Auditing systems for cloud activity 21. Network security characteristics and challenges	and auditing activities for cloud services implemented within an organization. Plan methods and tools for enhancing and monitoring network security in cloud computing.	for improvement of related competencies. Performs audit actions for cloud services and provide advice for further developments. Manage the design and implementation of customized methods for guaranteeing the security of virtual networks. Review of self and staff performance in the field and provide support for further improvements.
Design approaches and propose specific technologies to protect data, applications, associated infrastructure of cloud computing and to enhance the security of virtual machine platforms	Has comprehensive, specialised, factual and theoretical knowledge on: 1. Cloud Service Security policies, technologies, and controls deployed to protect data, applications, and the associated infrastructure of cloud computing 2. Virtual machine platform characteristics and protection methods 3. Methodologies and tools for enhancing the protections of permanent data access loss	Develop and advice on the implementation of appropriate cloud security solutions for all cloud models. Illustrate existing methods and propose new approached for enhancing the protection of virtual machine platforms. Develop and implement customized methods and tools for guaranteeing the security of permanent data access in cloud computing.	Has the ability to manage and to propose innovative solutions to unpredictable security challenges in cloud computing. Analyse and develop self performance and of others in implementing appropriate solutions for the protection of virtual machine platforms. Manage the implementation of security measures for the protection of permanent data access according to the organization's context and objectives.
Provide advice to cloud users on appropriate trusted cloud resources to implement within their organizational context.	Has comprehensive, specialised, factual and theoretical knowledge on different trusted cloud resources, such as: trusted platform modules (TPMs), validating digitally signed code, geotagging, remote monitoring of the platform security status.	Has the ability to plan and implement a strategic approach for the selection and implementation of trusted cloud resources, according to the organization's contexts.	Manage and supervise the technical implementation of selected trusted cloud resources and recommends solutions for new challenges occurred.
Is able to perform risk analysis and to	Has comprehensive, specialised, factual and theoretical knowledge on:	Is able to perform specific functions within the whole security lifecycle.	Control of the implementation of the three

develop and implement proactive mitigation methods and tools regarding the whole security lifecycle in cloud computing.	1. The characteristics of the security lifecycle: create, store, use, share, archive, destroy 2. The functions (access, process and store) that can be assumed towards a specific datum, in the different security stages. 3. Security risks regarding the implementation of cloud-based services. 4. Approaches and instruments for conducting risk analysis related to cloud computing.	Conduct risk analysis using existing and innovative methods and tools for identifying security challenges in cloud services and provides recommendations for further improvements.	functions during the security lifecycle. Analyse and improve self and others' performance in conducting risk analysis for enhancing the cloud computing security.

	Unit 2 of Learning Outcomes: **Cloud models and providers**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Provide innovative solutions for the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Supervise the design and implementation of the four deployment models for cloud computing: public/private/hybrid/community. Define and supervise the application of Service Level Agreements (SLAs). Illustrate the main providers for cloud-based business services and solutions at international and national level and provide details regarding the main characteristics of their services. Evaluate and illustrate specific reference regarding the main commonalities and differences among the different cloud providers.
	Key performance indicators: Make customized proposals and supervise the implementation of SaaS, PaaS and IaaS applied to the different deployment models for cloud computing. Define national / international provisions of the SLAs and monitor its application. Conduct deep analysis of both national and international cloud computing providers and the services they offer.
	Behaviours underpinning effective performance: Accuracy and precision in making innovative proposals of cloud models to specific organizational environment. Demonstrate an equilibrate approach in selecting different cloud providers and services. Show an ethical approach to the definition and implementation of the SLAs requirements.

TOTAL ECVET POINTS: 1

Key activities:	Knowledge	Skills	Competences
Provide innovative solutions for the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).	Has comprehensive, specialised, factual and theoretical knowledge of: 10. Software as a Service (SaaS)	Provide creative solutions for the application of the SaaS delivery model within organizations.	Manage the development and application of cloud models in line with organizational contexts.

	11. Platform as a Service (PaaS) 12. Infrastructure as a Service (IaaS)	Provide creative solutions for the application of the PaaS delivery model within organizations. Provide creative solutions for the application of the IaaS delivery model within organizations. Advice cloud users on the proper appropriate cloud computing models to be implemented according to the organizations' needs and development objectives.	Supervise and evaluate the work of the others and provide support for enhancing performance for an efficient implementation of the delivery models.
Supervise the design and implementation of the four deployment models for cloud computing: public/private/hybrid/community.	Has comprehensive, specialised, factual and theoretical knowledge of: 13. Private cloud 14. Public cloud 15. Hybrid cloud 16. Community cloud	Propose create approaches and apply the four deployment models for cloud computing. Design supportive instruments for enhancing the utilization and monitoring of the cloud services delivered through each of the four delivery models.	Supervise the development and implementation of the most suitable model for the organization in line with its needs and general trends in the field. Evaluate and support self and others' performance development order to support the efficient application of the selected model.
Define and supervise the application of Service Level Agreements (SLAs).	Has comprehensive, specialised, factual and theoretical knowledge of the provisions of Service Level Agreements regarding: principles for development, performance service, security service, data management services, personal data protection service.	Analyze and provide innovative proposals for defining the requirements of SLAs. Assist auditing actions regarding the accurate application of SLAs.	Provide advice to cloud users on the contents of the SLA, based on the organization's needs and objectives in implementing cloud computing. Manage and supervise the implementation of SLAs at organizational level.

	Is aware of the relevance and impact of the SLA provisions for the cloud users.		
Illustrate the main providers for cloud-based business services and solutions at international and national levels and provide details regarding the main characteristics of their services.	Has comprehensive, specialised, factual and theoretical knowledge of the different services offered by the main cloud providers at international and national levels.	Evaluate and describe the innovations offered by the most relevant cloud providers at international and national levels, for each cloud component: infrastructure, platform& development, software, storage and security.	Manage the evaluation process and provide recommendations to cloud users on the most appropriate cloud providers, based on their needs and general trends in the field.
Evaluate and provide specific reference regarding the main commonalities and differences among the different cloud providers.	Has comprehensive, specialised, factual and theoretical knowledge of methods and instruments for analysing the strengths and weaknesses of the different cloud providers.	Implement innovative approaches for analysing and illustrating the strengths and weaknesses of the different cloud providers, specific for each cloud component.	Supervise the evaluation process for illustrating the strong and weak characteristics of the different cloud providers, related to each cloud component. Make proposals to cloud computing users, based on the analysis conducted and future trends in the field.

	Unit 3 of Learning Outcomes**: Cloud architecture**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Analyze and provide creative approaches in designing cloud computing components for front end and back end platforms customized based on the consumer's requirements and future trends. Manage the efficient implementation of cloud based delivery services and provide recommendations for further improvements.
	Key performance indicators: Make customized proposals and supervise the design and implementation of cloud computing components and services.
	Behaviours underpinning effective performance: Accuracy and precision in designing and implementing cloud computing components and services.

TOTAL ECVET POINTS: 1			
Key activities:	**Knowledge**	**Skills**	**Competences**
Analyze and provide creative approaches in designing cloud computing components for front end and back end platforms customized based on the consumer's requirements and future trends.	Has comprehensive, specialised, factual and theoretical knowledge of: 1. Characteristics and components of front end platform: fat client, thin client, mobile device. 2. Characteristics and components of back end platforms: servers, storage, computers.	Make proposals and implement front end and back end platforms customized for the organization's requirements.	Supervise the definition and application of front end and back end platforms in dynamic organizational contexts. Support the development of competencies for enhancing performance in the field of cloud architecture design and implementation.
Manage the efficient implementation of cloud based delivery services and provide recommendations for further improvements.	Has comprehensive, specialised, factual and theoretical knowledge of: 1. Models of cloud service delivery 2. Methods and tools for managing systems, and for	Illustrate and provide creative solutions for implementing any of the three types of delivery models for cloud computing: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).	Manage the development and application of cloud models in line with organizational contexts. Supervise and evaluate the work of the others and provide support for enhancing performance for an efficient

	monitoring traffic and customer's demands.	Propose and apply specific methods and tools for enhancing the administration of cloud based systems. Monitor and analyze client's requirements and cloud traffic for supporting further improvements.	implementation of the delivery models. Supervise the administration of cloud systems and the monitoring activities and provide proposals for performance development.

	Unit 4 of Learning Outcomes**: Cloud virtualization**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Is able to set up, configure and use virtualized computing environments. Illustrate and make proposals regarding virtualization technologies through software and hardware solutions. Design approaches and propose specific technologies to enhance the security and reliability of virtual machine platforms.
	Key performance indicators: Propose specific approaches for developing secure and reliable virtualized computing environments.
	Behaviours underpinning effective performance: Have an equilibrate approach in selecting virtualization technologies. Demonstrate ethical and legally correct approach in proposing specific technologies for ensuring the security and reliability of virtual machines.

TOTAL ECVET POINTS: 1,25			
Key activities:	**Knowledge**	**Skills**	**Competences**
Is able to set up, configure and use virtualized computing environments.	Has comprehensive, specialised, factual and theoretical knowledge of: 1. Different types of hardware virtualization (full, OS-level, partial, para and hardware assessed virtualization) 2. Approaches and methods for configuring and using virtualized computing. 3. Main areas where virtualization is making headroads: network virtualization, storage virtualization and server virtualization.	Illustrate and propose innovative solutions for developing and using virtualized computing environments.	Manage and provide improvement solutions regarding the set up, configuration and utilization of virtualized computing environments.

Illustrate and make proposals regarding virtualization technologies through software and hardware solutions.	Has comprehensive, specialised, factual and theoretical knowledge of existing virtualization technologies at different levels: architecture, hardware, operational system, programming language, library.	Promote creative approaches and implement virtualization technologies, based on the customer's contexts and cloud services requirements.	Manage the selection and implementation of virtualization technologies and provide recommendations for further changes. Analyze and develop self and others' competencies and work performance for enhancing the efficient use of virtualization technologies.
Design approaches and propose specific technologies to enhance the security and reliability of virtual computing environments.	Has comprehensive, specialised, factual and theoretical knowledge of backup, security and reliability of virtual computing environments.	Propose innovative methods and tools for backup and security approaches in order to enhance the reliability of virtual computing environments. Advice on the most suitable tools to be applied according to user's needs and development objectives.	Supervise the definition and application of specific methods and tools for enhancing the reliability of virtual computing environments in dynamic organizational contexts. Monitor and support the development of self and other performance in identifying and implementing the appropriate approaches for enhancing the reliability of virtualization computing environments.

	Unit 5 of Learning Outcomes**: Cloud service and application development and implementation**
	RELATED PERFORMANCE DESCRIPTION/OCCUPATIONAL STANDARD
	Key activities supported by the learning outcomes: Analyze and make customized proposals of paradigms, frameworks, and programming languages for setting up specific cloud applications. Illustrate and apply development techniques for providing cloud based infrastructure and platforms, and support the development of software as part of cloud services. Propose technologies to be implemented for reliable data storage in the cloud and illustrate relevant case studies. Select and implement approaches and tools regarding data security and privacy in cloud computing.
	Key performance indicators: Provide customized proposals for developing and implementing cloud applications, infrastructure, platforms and software, as part of cloud services. Identify and apply up to date technologies for enhancing the reliability of data storage and the security and privacy of data.
	Behaviours underpinning effective performance: Demonstrate ethical approach in managing security and privacy of data in cloud computing. Consider organization's values and objectives when providing cloud services.

TOTAL ECVET POINTS: 1,5			
Key activities:	**Knowledge**	**Skills**	**Competences**
Analyze and make customized proposals of paradigms, frameworks, and programming languages for setting up specific cloud applications.	Has comprehensive, specialised, factual and theoretical knowledge of: • paradigms and frameworks for developing cloud applications • programming languages for cloud applications	Illustrate specific approaches and frameworks for designing, developing and implementing cloud applications. Make creative proposals for implementing the most appropriate framework for reaching cloud user's requirements.	Manage the selection and application of the most appropriate framework for developing cloud applications in line with cloud user's expectations, Make proposals for further improvements of cloud applications and for solving unpredictable challenges.

		Is able to implement existing programming languages for defining cloud applications and has the capacity to propose creative solutions for enhancing the quality of these applications.	
Illustrate and apply development techniques for providing cloud based infrastructure and platforms, and support the development of software as part of cloud services.	Has comprehensive, specialised, factual and theoretical knowledge of specific techniques for developing the different three cloud models: IaaS, PaaS and SaaS.	Has a comprehensive range of abilities to propose and implement techniques for developing IaaS and PaaS according to the cloud user's requirements. Capable to support the development of software for cloud computing services.	Supervise the development and implementation of IaaS and PaaS and provide support for further improvements and for addressing new technical challenges that may occur. Manage the design and development of software for cloud computing and provide technical support.
Propose technologies to be implemented for reliable data storage in the cloud and illustrate relevant case studies.	Has comprehensive, specialised, factual and theoretical knowledge of: 1. Technical experiences and instruments for data storage in cloud. 2. Existing case studies of data storage in cloud.	Analyze and implement existing data storage technologies and propose creative technologies for enhancing data storage as part of cloud services. Describe in depth relevant case studies in the field and demonstrate their impact on technological trends at international level and for organizations.	Manage the definition and implementation of data storage technologies appropriate for the customer's needs and development objectives. Assess and improve self and others' performance in applying data storage technologies and selecting case studies.
Select and implement approaches and tools regarding data security and privacy in cloud computing.	Has comprehensive, specialised, factual and theoretical knowledge of up-to-date methods and tools for enhancing data security and privacy in cloud computing.	Illustrate and make proposals for customized instruments for enhancing data and privacy protection in cloud computing within organizations.	Supervise and provide creative solutions for the definition and implementation of specific methods and tools for data protection and privacy in cloud computing.