

NEBULA

**“Mismatch of needs and current situation
on cloud computing skills in territorial
public administrations”**

PROMEIA

September 2014

Project acronym: NEBULA
Project name: A novel vocational training programme on cloud computing skills
Project code: 540226-LLP-1-2013-1-GR-LEONARDO-LMP

Document Information

Document ID name: Nebula_WP3_D3.4.1_Mismatch of needs and current situation on cloud computing skills in territorial public administrations_2014_30_09
Document title: Mismatch of needs and current situation on cloud computing skills in territorial public administrations
Type: Report
Date of Delivery: 30/09/2014
Work package: WP3
Work package leader: PROMEA
Dissemination level: Public

Document History

Versions	Date	Changes	Type of change	Delivered by
Version 1.0	30/09/2014	Initial Document	-	PROMEA

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1 Introduction

Cloud computing representing a new model for IT engineering and management solutions, is expected to bring significant changes to European territorial public administrations, which will need to fundamentally modernise their IT infrastructures and change the way they consider IT. Furthermore, it seems to create a new demand for skills and competences on the integration, use and management of cloud computing infrastructure and relevant operations, which can be described with the term “cloud computing skills”.

The strategic objective of the NEBULA project is to form a Sector Skills Alliance that will tackle the mismatch of cloud computing skills in the sector of territorial public administrations aiming to improve employability of staff by enhancing their skills and bringing them up to speed. This ambitious goal foresees the development and delivery of a VET curriculum that will equip current or/and future public servants with the skills necessary to drive all the stages of the migration process and use of cloud services.

Work Package 3 of the Nebula project comprises a series of activities that work towards identifying the skill mismatch for cloud computing in territorial public administrations. These results will set the requirements in terms of learning objectives that the developed VET program will need to achieve.

This report is the outcome of the task 3.4, namely “Report highlighting the identified mismatches between skill supply and demand in territorial public administrations”. Building upon the findings of the previous tasks related to skills demand and skills supply documentation (T3.1 and T3.3), this deliverable aims to define the existing skills mismatches between public administrations’ workforce skills / competences and required skills for the migration of IT infrastructures and operations to cloud computing services.

Cloud Computing

Cloud Computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

By enumerating and describing the skill mismatch between public administration needs and average available skill sets of public servants, the objectives of the VET program can be set as to maximise relevance of competence acquisition for learners. Furthermore, information will be provided about the perceptions of territorial public administrations with regards to the importance of these skills, which will lead to a classification in terms of priority and guide the curriculum design and development. Last, the results drawn from the report will be communicated to CEDEFOP¹ for further investigation and validation.

This report is structured as follows. Section 2 presents the business case for cloud computing in the public sector; section 3 describes the methodological framework and presents the results on identified skill mismatches; and section 4 summarises the key findings.



¹ CEDEFOP is the European Centre for the Development of Vocational Training; an EU agency that supports the development of European vocational and training (VET) policies and contributes to their implementation (www.cedefop.europa.eu).

2 Cloud computing for public sector

2.1 Value proposition of cloud computing in public sector

Cloud computing enables alternative modes of ICT provision based on the virtualisation of IT resources and infrastructures and provision of services through the Internet. The public sector has embraced cloud computing as a means to increase its operation efficiency and productivity and at the same time diminishing costs, despite the concerns on privacy, security and sovereignty of data. This is why, this utility model has a strong potential for cost-effective, scalable and rapidly deployable digital public services that can significantly improve virtual accessibility for citizens and businesses. This section outlines the business case for introducing cloud computing in the public sector and offers an overview of the associated benefits.

Territorial public administrations operate in a heavily scrutinized environment where they should stretch limited budgets to meet their increasing demands and comply with emerging mandates. In that context, public administrations have the incentive to devise new ways for delivering services more efficiently, increasing productivity and improving competitiveness; at the same time decreasing funding made available from central government constitutes a major barrier. As a result, more and more public administrations and organisations are considering the option of migrating to the cloud with the aim to leverage the benefits associated with the technology of cloud computing in terms of a) cost savings; b) business agility; c) quality public services delivery; and d) access to most updated technology.

Cost Savings

The fundamental driver for migrating to cloud computing is the expectation of significant reduction in ICT spending. By migrating to the cloud, public administrations can create a central pool of shared resources, software and infrastructures that will decrease the cost of running a server and will result in lower power consumption and better administration. Additionally, the reduction in ICT spending will also come from the aggregation of demand that would result in efficient use of existing IT infrastructures and optimise whichever procurement of new resources.

Business Agility

For public administrations, business agility translates into organisational agility. Territorial public administrations usually operate in a strict hierarchical way with fixed processes where decision making, approvals and purchase orders usually constitute time-consuming activities; a fact that impedes rigid and risk-averting public organisations to adapt rapidly and lower competitiveness. Cloud computing offers public administrations the capability to gain in agility and become more responsive, more cost effective and more competitive by eliminating time consuming procedures and providing resources on the fly.

Quality Public Services Delivery

Public administrations should roll out more efficient services to accommodate the emerging needs of citizens, provide high quality services and increase competitiveness compared to private sector. Given that cloud computing is delivered via the Internet, public administrations can benefit from the universal access to resources and as a result identify and rapidly deliver new e-services to citizens, improve citizen engagement and experience with institutions and quickly adapt to new policies.

Access to Most Updated Technology

Cloud computing offers the most sophisticated and up-to-date software and hardware in the market. The onus of upgrading IT infrastructures is not on the public administrations any more but on the cloud service provider who ensures the availability of the most updated technological solutions; fact that also results in reducing the costs for the purchase of physical infrastructures and software.

2.2 Deployment of cloud computing in public sector

The European Commission released a report², namely “Analysis of Cloud Best Practices and pilots for the Public Sector”, which among others analysed the current national initiatives for the deployment of cloud computing in public sector. The intuition drawn from the analysis is that Member States have adopted different approaches for migrating to cloud in terms of application covered, types of infrastructure and relations with e-government. Three main emerging models for deployment of cloud, which are differentiated mainly in the nature of infrastructures and the level of centralisation, can be defined from

² Bonneau, V. et al., (2013), “Analysis of cloud best practices and pilots for the public sector), European Commission Report, DG Communications Networks.

the clustering of practices: a) procurement and marketplace; b) resource pooling; and c) standalone applications.

Model A: Procurement and Marketplace

The first major emerging model concentrates on procurement of cloud solutions from a market place where local suppliers are encouraged to get involved in the provision of cloud services to the public sector. Such a model is operational in the UK and under development in Portugal. The main idea is to focus on cost saving and the improvement of the local economy by turning to the market and exploiting the external providers' applications and infrastructure. On the other side, this model has some limitations. The establishment of procurement is a long process that needs to be repeated at regular intervals to comply with public procurement framework while at the same time it does not encourage public administrations to cooperate or attempt to break existing silos.

Model B: Resource Pooling

The second model involves resource pooling across administrations through a common central infrastructure and/or platform for deploying cloud computing. The underlying strategic concept is to develop a common centralised infrastructure, which allows easier cooperation with other public administrations and increasing cost reduction due to various economies of scale as well as the elimination of procurement and maintenance costs for hardware and software. This is why administrations through the common platform have the capability to share applications and features avoiding duplication and optimising the use of resources. The main drawback of such a model is the overall slow process to set up the centralised infrastructure as well as a series of associated concerns on technicalities related to the integration, the upfront costs and the limitations on local flexibility. This model is already in operation in Spain, France, Belgium and the Netherlands.

Model C: Standalone applications

The third emerging model contains standalone applications developed by public administrations (no central application). Such an endeavour is concentrated on the migration of existing applications to the cloud while the cloud adoption is cost-reduction driven. In comparison with the other models, standalone applications are very pragmatic and allow for faster development; however some key problems have been identified in terms of data security and legal issues. Also, the main drawback of this

approach is that it does not encourage cooperation among public bodies and lacks widespread visibility. Such a model is in operation in Italy and Denmark and to some extent in Germany and Austria.

Different approaches adopted by Member States for cloud computing deployment may differentiate the skill set required by public servants to manage and implement the migration to cloud computing. In our case, the identification of skill requirements for territorial public administrations' staff engaged with migration process has been developed upon the assumption of an individual territorial public administration with a discrete ICT department, which undertakes the responsibility to run the migration process on its own. Even though this approach of cloud adoption seems to correspond better to the models of procurement and marketplace and standalone applications, the identified skill demand (T3.1) for cloud migration as well as the identified skill mismatches (T3.4) are also applicable to any deployment model given that process of migrating to cloud computing consist of a series of steps that must be followed in any case. As a result, the VET curriculum that will be developed in the project will serve to accommodate the skill requirements for cloud computing in territorial public administrations no matter what deployment model will be set forward.

3 Cloud computing skill mismatch

3.1 Overview of research methodology

The identification of the possible skill mismatches between public servants current skills/ competences and the required skill set for cloud computing will be realised on the content analysis of previous tasks of the Nebula project related to skill demand and supply documentation.

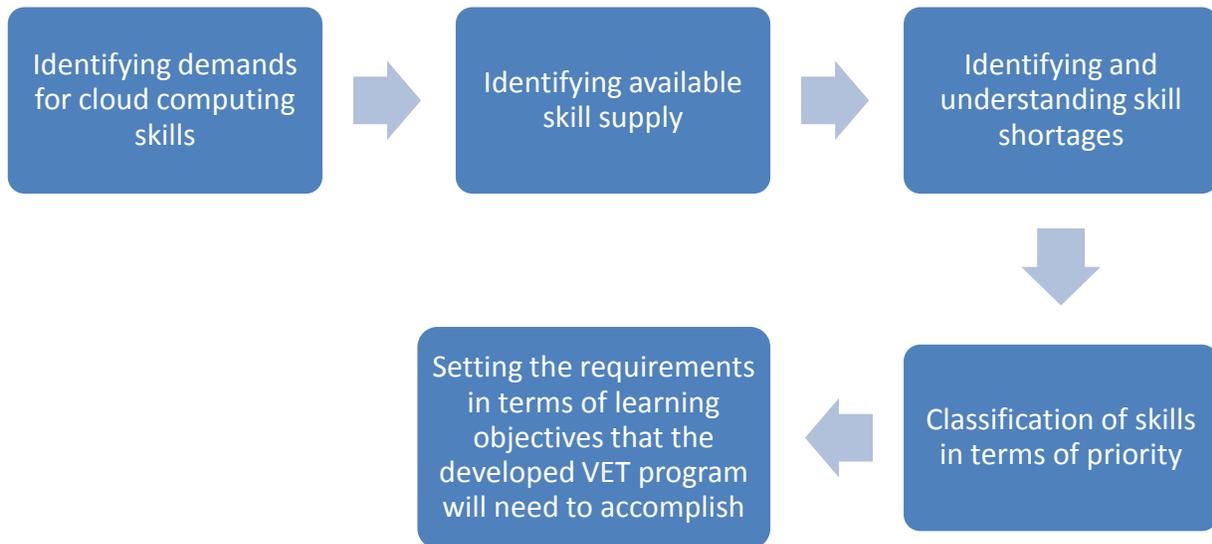
A comparative analysis between the validated set of skills identified in T3.1 (target skill demand for cloud computing) and the expected typical skill supply of employees as drawn from the analysis of existing academic and commercial courses in T3.3 will be conducted as the main method to determine cloud computing skill mismatch in the public sector. A very simplified depiction of this conceptual framework is illustrated in figure 1.

Supplementary to the above, desk research has been also conducted for reviewing the existing literature on cloud computing skill mismatch and assessing whether the evidence drawn from the comparative analysis are consistent with experts' views. Sources of information were the content of existing national, European-level and international analyses, case studies and surveys conducted for business organisations, governments, as well as articles and expert opinions.

“Skill Mismatch”

Mismatch on cloud computing skills is defined as the inadequate level or types of skill of current and potential public administration staff to deal with the end-to-end migration of IT infrastructure to cloud computing within a rigid, risk-averting public organisation with fixed processes.

Figure 1: Framework of the analysis



Skill Conceptual Framework

The deliverable pays particular attention to the skills that current and prospective employees of territorial public administrations need to be equipped with in order to be employable and capable of dealing with the end-to-end migration process. The skill set for cloud computing (as drawn from T3.1) comprise four categories of skills (technical, managerial, security and transversal), which are central to accomplish the cloud migration and are the result of the education and training received. From that point of view, existing academic and commercial courses, which relate to the training received, can act as an indirect measure for indicating a broad range of skills. However, examining certain academic or commercial courses can only “signal” skills, which does not translate into “possessing” these skills considering that skills are acquired in several ways. Notwithstanding, given the availability of collecting data and limited resources, evidence on existing academic and commercial curricula can be a useful proxy for receiving an insight into the available skill supply for cloud computing that will lead to the identification cloud computing skill mismatches.

3.2 Analysis

3.2.1 Critical skills for migrating to cloud computing (skill demand)

The Nebula skill demand report (D3.1.1) outlined the set of skills that public administration staff needs in terms of managing and carrying out the migration of IT infrastructures and operations to cloud computing. The identification of the skill demand was primarily realised on the content of the migration process whereas the analysis of the specific steps and actions that territorial public administrations should take during the transition period led to the target skill requirements for cloud computing. Key stages in the migration process include:

1. Assessing whether to migrate to the cloud or not based on public administration's needs and priorities;
2. Selecting cloud service infrastructure and cloud deployment model;
3. Ensuring interoperability with in-house infrastructure, consolidation and security of public administrations IT resources;
4. Selecting the most reliable cloud service provider;
5. Setting up and exploiting a cloud pilot; and
6. Carrying out the migration and addressing post-migration issues.

Moving from traditional IT infrastructures to a cloud based solution implies a shift from mainly technical skills to more business related skills including an increasing demand for new skills with a greater focus on 'soft' or intangible capacities. In that new context, managerial skills are placed at the very core of the public administration's staff skill set involved in the migration process since the transition from asset acquisition to utility services brings also a shift of skill demand towards managerial competences and capacities instead of purely technical expertise.

Technical skills are still necessary given that migration to cloud computing includes significant technical related aspects that public administration staff should be able to deal with (for example in identifying technical needs, ensuring interoperability with in-house premises and evaluating the capacity of cloud service providers); however these technical skills need to be supplemented and combined with security skills. The sensitive nature of information transferred as well as the amount of applications and data

stored in the cloud have placed skills related to security in the top category of skills required for cloud computing.

Moreover, financial literacy of public administrations' staff is also essential to ensure the financial sustainability of the project and assess how to balance the need of the service with rental costs while know of the law and institutional policies are required to comply with the regulations and the data-handling laws respectively.

Last but not least, throughout the journey to cloud migration a series of transversal skills (negotiation, communication and analytical skills) are also required to successfully address specific issues of the migration process for example implementing effective service level agreements, interacting with cloud providers and stakeholders and analysing organisational needs.

Table 1 highlights the skills requirements identified by the Nebula skill demand report; the relevance of whom has been validated by public administrations' stakeholders and field experts within the T3.2 of the Nebula project.

Table 1: Skill demand for cloud computing in territorial public administrations

Type of skills	Thematic area of skills	Skills required (Be able to)
Technical	<i>System and Data Integration</i>	Assess the suitability of the existing legacy application and data to migrate to the cloud; specify the end-to-end tools for system and data integration; ensure integrity and interoperability of existing and new modules; plan and deliver system & data integration; measure system performance
	<i>Virtualisation</i>	Determine which applications should be web-service enabled and virtualised; use virtualisation platforms; deal with the intricacies and critical changes caused in management infrastructure and applications
	<i>Service Delivery</i>	Develop strategies and contracts for service delivery; monitor and report on service delivery metrics and overall performance; analyse service delivery provision
	<i>User Support</i>	Respond to users request and issues; identify areas of errors and technical failures; interact with cloud vendors for resolving incidents
Managerial	<i>Project/Process Management</i>	Plan and direct the migration project by defining relevant activities, responsibilities, resources and budget; set appropriate targets during the project management lifecycle; monitor project progress and meet timeline and milestones
	<i>Business Change Management</i>	Examine and evaluate the anticipated changes in every-day operations; manage and schedule the deployment of change; maintain business and process continuity throughout change by monitoring the impact and taking any required supplementary action
	<i>Risk Management</i>	Identify and assess all the risks associated with cloud computing; implement the management of risk across information systems; anticipate and mitigate against potential risks and likely service disruptions
	<i>Financial Literacy</i>	Identify sources of financial value for migrating to the cloud; conduct feasibility analysis; evaluate the market competitive landscape and maturity; assess different pricing models and compare pricing pages from providers
	<i>Know of the Law</i>	Determine the legal requirements on information & data security; address a series of legal issues (liability, compliance, data protection, data portability, applicable law and copyright); develop & evaluate Service Level Agreements
Security	<i>Security Strategy Development</i>	Identify weaknesses and possible security threats; develop the organisation's strategy for information security; ensure that relevant standards, best practices and legal requirements for information security are provisioned by the cloud provider; formulate specific demands for security improvements
	<i>Information Security Management</i>	Implement the information security policy; carry out the day-to-day management of system security; monitor and take measures against intrusion, potential fraud and security leaks; assess & review security incidents and potential threats making recommendations for continuous security enhancing
Transversal	<i>Negotiation</i>	Develop and negotiate contracts and SLAs with providers; ensure that providers meet quality standards and comply with agreed service levels; ensure providers compliance to legal, safety and security standards; address non-compliance issues and amend contracts or re-negotiate agreements as necessary
	<i>Communication</i>	Interact with the cloud service providers; communicate needs and demands internally in the organisation; present reasoned arguments against or in favour of the migration to the cloud; explain changes in business processes and disseminate the migration benefits to stakeholders
	<i>Analytical</i>	Apply logical thinking to evaluate the current IT and operational state of their organisation; define specific needs and requirements for cloud services; suggest actions to accommodate such issues

3.2.2 Cloud migration skills supply (skill supply)

The evaluation of the typical skill supply of employees or those seeking jobs at the public sector (T3.3) was based on the examination of the availability and content of existing educational and training curricula³. AELP examined a sample of 83 academic and 48 commercial courses related to relevant cloud computing learning objectives across Europe (a process which included the detailed review of modules, programme guides, brochures, and academic papers) and evaluated the extent to which these courses meet the requirements of cloud migration process in territorial public administrations. The main conclusions drawn from AELP's analysis are presented below.

Existing academic and commercial courses are categorised as falling within one of three distinct pathways: a) business/management; b) software development; and c) networking and hardware (infrastructure), which relate to the underlying academic focus and the core content of the curriculum offered. Evidence shows that each of three different pathways offers intensive training modules on their distinct focus area, without however covering sufficiently the other skills that have been highlighted as necessary through the skill demand analysis. For example, business / management oriented courses include modules that develop students' managerial skills covering several business related thematic areas (e.g. project management and business change management) while the technical aspects of cloud computing are not covered in depth. The same seems to apply to each one of the three different pathways. As a consequence, this fragmentation has resulted in individuals having a subset of the skills (depending on the training path they have selected) required to deal with the migration process and operate in a cloud-based office environment.

“Calculation of balances” (Methodology used to determine available skill supply)

In order to determine the extent to which the distinct thematic areas of skills are covered by existing curricula and identify the acquired skill set/competence set of public servants that are likely to get

³ Analysis of the relevance and quality of education and training is an indirect way to measure a broad range of skills. Examining certain academic or commercial courses can only “signal” skills, which is not synonymous with “possessing” these skills, considering the multiple ways to acquire skills. Notwithstanding, it can be considered a useful proxy to determine existing skill mismatches.

involved in the effort of migration to cloud computing services, we employed a methodology used by the European Commission in similar surveys that is based on the calculation of balances⁴.

Building upon the evidence provided by AELP in its effort to map the curricula of a sample of 23 courses to the skills demand matrix, we calculated balance values for each skill area enabling the determination of available skill supply. Assuming that the thematic areas of skills can be developed through a course in three different levels (a: skill is covered, b: skill is probably covered but insufficient evidence to be certain and c: skill is not covered) and assigning three different values for each level of coverage (+1 in case a skill is covered, 0 in case a skill is probably covered and -1 in case a skill is not covered), balances are calculated as the difference between total positive and negative values, normalised in the total sample.

For example, as skills can be developed in three different levels, one “positive” (skill is covered), one “negative” (skill is not covered) and one “neutral” (skill is probably covered) and if P (positive), E (neutral) and M (negative) denote the percentages of such values in total sample (with $P+E+M=100$), the balance is calculated as the difference between positive and negative values ($B = P - M$). Balances thus range from -100, when all courses do not cover at all a particular area of skill to +100, when such an area is fully-covered by existing curricula.

In that context, a positive value indicates that the particular thematic area is covered by existing curricula and therefore public servants has acquired the relevant skill set, while a negative value demonstrates that the such an area is covered at an introductory level and hence a skill shortage prevails. Moreover, the higher the value received a skill area, the higher the level of area’s coverage from existing courses. The threshold to determine the available skill supply has been set for the purposes of this report to zero. Overall, skill areas received a positive degree constitute the available skill supply of employees or potential working force in territorial public administrations.

Available skill supply

Table 2 presents the extent to which existing academic and commercial courses cover the distinct thematic areas of skills. Evidence shows that existing academic and commercial courses seem to cover

⁴ The joint harmonised EU programme of business and consumer surveys, European Commission, March 2014.

sufficiently the technical related topics of cloud computing. In particular, the skill area of “Service Delivery” received the highest balance value +78, followed by “Virtualisation” and “System and Data Integration” with balance values +57 and +43 respectively. These areas of skills appear to be well-covered by more than 60% of the available courses; fact that demonstrates the sufficient technical background of learners and trainees to cope with the technical aspects of cloud computing. Next, modules focused on system and data security are also included in the majority of available courses across Europe resulting in employees who possess the necessary skills to plan security strategies, manage security risks and hence leverage cloud computing in a secure manner. “Security Strategy Development” has the second highest balance value +70, while “Information Security Management” has also received a positive balance value.

On the other side, the group of transversal skills (“Communication”, “Financial” and “Analytical”) supplemented by “Business Change Management” related skills displayed the lowest degrees of coverage ranging from -52 to -57. Alike, managerial skills constitute a group of areas receiving negative balance values and hence it cannot be considered acquired skill set.

Table 2: Available skill supply

Thematic area of skills	Type of skill	Balance values
<i>Service Delivery</i>	<i>Technical</i>	78
<i>Security Strategy Development</i>	<i>Security</i>	70
<i>Virtualisation</i>	<i>Technical</i>	57
<i>System and Data Integration</i>	<i>Technical</i>	43
<i>Information Security Management</i>	<i>Security</i>	9
Financial Literacy	Managerial	-13
User Support	Technical	-35
Knowledge of the Law	Managerial	-35
Project/Process Management	Managerial	-39
Risk Management	Managerial	-39
Negotiation	Transversal	-52
Analytical	Transversal	-52
Communication	Transversal	-57
Business Change Management	Managerial	-61



3.2.3 Identification of skill mismatches

To identify the skill shortages for cloud computing and define the cloud computing skill mismatch in territorial public administrations, we rely on the evidence drawn from the skill supply analysis. We consider that a negative balance value is the threshold for determining whether a particular area of skill (skill demand) is not well covered by available skill supply and therefore a skill shortage prevails. Moreover, the extent to which skill areas are covered by available skill supply can be identified looking at the range of estimated balance values. The lower the balance value, the higher the need of employees for education and training in the particular thematic area of skill related to migration process.

Table 3 presents the computed balance values per each thematic area of skill for which there is a demand according to T3.1, while a traffic light “Red, Amber, Green” coding has been used to determine the extent to which these skills are covered by the available skill supply (Green = skill is covered, Yellow = skill is covered at an introductory level, Red = skill is not covered). Balance values with positive sign receive a green traffic light indicating that skill area is well covered by available skill supply; balance values between -1 and -49 receive a yellow traffic light indicating a limited skill supply; and balance values below -50 receive a red traffic light which translates into skill shortage.

Table 3: Matrix of skill shortages

Type of skills	Thematic area of skills	Balance values	Skill covered	Status
Technical	System and Data Integration	43		Available skill supply
	Virtualisation	57		Available skill supply
	Service Delivery	78		Available skill supply
	User Support	-35		Limited skill supply
Managerial	Project/Process Management	-39		Limited skill supply
	Business Change Management	-61		Skill shortage

Type of skills	Thematic area of skills	Balance values	Skill covered	Status
	Risk Management	-39		Limited skill supply
	Financial Literacy	-13		Limited skill supply
	Know of the Law	-35		Limited skill supply
Security	Security Strategy Development	70		Available skill supply
	Information Security Management	9		Available skill supply
Transversal	Negotiation	-52		Skill shortage
	Communication	-57		Skill shortage
	Analytical	-52		Skill shortage

Evidence reveals a less than perfect alignment between training offerings and actual cloud relevant skills in demand. Nine out of fourteen areas of skills received a negative balance value indicating a severe skill mismatch for cloud computing. To begin with, transversal skills have the lowest balance values ranging from -52 to -57; fact that demonstrates a shortage of transversal skills in territorial public administrations. Existing courses do not address such areas of skills even if the demand for individuals with soft and intangible capacities is increasing. Next, managerial skills constitute a distinct group of skills in demand where skill supply is limited. Even though the shift from asset acquisition to utility services computing has placed managerial skills at the very core of public administrations' staff skill set, available skill supply of trainees does not seem sufficient to ensure a successful migration to cloud computing. "Project Management", "Risk Management", and "Legal" skills have received negative balance values ranging from -35 to -39 indicating that such areas should be covered in more depth by training programs. More emphasis should be given in the development of skills related to "Business Change Management" as the identified skill shortage stresses the need for employees who acquire the necessary capacities to plan and handle changes in business processes. Financial literacy of employees who are likely to get involved with the migration process is also limited as "financial skills" received a

slightly negative balance value; fact that shows the lack of skilled employees to perform cloud related comparative financial projections and address issues of financial modelling, which are in the “core” of cloud computing related processes. Last, although technical skills required for carrying out and implementing the transition from tradition IT infrastructures to cloud computing are well covered by existing skill supply, the area of “User Support” is lagging behind.

Table 4: Skill mismatch

Thematic area of skills	Type of skill	Balance values
Service Delivery	Technical	78
Security Strategy Development	Security	70
Virtualisation	Technical	57
System and Data Integration	Technical	43
Information Security Management	Security	9
<i>Financial Literacy</i>	<i>Managerial</i>	-13
<i>User Support</i>	<i>Technical</i>	-35
<i>Knowledge of the Law</i>	<i>Managerial</i>	-35
<i>Project/Process Management</i>	<i>Managerial</i>	-39
<i>Risk Management</i>	<i>Managerial</i>	-39
<i>Negotiation</i>	<i>Transversal</i>	-52
<i>Analytical</i>	<i>Transversal</i>	-52
<i>Communication</i>	<i>Transversal</i>	-57
<i>Business Change Management</i>	<i>Managerial</i>	-61



3.2.4 Classification of skills

Figure 2 displays a visualisation of the calculated balance values in descending order offering an insight into the classification of identified skill mismatches in terms of priority that will guide the curriculum design and development. Information about the perception of public administrations with regards to the importance of skills is also provided to set specific priorities towards the closing of skill mismatches.

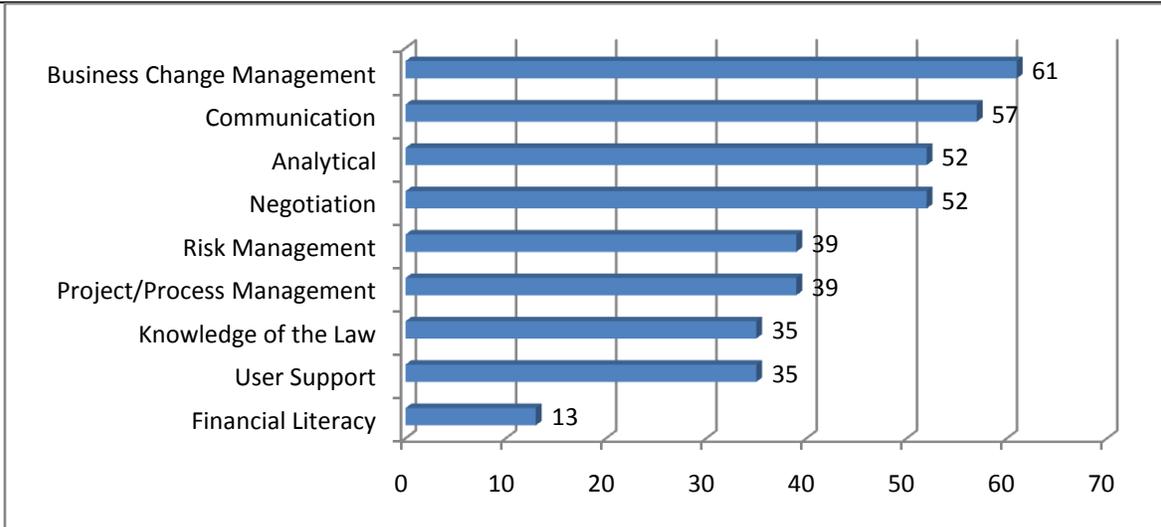
Evidence shows that “Business Change Management” has the highest negative balance value, followed by the group of transversal skills with balance values lower than -50. The existing skill mismatch related to transversal capacities (communication, analytical and negotiation skills) highlights a first group of skills that needs to be addressed by specific learning objectives. As cloud migration process needs to address issues related to the analysis of organisational needs, the negotiation of service delivery agreements and security agreements with cloud providers as well as the communication with stakeholders, vendors and decision makers, we can conclude that the importance and demand for transversal skills at public sector is in relative growth. Such evidence is also highlighted in the skill demand validation report (T3.2) where public administration stakeholders stressed the necessity of transversal skills for public administrations’ staff wishing to migrate IT infrastructure and operations to the cloud.

Next, managerial skills including “Business Change Management”, “Risk Management”, “Project Management”, “Know of the Law” and “Financial Literacy” constitute a second group of skill areas in demand with zero or limited available skill supply. Managerial skills related to cloud computing are considered one of the top priority areas for relative skill development; a trend which is consistent with the perception of public administration stakeholders, who rated the importance of managerial skills (especially “Project Management” and “Business Change Management skills) for cloud migration very highly.

Last, the identified demand for training in the area of user support adds specific technical requirements in terms of learning objectives that the developed VET program will need to achieve. Technical skills are deemed necessary input for employees wishing to migrate IT infrastructure and operations to the cloud

even if their level of importance has declined compared to business related skills (European Commission, 2012)⁵.

Figure 2. Negative balance values per thematic area of skills from largest to smallest



Evidence drawn from the analysis of expected skill mismatches on cloud computing is consistent with articles and existing literature, which suggest that there is a serious shortage of cloud computing skills that seems to hamper cloud adoption in both public and private sector. According to a study conducted by IDC, about 1.7 million cloud computing-related jobs globally could not be filled in 2012 because applicants lacked relevant training and capacities required to deal with cloud deployment and work in a cloud-based working environment. Moreover, findings from a research by Databarracks (infrastructure as a Service (IaaS) provider) suggest that 43% of IT professionals in the UK rate their current competence in cloud implementation and management as highly poor. Greg Pierce, cloud strategy officer within consultancy TriBridge, states that “People who understand cloud operations and how to deploy cloud solutions are really sought after right now”. In that new context, CIOs, technology vendors highlight the shift from purely technical skills towards a demand for business related and managerial skills as the main cause behind limited skill supply for cloud computing. Forbes⁶ argues that cloud computing calls for a

⁵ Fraunhofer, Danish Technological Institute (2012), “Cloud computing. Cyber security and Green IT. The impact on e-skills requirements” Prepared for the European Commission.

⁶ <http://www.forbes.com/sites/joemckendrick/2012/08/27/the-8-most-important-skills-needed-for-cloud-computing-today/>

range of new skills – including both transversal and business related skills - which are in shortage among IT professionals.

Priorities for the Nebula’s VET program

1. Develop a comprehensive training approach that will cover the complete set of skills required to implement the end-to-end migration of IT infrastructures and operations to cloud computing. A balanced curriculum whereas technical skills are supplemented and combined with “soft” skills will maximise relevance acquisition for learners.
2. Improve generic intangible skills. There is a growing need for transversal skills across all tasks associated with cloud computing, which derives from the gaps identified in the existing training offerings.
3. Address the need for more emphasis on managerial skills in conjunction with technical aspects, which are in the “heart” of cloud computing. Severe skill shortage in “Business Change Management” set specific learning objectives that the developed VET program will need to achieve.

4 Key findings

1. Existing academic and commercial courses approach cloud computing from an initial perspective of either business/management, software development or networking/infrastructure resulting in individuals having a subset of the skills required to implement the end-to-end migration to cloud computing. The absence of a holistic training approach dealing with cloud migration has created severe skill gaps, given that existing courses do not cover all areas of skills or they are covered in a limited way.

2. **Mismatches identified in the areas of managerial and transversal skills** related to cloud computing set the requirements in terms of learning objectives that the developed curriculum will need to accomplish. To address the skill requirements for cloud migration, technical areas should be supplemented and combined with managerial and business related modules in a **holistic training approach**.

3. Managerial skills are placed at the very core of the public administration's staff skill set involved in the migration process; however the **available supply of business related skills in territorial public administrations is insufficient** to deal with cloud migration. Managerial skills should be covered in depth by the developed curriculum as the demand of managerial skills is in relative growth. Among thematic areas of managerial related skills, more emphasis should be given in the development of skills related to "Business Change Management" as evidence demonstrates a severe gap of skills related to the implementation and management of organisational changes and changes in business processes.

4. Transversal skills received the highest negative balance values ranging from -52 to -57, indicating a **significant shortage of intangible skills**. These skills are required to perform vital tasks throughout the migration process such as the analysis of organisational needs and requirements, the communication with vendors and staff and the negotiation of service level agreements with cloud service providers.

5. **Technical and security skills are well covered** by existing academic and commercial courses. That demonstrates the sufficient technical background of public servants to deal with a series of technical and security related issues including the formulation of specifications for cloud solutions, analysis of technological solution features, system and data integration and security strategy development.



Notwithstanding, the skill mismatch identified in the area of “User Support” sets specific technical requirements in terms of learning objectives that the developed VET program will need to achieve.

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