Education and training for Data Science and data related skills: Roadmap Recommendations

Input document for EDISON workshop on29 August 2017, Amsterdam

Content

1 EDISON Data Science Framework (EDSF) and Educational Model

The section briefly describes the EDISON Data Science Framework that provides a basis for the Educational Roadmap and powers other project's exploitable results and activities such as Community Portal (CP), EDISON Network that includes EDISON Liaisons Groups, the Champions universities network and Champions Conferences.

1.1 EDSF structure

The EDSF provides a conceptual basis for defining the Data Science Profession in support of targeted education and training, professional certification, organizational and individual skills management and career transferability.

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The EDSF allows for a consistent presentation and terminology for job vacancies, candidate profiles, CVs, education and training programmes, and career transferability. With these facilities, EDSF helps improving the organisational capacity and skills management, career and skills development and labour market intelligence.

EDSF was developed on the basis of best practices and methodologies as specified in related standards and frameworks such as NIST SP 1500: NIST Big Data interoperability Framework, European e-Competence Framework (e-CFv3.0, European ICT profiles CWA 16458 (2012), European Skills, Competences, Qualifications and Occupations (ESCO), ACM Computing Classification System (ACM CCS2012) – making EDSF a good platform for consistent definitions of the Data Science profession and integration with other standards and frameworks.

1.1.1 EDISON definition of Data Science

The EDISON definition of Data Science is based on the NIST definition and extends it with important aspect of organisation oriented professional attitude to deliver value to organisations, businesses or projects.

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A Data Scientist is a practitioner who has sufficient knowledge in the overlapping regimes of expertise in business needs, domain knowledge, analytical skills, and programming and systems engineering expertise to manage the end-to-end scientific method process through each stage in the Big Data lifecycle till the delivery of an expected scientific and business value to organisation or project.

Data scientists and data science teams solve complex data analysis problems by employing deep expertise in one or more of these disciplines, in the context of a relevant scientific and/or business strategy, and under the guidance of domain knowledge. Personal skills in communication, presentation, and inquisitiveness are also considered to be crucial in view of the complexity of interactions within organisations dealing with Big Data processing and analysis.

1.1.2 EDSF components

The EDISON Data Science Framework (EDSF),[1] is a core product of the EDISON Project and providing a basis for the definition of the Data Science profession and other components related to Data Science education, training, organisational roles definition and skills management, as well as professional certification. Figure 1 below illustrates the main EDSF components and their inter-relations:

- CF-DS – Data Science Competence Framework [1]
- DS-BoK – Data Science Body of Knowledge [2]
- MC-DS – Data Science Model Curriculum [3]
- DSPP - Data Science Professional profiles and occupations taxonomy [4]
- Data Science Taxonomy and Scientific Disciplines Classification

The proposed framework provides also a basis for other components of the Data Science professional environment such as

- EDISON Online Education Environment (EOEE)
- Education and Training Directory and Marketplace
- Data Science Community Portal (CP) that integrates the Marketplace and Directory services and provides gateway to EOEE. CP also includes tools for individual competences benchmarking and personalized educational path building
- Certification Framework for core Data Science competences and professional profiles

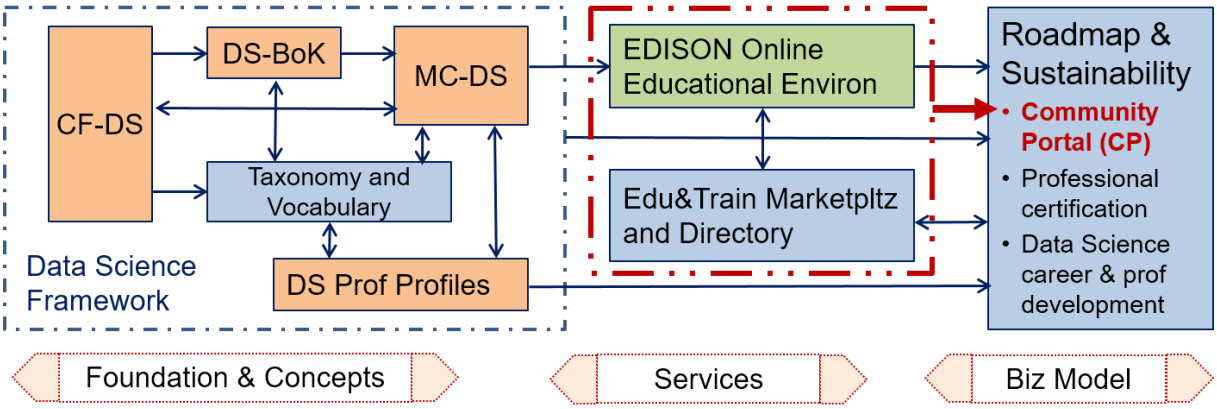

Figure 1 EDISON Data Science Framework components and Data Science professional environment.

The CF-DS provides the overall basis for the whole framework. The CF-DS includes the core competences required for successful work of Data Scientist in different work environments in industry and in research and through the whole career path. The CF-DS is defined using the same approach as e-CFv3.0[2] (competences defined as abilities

[1] EDISON Data Science Framework: http://edison-project.eu/edison/edison-data-science-framework-edsf

[2] European e-Competence Framework 3.0. A common European Framework for ICT Professionals in all industry sectors. CWA 16234:2014 Part 1 [online] http://ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0_CEN_CWA_16234-1_2014.pdf

supported by knowledge and skills with applied proficiency levels) but have competence structured according to the major identified functional groups (as explained below).

The following core CF-DS competence and skills groups were identified:

- Data Science Analytics (including Statistical Analysis, Machine Learning, Data Mining, Business Analytics, others) (DSDA)
- Data Science Engineering (including Software and Applications Engineering, Data Warehousing, Big Data Infrastructure and Tools) (DSENG)
- Data Management and Governance (including data stewardship, curation, and preservation) (DSDM)
- *Research Methods and Project Methods (DSRMP)*
- Domain Knowledge and Expertise (Subject/Scientific domain related)

The DS-BoK defines the Knowledge Areas (KA) for building Data Science curricula. that are required to support identified Data Science competences. DS-BoK is organised by Knowledge Area Groups (KAG) corresponding to the CF-DS competence groups. It incorporates best practices in Computer Science and domain specific BoK's and specifies Knowledge Areas (KAs) based on the Classification Computer Science (CCS2012), and components taken from other BoKs. It also includes proposed new KA for incorporating new technologies and scientific subjects required for a consistent Data Science education and training.

The MC-DS is built upon DS-BoK and linked to CF-DS where Learning Outcomes are defined based on CF-DS competences and Learning Units are mapped to Knowledge Units in DS-BoK. Three mastery (or proficiency) levels are defined for each Learning Outcome to allow for flexible curricula development and profiling for different Data Science professional profiles.

The DSPP profiles are defined using CWA 16458 (2012) approach and templates and organised as an extension to European Skills, Competences, Qualifications and Occupations (ESCO) introducing new taxonomy classification (sub)groups. DSPP definition provides an important instrument to define effective organisational structures and roles related to Data Science positions and can be also used for building individual career path and corresponding competences and skills transferability between organisations and sectors.

1.1.3 Data Science Professional Skills and 21st Century skills

The CF-DS defined two groups of skills that are increasingly demanded by employers and required for Data Scientist in order to efficiently work in modern agile data driven companies:

- Data Science Professional and Attitude skills (Thinking and acting like Data Scientist) defining a special mindset that be developed by a practicing Data Scientist along their career progression
- 21st Century skills comprising a set of workplace skills on critical thinking, communication, collaboration, organizational awareness, ethics, and others.

1.2 EDISON Educational Model

The EDISON Education Model is a part of EDSF and provides components to design customizable curricula and individual courses. The Educational Model can address specific professional profiles and be adapted to different forms of education or training delivery: residential (or campus based) education, vocational or online education, professional and workplace training, certification training and knowledge assessment.

Figure 2 illustrates how EDSF components may define specific academic or professional training programmes or can be tailored for specific target Data Science professional groups. The target learners group is defined based on DSPP professional groups and corresponding Learning Outcomes (LO) that are defined based on individual competences and proficiency levels defined specific professional profile(s). LOs are mapped to Learning Units (LU) that are defined in the Model Curriculum MS-DS and mapped to Knowledge Units (KUs) specified in the Body of Knowledge DS-BoK. The selected LUs and corresponding KUs provide an advice to the programme or course developer. The final set of LUs, KUs and LOs provide a basis for the full curriculum or course specification and further delivery and knowledge assessment.

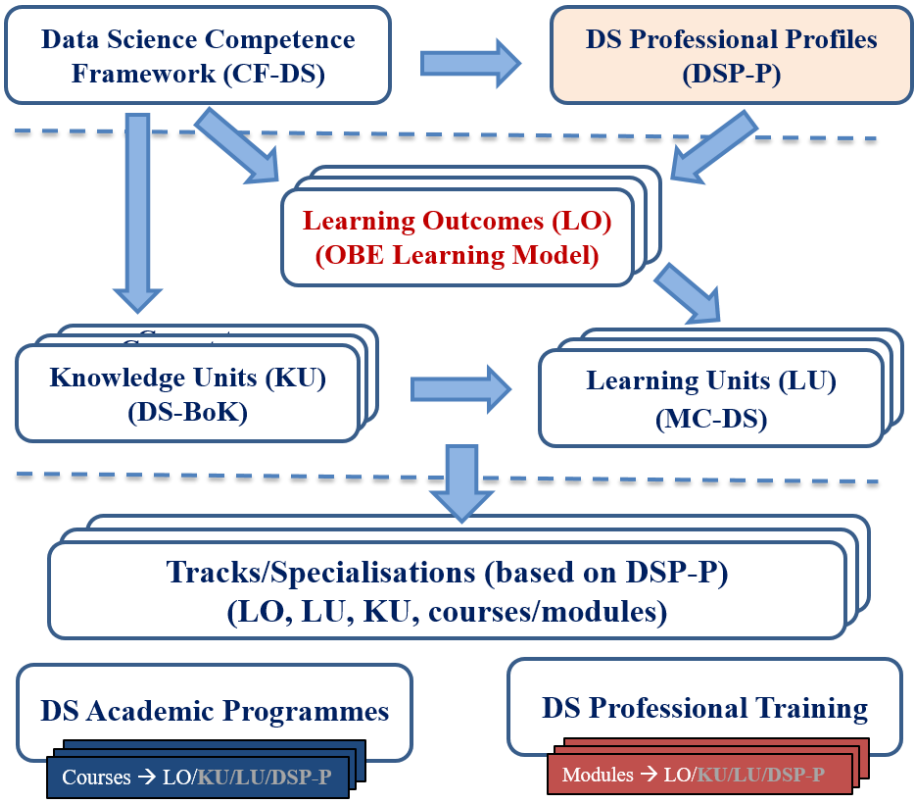

Figure 2. EDISON Educational Model components and interaction between different components of EDSF when designing customized curriculum for target professional groups of learners or trainees.

1.3 European added values

The whole complex of project activities and obtained results have already demonstrated its potential with added value to address needs and challenges of European DSM and EOSC:

- Networking: An established network of relevant projects, initiatives, interested organisations and experts has emerged and these are involved in cooperative development and they share experience on addressing vital needs for Data Science profession recognition, education and training.
- Facilitating (European) excellence and capacity-building: the EDISON digital facilitating environments help in dealing with demands for Data Science and general digital skills in Europe. The developed EDSF created a basis for such facilitation.
- Coordination of critical mass. The project activity is recognised by the European academic, research communities and industries creating a basis for growing acceptance and synergies in developing an accepted Data Science profession and data related capacities in Europe.
- Fostering mutual learning and harmonisation in (and beyond) Europe: Project cooperation with the USA and Asia Pacific countries in joint projects and initiatives (such as DARE project, ACM curriculum initiative) where the EDISON contributed to the further definition of the Data Science profession and at the same time benefited from external expertise and contribution.
- Avoiding redundancies and acting economically and effectively: The proposed EDSF provided a basis for cooperation and coordination between European research, academia, public sector and industry in addressing key challenges of the emerging digital economy and in this way avoid redundancy and consolidate efforts.

1.4 Who can benefit from EDSF: Value and Opportunities for different stakeholders

EDSF provides a conceptual basis for developing the different parts of a landscape of Data Science professionals relevant for different sectors in European digital and data driven science and economy.

a) EDISON for DSM

- EDSF provides a consistent model for addressing data skills gap and develop sectoral frameworks for skills and capacity management
- EDSF creates a basis for cooperation between industry, business and academy in addressing challenges of targeted delivery of critical skills for European research and industry
- Coordination and Integration of the stakeholders efforts to address critical skills gap

b) EDISON for Digital Skills and Jobs Coalition
   - EDSF extends existing ICT competence framework and profiles with Data Science competences and professional profiles, at the same it can be used to update definition of existing ICT profiles with the new DSA enabled competences and skills
   - EDSF provides an approach and a model for defining educational model for other critical for DSM competence areas such as ICT leadership, Cybersecurity, and other DSA enabled key enabling technology domains

c) EDSION for EOSC
   - EDSF provides a basis for the formal definition and recognition of the Core Data Experts/specialists as they are defined in the HLEG EOSC report, in particular the Data Steward and its corresponding competences, skills, and Body of Knowledge that can be used for effective curriculum design
   - EDISON Education Model offers an approach to customized and targeted training programmes delivery to the large number of data experts as identified in the EOSC report
   - EDSF helps in developing strategies and policies on critical skills management and corresponding education and training programmes.

Adoption of, and compliance with the proposed EDSF will bring benefits to stakeholder in the Data Science Supply-Demand chain by ensuring a common approach, definition, semantics and interoperability of all data related competences and skills management. The following list of beneficiaries illustrates high exploitable potential of the project results:

- Universities
- Professional training organisations
- Research (e-) Infrastructures
- Business sector and individual companies
- Government, public sector
- Application developers and education service providers
- Certification authorities
- Learned Societies, Research Communities, Scientific and Professional Associations

2 Recommendations and suggested actions

The above introduction has implications on a number of issues required to be addressed by educators, trainers, skills/HR and career management departments, governmental authorities, as well as by the researchers and employees themselves. This chapter summarizes a range of individual recommendations and aligns them with the main actors or stakeholders in the whole Data Science competences and skills management landscape.

2.1 Stakeholders, facilitators and actors

There are a number of major stakeholders in the Data Science job market supply demand chain: Research Infrastructures, research organisations, companies and businesses representing demand side; universities and professional training organisations representing supply side; as well as leaners, students and professionals that involved as direct consumers of education, training and other professional services such as certification and job search.

The EDISON Data Science Educational Model mentions the following direct actors involved into delivering education and training, certifications and market monitoring activities:

- Universities as providers of long term solutions in educating and training new specialists
- Professional training organisations, including on-site enterprise training that primarily work with professionals and practitioners that provided targeted and focused training to solve short term demand for specific knowledge competences and skills
- Online training platforms and providers such as Coursera, Udacity, DTWI, Microsoft, IBM, providing focused training and micro-degrees for massive number of practitioners who want to improve their knowledge and skills to find a new job or advance in their professional activity
- Certification and accreditation bodies that can use EDSF for defining their own certification of accreditation schemes

In addition, the following are facilitators and enablers are relevant as independent actors to establish community practices, standards and facilitate information exchange and cooperation:

- Standardisation and professional bodies defining common standards such as scientific and academic disciplines classification and taxonomies
- Professional and university associations and bodies such as EUA, LERU, LIBER, BSC, IEEE, ACM, and others,
- Professional communities and networks

Data Scientists and practitioners in different subject domains, including self-made data scientists and practitioners, who are interested in having opportunity to get necessary training and professional certification to further their professional development and advance their career

- This group of consumers should be supported in certification scheme and practical implementation of training curricula by proposing competences benchmarking, knowledge assessment and designing individual training and upskilling path

Policy defining bodies and funding organisations such as European Commission and its structures, national governments and ministries must play important role establishing effective policy and regulation to address critical skills demand.

2.2 Barriers and restricting factors

Taking next steps as suggested in this document will face challenges, limiting factors and barriers that may both objective and subjective nature. Barriers to successful next steps are:

- Commonly accepted Data Science definition: There is no commonly accepted definition of Data Science as profession and as a subject domain. EDSF and the proposed Data Science definition is becoming a standard-de-facto, being backed up by implementations in the Data Science programmes and competences definitions with respect to Data Analytics, Machine Learning or Artificial Intelligence. Required is much more attention for Data Governance, Data Science Engineering and Research Methods making the Data Science profession different from other professions.
- Complexity of the Data Science domain: Data Science domain is complex, multi-disciplinary and relies on team work and related competences aggregation. Understanding of this should be accepted by all stakeholders in their various roles from practitioners and educators to managers and policy makers.

- Fast and continuous technology in Data Science and related areas. This provides challenges for both Data Scientists to continuously update their knowledge and skills, and educators to update educational and training curricula and courses.
- Availability of modern education and training infrastructure and platform that needs to combine HPC and large scale storage facilities, on-demand cloud resources.
- Absence of continued funding for joint activities, for example in different new projects. Sustaining common interests should not be limited to individual partners resources..

It is recommended that decision-makers are aware of these barriers and conclude on actions as recommended below.

2.3 Community based EDSF sustainability model

EDSF is already widely recognised and practically used by universities, training and consulting organisations. However, it requires continuous maintenance, updating, and interaction with the community of practice.

A sustained arrangement to keep professionals engaged is essential to create a critical mass of suppliers to curb demand and dramatically increase number of Data Science students graduated from EU universities. Suggestions for ensuring a continuous community driven maintenance and development of the EDSF are:

- Explore feasibility of the community supported shared EDSF sustainability model that would rely on the voluntary community efforts; assess an Open Source Software maintenance model. The EDISON community portal <datasciencepro.eu> is a mechanism to promote this, but its sustainable functioning will depend on possibility to find financial support from interested communities.
- Actively use and involve professional networks and social networks for building a critical mass of users and adopters to identify potential organisations and individuals that could contribute efforts and resources to EDSF sustainability and further development.
- Explore different forms to continue Champion universities networking, in a form of annual or biannual conferences, involve practitioner universities as an important factor for EDSF sustainability and development.
- Initiate community led and/or funded projects to develop tools for personal competences assessment and profiling.

2.4 Policy recommendations for the EC and Member States

Policy development should become aware of what is crucial about data science competences and promote a sense of urgency for educating and training the required skilled data scientists in much larger numbers as presently. Another crucial issue is the understanding of each one's roles in this process and what are possible actions. National action meetings could result in emerging common feelings of action and to agreements about action.

R1. Critical skills management and training

- Skills management and training on critical skills should be a part of national and EU funded projects and should be treated as additional value and exploitable result.
- Critical skills management plan should be a part of the project proposal and a final report. It should include such information as skills assessment, required education and training, supporting materials and data sets.
- A service or an entity (by EC or 3rd party) should be established to register required professional profiles and competences related project research and technology domain
    - Such registry would also act as a link with universities to provide an input to education and training market supported by RIs or professional associations, and contribute to career transferability between different sectors of economy
- Find mechanisms and resources to involve all stakeholders in the Data Science education and production ecosystems to achieve consensus on effective model of producing and sustaining demanded Data Science competences and skills, creating and supporting technical education infrastructure, facilitating professional network

R2. Gender balance and multi-cultural environment is a very strong source of increasing available active data literate and driven workforce and bridging the gap between demand and supply of data workers and researchers

- To avoid gender shift, the policy makers, companies, education and training organisations, professional community should promote gender equality, common skills assessment criteria
- Promote multi-cultural work environment supported by workplace flexibility

R3. Common data literacy is crucial in fast technology uptake and skills acquisition. It should be addressed and supported in educational programmes starting from schools and kindergarten

- Data is an abstract concept and heavily based on the following foundation that needs to taught from early education stages: computer technologies, mathematics and statistics, computational thinking and programming
- Support corresponding programs with EU funding, make it a part of DSM and Digital Skills and Jobs Coalition policy focus
- Initiate and promote best experience and initiatives in this area

R4. Data driven technology and education divide. Data Science education and skills acquisition requires access to modern Big Data technologies, infrastructure, applications and services. Limited availability and access to such resources in countries underdeveloped ICT infrastructure can impact education on Data Science and data driven technologies.

- Cooperative support model should developed and realized to support Data Science education and training in countries with underdeveloped data infrastructure, like Ukraine, other former Soviet Union countries, and countries with low and middle income (LMIC)
- Support different forms of knowledge and education transfer. Cooperation with EU universities is vitally required to uncover talents and unleash potential of data driven technologies
- Address language issues, terminology and definition in local languages, made EDSF translation and localisation id applicable and resources allow
- Use such form as summer school with well crafted curricula to provide basic training and promote leadership in data driven technologies development.

R5. European studies on demand and role of Data Science and Analytics skills should be commissioned in Europe to identify key action points and develop a roadmap for increasing Data Science and Analytics enabled workforce supply in Europe and sustain global competition for Data Science talents. Chapter 3 provided examples of such studies by BHEF, IBM and PwC where the EDISON project contributed to two of such studies.

- Create a dedicated High Level Expert group to run a new European study focused on Data Science and data related competences and skills and role of core data experts; involve experts from EDISON community, RIs, and industry to deliver complex multi-stakeholder analysis and roadmap
- Consider a new study as continuation of work done in past HLEG reports “Riding the wave” (2010) and “The Data Harvest” (2014). Use EDISON project results and recommendations as an initial input to such study

R6. Include the above actions in the European Digital Single Market Scoreboard as decided by the European Council (26-27 May 2016). This scoreboard is meant to monitor developments in relation to the human capital and promotion of training and skills.

2.5 Recommendations to universities and professional training organisations

Universities are the key stakeholders in the Data Science demand-supply chain and a key actor in delivering consistent Data Science education and training. The project cooperated with the champion universities and general higher education community to develop, review and pilot implementation of the proposed EDSF. The following recommendations are based on experience of cooperating with universities and engaging into practical Data Science education and training.

R7. EDSF adoption by universities

- Universities should consider adopting EDSF as a market-aware and data driven educational model for Data Science and Analytics enabled professions
- Professional training organisation should consider using Data Science Professional profiles to shape their offering for target professional groups and economy sectors
- Universities, researchers and Data Science practitioners should cooperate to develop set of education and training courses on key competences and knowledge areas making the Data Science profession different

from other data related professions. The following courses have been identified and piloted during the project time, however need further development and community contribution:
    - Professional issues in data Science, including data analytics techniques overview, skills management and ethical issues
    - Research Data Management
    - Data Literacy: Data Analytics and Data Management
- Establish doctoral schools for advanced Data Science education and curricula development to increase numbers of Data Scientists in different disciplines, facilitate teaching staff development.

R8. Addressing Data Science professional and workplace skills in university curricula

- University curricula should include new range of professional attitude and workplace skills which are essential for future graduates and professional to effectively work in multi-disciplinary and multi-cultural environment in modern data driven agile companies and often referred to as 21st Century skills
- The highly demanded skills include but not limited to critical thinking and problem solving, design and system thinking, innovation and creativity, global perspective, cognitive flexibility, inter-disciplinary capability

R9. Multiple delivery form

Universities should use different delivery forms to deliver lecturing, self-study and practical materials

- Using cloud resource and cloud based data analytics applications is highly advised and can be organised in a form of hybrid classroom or hybrid lab that combines both campus resources and cloud based resources. Such course organisation would bring better workplace experience as use of cloud based resources by companies is increasing
- MOOC and other online education platforms can provide effective delivery form to some courses and to different categories of learners.
- Universities should assess benefits of popular online education and training platform and services provided by Coursera, Udacity, Google, Microsoft, IBM

R10. Sharing experience, courses and instructors

Universities should setup a network to share experience, courses and tutors to facilitate establishing advanced and exchangeable Data Science programmes and courses

- University association (EUA, LERU) consider establishing a framework for exchange of courses and teachers at a Pan-European level to address limited resources and teaching staff of single universities
- Cooperate with RI and RDA to develop academic grade education materials on Research Data Management. Despite importance of including the whole spectrum of Data Management and Governance topics into Data Science curricula, there is no academic grade Data Management programme or courses that would include topics related to Open Data, linked data, data provenance and data protection compliance with the recent regulations and technologies.
- Establish educational and training materials and services directory and marketplace supported by network of trainers and educators. Use experience of Open Source community such as Software Carpentry or Data Carpentry.
    - Consider EDISON Community Portal Educational Resources directory candidate platform for this

R11. Supporting technical infrastructure for Data Science and data related education and professional training

University and professional training providers should cooperate with European RIs, EGI, EOSC and major cloud providers to create supporting infrastructure for Data Science education to facilitate practical skills acquisition by students and trainees

- The intended supporting education infrastructure should provide persistent or on-demand provisioned computing and storage resources, datasets and special analytics applications.
- Establish Data Labs and Virtual Labs that would provide access to educational datasets and special data analytics applications.
- Research institution providing educational datasets should also provide guidance to learners on datasets analysis and corresponding domain specific analytic applications development
- The universities should explore EDISON Online Education Environment provided as a part of Community Portal services

2.6 Recommendations for Research (e) Infrastructures

Staff and users of Research (e-) Infrastructures are strongly dependent on Data Science competences. The Research (e) Infrastructures are employing the expert Data Science staff who can design and develop the data-related operations of the infrastructure, and who are able to install the user-friendly portals allowing not experienced users to deploy data science services. These are common challenges and problems for each infrastructure.

R12. Critical skills management in Research (e) Infrastructures

The following recommendations for addressing critical skills management by exploring the EDISON project results are suggested.

- Research (e-) Infrastructures can explore which EDSF components are crucial for their operations and help defining required staff skills and recruitment strategies or staff mobility. This may include arrangements with universities to offer specialist training.
- Similarly for users, training options for interested scientists and others should come into place. This may range from "Data Science introduction" to advanced domain-specific training.
- In view of the fast Data Science developments, cooperating Research (e-) Infrastructures are dependent of a continuously trained pool of data scientists. It is recommended to explore how EDISON outcomes (EDSF, Champions network, case studies, pilot implementations) can help in developing sustainable approaches to realise such a pool in relation to career development.

2.7 Required support and contribution to the standardisation bodies

Standardisation is an important facilitating factor in wider technology adoption and ensuring interoperability and transferability of technologies and knowledge. EDISON project demonstrated effective use of existing standards and best practices in developing EDSF. Further EDSF adoption and development will require support from standardization bodies and professional communities of practice.

R13. The following are essential measures to achieve EDSF support existing and new standards.

- Provide input to European e-Competence Framework and related ICT professional profiles (CWA 16458) to extend existing ICT competences and ICT profiles with new DSA related competences and Data Science related professional profiles. Enrich existing ICT profiles with essential DSA enabled competences
- Provide input to ESCO on the proposed Data Science Professional related profiles definition
- Cooperate with ACM and IEEE standardisation and education committees to define Data Science as a separate classification tree/hierarchy in current CCS (2012) classification, contribute to the definition of the future Data Science curricula
- Recommended best practices, Body of Knowledge, learning objects, subject ontologies

2.8 Advocacy and strategic partnership

Advocacy is identified as a crucial element for successful implementation of new approach to skills and career management by organisations, in particular RI institutions.

- Additional and targeted discussion need to be prepared amongst stakeholders and main actor in education and skills management demand-supply chain to develop and clearly articulate incentives for all stakeholders and practitioners to promote best practice in Data Science and related data driven and DSA enabled occupations education and skills transferability.
- Promote new professional development model that suggests shared responsibility in competences and skills development between employer and employee. Employers to accept supportive role for employee's self-development, treat employee's competences and skills as important capital and resource for organisational grow and sustainability
- Actively use social and professional networks to build critical mass of EDSF adopters and potential contributors. Use local Meetup communities to disseminate initiatives, involve follower in EDSF development and dissemination
- Explore possibilities and benefits of establishing strategic partnership to sustain EDISON results and activities among main actor concerned with the Data Science education and skills sustainability, including but not limited to RDA, EGI, EOSC, EUDAT, ELIXIR, OpenAIRE, EUA, LERU, FAIR

3. Scoreboard: Recommendations and suggested actions – Priority and support

Note: Please fill in and handover to organisers

Refer for details on recommendations to the main text

Recommendation	Priority Level 1-10 (including time wise)	Interested to contribute (be involved) Yes/No/Have resources	Comments (can be also inline in text)
2.4 Policy recommendations for the EC and Member States			
R1. Critical skills management and training			
R2. Gender balance and multi-cultural environment			
R3. Common data literacy			
R4. Data driven technology and education divide.			
R5. European studies on demand and role of Data Science and Analytics skills			
R6. Include the above actions in the European Digital Single Market Scoreboard			
2.5 Recommendations to universities and professional training organisations			
R7. EDSF adoption by universities			
R8. Addressing Data Science professional and workplace skills in university curricula			
R9. Multiple delivery form			
R10. Sharing experience, courses and instructors			
R11. Supporting technical infrastructure for Data Science and data related education and professional training			
2.6 Recommendations for Research (e) Infrastructures			
R12. Critical skills management in Research (e) Infrastructures			
2.7 Required support and contribution to the standardisation bodies			
R13. The following are essential measures to achieve EDSF support existing and new standards.			

Your contact information (Optional)

_____ (name)

_____ (email)

_____ (organisation/RI)