



## From Research to Sustainable Innovation and Entrepreneurship: Which Competences?

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### Article Information

#### Keywords:

*Innovation,  
Innovation Transfer,  
Entrepreneurship,  
Lifelong Learning*

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### Abstract

The research and development of modern products and systems is coined by the increasingly important requirement to create sustainable innovation. Innovation is intimately linked with entrepreneurship. Research, Innovation and Entrepreneurship are considered the keys to a wealthy and sustainable economy. The best way to turn research into innovations is to consider key innovation factors from the earliest phases of research all along the way to products and services. Existing entrepreneurship study and training programs, however, do not take into account these early phases, but rather focus on the process of creating a new enterprise. This paper presents key results of ResEUr, a European Project that has conceived and implemented a unique e-Learning enabled training and EU-wide certification program to sensitize young researchers for innovation and entrepreneurship in our modern environment.

### 1 Introduction

At a time when entire economies and industries are reeling from the financial crisis, business leaders are struggling to balance the near-term needs of survival with the long-term demand to find new sources of growth. Never has the need to innovate and be entrepreneurial been more urgent.

If it is to make a success of the Lisbon strategy for growth and employment, Europe needs to stimulate the entrepreneurial mindsets of young people, encourage innovative business start-ups, and foster a culture that is friendlier to entrepreneurship and to the growth of small and medium-sized enterprises (SMEs). The important role of education in promoting more entrepreneurial attitudes and behaviours is now widely recognised [1].

However, the benefits of entrepreneurship education are not limited to start-ups, innovative ventures and new jobs. Entrepreneurship refers to an individual's ability to turn ideas into action and is therefore a key competence for all, helping young people to be more creative and self-confident in whatever they undertake. At higher education level, the primary purpose of entrepreneurship education should be to develop entrepreneurial capacities and mindsets.

In this context, entrepreneurship education programmes can have different objectives, such as:

- 1) developing entrepreneurial drive among students (raising awareness and motivation);
- 2) training students in the skills they need to set up a business and manage its growth;
- 3) developing the entrepreneurial ability to identify and exploit opportunities. Graduates' start-up is one of a range of possible outcomes.

The majority of courses and training programs focus on target 2). Sensitising young researchers for

sustainable entrepreneurship and innovation, however, is often neglected. The research presented in this paper concerns the establishment of a competence specification of entrepreneurial spirit of young researchers, as well as a corresponding training and certification program. It is the result of a project in the Leonardo da Vinci Lifelong Learning Programme of the European Commission.

Section 2 of this paper outlines the background of this activity. Section 3 points out the methodology that has been used in order to come up with a set of competences required by young researchers to take into account innovation and entrepreneurship in their research. Section 4 introduces this competence set. Section 5 proposes a scheme to teach and certify these competences. Finally, conclusions will be drawn, and an outlook will be given to the deployment of the proposed training and certification program.

### 2 Background

The Global Entrepreneurship Monitor, a program initiated by Babson College and the London Business School to assess entrepreneurial activity around the world [2], explores the link between economic growth and entrepreneurship. The 2008 report discusses this positive relationship in terms of the diverse phases of economic development that vary from country to country: Factor-driven economies, i.e., economies relying on unskilled labour and natural resource extraction, will need to focus on institution-building, infrastructure and the provision of such basic services as healthcare. Efficiency-driven economies, i.e., growing economies in need of improving production processes and quality, will be most concerned with such priorities as domestic and/or foreign market size, financial market sophistication and labour market efficiency. Innovation-driven economies—the most-advanced stage in which businesses compete primarily on the basis of innovation—will have needs related to

entrepreneurship-specific education and research and development [3].

Currently the teaching of entrepreneurship is not yet sufficiently integrated in higher education institutions' curricula. Available data show that the majority of entrepreneurship courses are offered in business and economic studies. The diffusion of entrepreneurship is particularly weak in some of the Member States that joined the EU in and after 2004 [1].

However, it is questionable whether Business Schools are the most appropriate place to teach entrepreneurship: innovative and viable business ideas are more likely to arise from technical, scientific and creative studies. So the real challenge is to build inter-disciplinary approaches, making entrepreneurship education accessible to all students, creating teams for the development and exploitation of business ideas, mixing students from economic and business studies with students from other faculties and with different backgrounds.

Entrepreneurship refers to an individual's ability to turn ideas into action. It includes creativity, innovation and risk taking, as well as the ability to plan and manage projects in order to achieve objectives. This supports everyone in day-to-day life at home and in society, makes employees more aware of the context of their work and better able to seize opportunities, and provides a foundation for entrepreneurs establishing a social or commercial activity [4].

Entrepreneurship is today recognised as a basic skill to be provided through lifelong learning. The European Council of Lisbon and the European Charter for Small Enterprises have emphasised this aspect. All these activities are part of a more general effort of the European Commission to promote SMEs and entrepreneurship, which includes the adoption of [5] and of a set of other related documents in January 2003.

### 3 Methodology

ResEUr – ECQA Certified Researcher-Entrepreneur – is the name of the innovation project that has been launched in November 2009 by a consortium of five partners in Europe in order to propose a competence set for entrepreneurial minds, as well as a complete e-Learning based training and certification program [6]. This project is financially supported by the European Commission in the Leonardo da Vinci action of the Lifelong Learning Programme.

The six partners are the following:

- 1) EMIRAcle - European Manufacturing and Innovation Research Association, a cluster leading excellence, Belgium
- 2) UPT – University Politehnica of Timisoara, Romania
- 3) Grenoble INP - Grenoble Institute of Technology, France
- 4) ISCN Ltd. - International Software Consulting Network, Ireland
- 5) proHUMAN Cooperation and Business Management Ltd., Slovenia
- 6) Skills International Ltd., Austria

All these partners have a long-time experience in entrepreneurship and innovation, and are active members of the ECQA [7]. With ResEUr, their target is to define a competence set that is complementary to existing training and education programs in entrepreneurship. ResEUr primarily addresses the phases before the decision of creating an enterprise is made. It aims at sensitising researchers for entrepreneurship and innovation rather

than teaching them how to do business plans. This idea results from the conviction that the issue of taking into account innovation and marketing issues already during research is crucial.

The first part of the project is the specification of the competence set, from which e-Learning based training material in five languages and test questions for certification have been developed. In this paper, the authors focus on the presentation of the competence set as it has been specified by the consortium according to the standard that is proposed by the ECQA. This standard is compliant with the European Qualification Framework (EQF) [8], and is based on the concept that the skills which characterize a specific job role define the so called Skill Card (or Skill Set), which contains skill units, which consist of skill elements. The competences expected from a candidate who wants to get certified for a particular skill element are specified by performance criteria. For certification, the candidate is tested on the basis of a pool of test questions that have been specified for each performance criterion. Alternatively, candidates can ask for the assessment of documents that prove that they have successfully applied the principles and associated performance criteria in their professional activities.

## 4 Researcher-Entrepreneur Key Competences

Figure 1 shows the Skill Card which has been developed by the ResEUr project consortium. The focus is clearly on networking and open innovation. Only one unit is dedicated to the typically taught entrepreneurial skills, which are mainly associated with mastering the process of creating an enterprise.

### 4.1 Shaping Ideas

This unit deals with key skills that are required to leverage brilliant ideas, starting from creating an innovative mindset in students' heads, passing via methods for structuring ideas, and ending by discussing methods and best practices for presenting ideas.

#### 4.1.1 Key Success Factors for Entrepreneurship

The aim of the element is to describe the main topics which young entrepreneurs have to understand in order to make relevant decisions of how to transfer products and/or services as innovations to the market.

- General life cycle from idea to production;
- key success factors (providing latest market research statistics);
- understanding finances (ex. topics like: dynamics of financing, business models for exploitation, etc.);
- understanding marketing of products;
- understanding legal issues;
- understanding the risks associated with entrepreneurship.

#### 4.1.2 Forming the Mindset of Students

Forming the minds of students means to train them in applying systematic techniques to find innovative solutions to concrete problems [9]. The method envisaged in this skill element is to create a library of case studies which demonstrate the key issues about creating ideas for innovative solutions. Most of them are based on the student's capability of taking into account basic proven principles from several different domains.

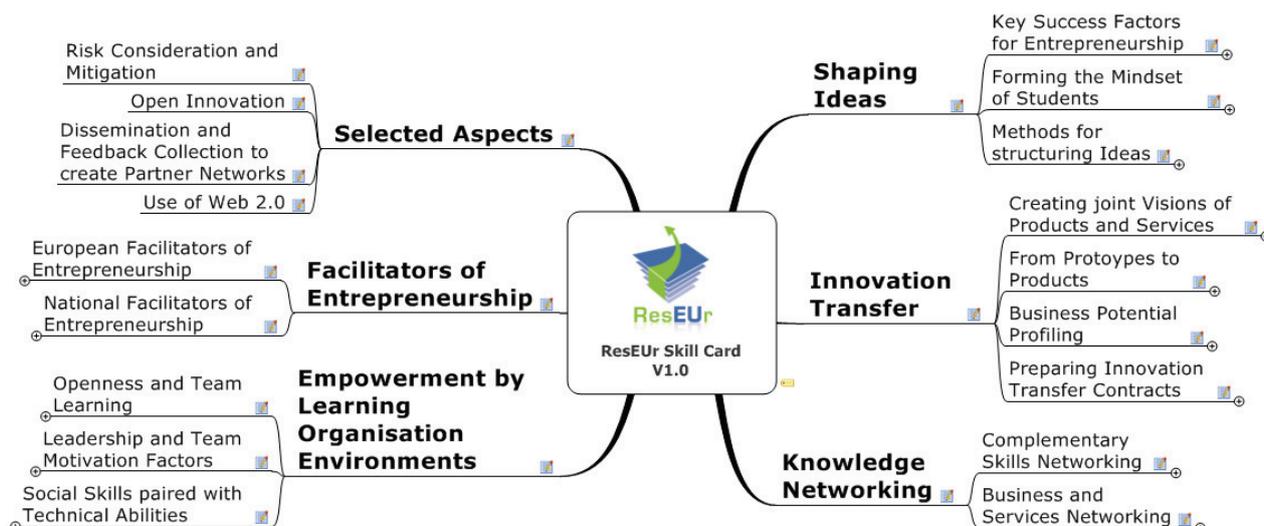


Fig. 1 The ResEUr Skill Card.

Some particular subjects addressed are:

- experimental learning;
- use of modern IT facilities (web, knowledge databases, etc.) to increase the understanding of the idea, and to gain deeper insight;
- using real working examples (prototyping);
- thinking about potential applications of concrete research in different contexts.

#### 4.1.3 Methods for structuring Ideas

The aim of the element is to provide methods for structuring the ideas based on the integration of complementary networked skills and in such a way that they address specific problems, and have a long term broader vision for development. Students specifically would learn to

- understand the Belkin and similar innovation theory models where a mix of complementary roles forms the basis for innovative teams and results. The components of the service/product shall be matched onto these skills;
- understand how to map ideas/solutions onto specific problems to provide answers for industry;
- do a joint goals analysis to formulate a vision for the future service/product and structure the idea aligned with the vision.

## 4.2 Innovation Transfer

This unit focuses on issues concerned with the transfer of research in the form of knowledge, technology, prototypes, and services as innovations from the academic environment to the competitive market. These issues are known to represent key success factors of entrepreneurship in the academic domain.

### 4.2.1 Creating joint Visions of Products and Services

Several types of modern products create customer value in combination with associated services. Furthermore, in many sectors margins are significantly higher in services than in products. It is thus increasingly important to think about services associated to a certain product in the very early product development phases.

This process can be highly facilitated by bringing together as many stakeholders of the product life-cycle as possible, in order to make them exchange knowledge about requirements and constraints with respect to a specific product and its life cycle [10]. This element gives an introduction into methods that help carry out this knowledge networking task with the target to create a vision about the future product and its associated services that is shared by as many different stakeholders as possible.

### 4.2.2 From Prototypes to Products

A significant number of Start-Ups fail due to the fact that effort for supporting one or several products on the market has been underestimated. The way from a research prototype to a sellable product that provides a certain level of quality is typically very long one. The necessity and the efforts of supporting the product once it is in the hands of customers is also often not sufficiently considered. This learning element focuses on the key factors that have to be taken into account before actually taking the direction to the creation of product out of a product idea or a prototype, including risk management issues.

### 4.2.3 Business Potential Profiling

The aim of the element is to describe the needs of industry on the one hand and researchers or research organisations on the other hand for successful knowledge and technology transfer. Technology transfer defines the process of transformation of the results of research and development into marketable products or services. Best practices are introduced of how to find out about the needs of industry and academia for collaboration and knowledge and technology transfer:

- needs analysis for knowledge and technology transfer for research organisations and industry;
- innovation audits, innovation scans;
- key criteria and elements of a technology profile;
- formulating the innovation transfer offer and request (for products, services, technology etc.).

The aim is also to describe how to formulate technology offers or technology requests for knowledge transfer for further dissemination:

- databases and service providers for diffusion and dissemination of technology profiles;
- researcher networks.

The element also highlights the ways of preparing and presenting cooperation needs in the field of knowledge and innovation transfer.

#### 4.2.4 Preparing Innovation Transfer Contracts

The aim of this element is to describe the different types of collaboration that are available for knowledge and technology transfer. Best practices are introduced of how to find out about the best suitable collaboration types for industry and research organisations:

- technology transfer and corporate strategy;
- types of cooperation;
- confidentiality and non-disclosure agreements;
- technology transfer agreement categories:
  - a) Patent or know-how licence,
  - b) Industrial franchise,
  - c) Technical cooperation,
  - d) Technical assistance,
  - e) Subcontracts,
  - f) Joint Ventures.

The element also deals with ways of choosing the right type of collaboration for knowledge and technology transfer.

### 4.3 Knowledge Networking

In the ResEUr qualification, Knowledge Networking is considered the core competence area for entrepreneurs. Networking knowledge from several different domains and sectors can create the decisive competitive advantage of modern and future-oriented enterprises. The unit highlights several significant factors of this networking paradigm with special relevance for enterprise creators in the academic domain.

#### 4.3.1 Complementary Skills Networking

The aim of the element is to provide examples and experiences from success cases about how to build and become integrated into complementary skills networks. Students will learn about specific success stories including

- the campus company concept (pool of students offering skills as services to industry);
- the company spin off concept (find a community of a mixture of companies, university institutions to support a spin-off);
- the integration in conferences and networking concept;
- the topic driven community building and extracting of ideas concept;
- the main reasons why such models are working.

The element also deals with principles that can be drawn from these case studies. The added value of using modern Web 2.0 facilities for applying the discussed skills are pointed out as well.

#### 4.3.2 Business and Services Networking

The aim of the element is to provide examples and experiences from success cases about how to interface with real business networks (beyond student and development networks). Students will learn to

- understand the rules and behaviour in business networks;
- know the main differences and potential synergies between research and business networks and how to identify and exploit such synergies;
- typical situations/concepts to get linked up with business networks and build on a group of customers;
- understand the requirements for services to allow business customers accepting solutions from young researchers.

The added value of using modern Web 2.0 facilities for applying the discussed skills is also pointed out.

### 4.4 Empowerment by Learning Organisation Environments

This unit puts the concept of the Learning Organisation [11] in the middle of the successful enterprise creation.

#### 4.4.1 Openness and Team Learning

The aim of the element is to provide methods for training openness, for new strategies in knowledge sharing in a team and its advantages, and for feedback and leadership approaches accepting and empowering the integration of new ideas. Students will specifically learn

- the requirements for a team learning culture and how to exploit it;
- the requirements for openness principles and how to socially train/exercise openness;
- the requirements of team (leadership) styles allowing innovation to grow and to empower new ideas.

#### 4.4.2 Leadership and Team Motivation Factors

This skill element focuses on:

- leadership behaviour when considering the entrepreneurial attitude (style, emotions, self motivation) - individual behaviour;
- leadership by a group (leadership teams, action oriented team leadership skills for cross-functional teams) - group/team behaviour.

#### 4.4.3 Social Skills paired with Technical Abilities

This skill element's objective is to train students in the field of social communication based on the valorisation of their emotional intelligence.

The key elements are related to:

- the intellectual capital concept and its relation/effects to entrepreneurship development;
- social communication skills development – elements that are derived from the emotional intelligence effects in the research-entrepreneur field and that are linked with behaviour attitude like adaptation, integration, differentiation, complexity and complementing;
- social responsibility;
- multicultural skills.

The skill element training will be based on case studies and best practices.

#### 4.5 Facilitators of Entrepreneurship

This unit provides highly condensed and concise information about key issues of entrepreneurship, which are typically taught in seminars which are currently offered by various institutions. The unit, however, does not want to replace such seminars and courses, but it rather seeks to give the student a convenient means of reflexion on whether she/he needs training in the respective competence areas, and where she/he can find complementary courses.

##### 4.5.1 European Facilitators of Entrepreneurship

The aim of the element is to provide information which institutions, programs, infrastructure, etc is available at European level:

- knowledge about entrepreneurship available on EU level (portals, models);
- facilitating systems at the EU level (scholarships for young researchers, opportunities for funded projects);
- funding opportunities;
- other facilitators (business angels, scholarships, etc.).

##### 4.5.2 National Facilitators of Entrepreneurship

The aim of the element is to provide information which institutions, programs, infrastructure, etc is available in certain countries in order to facilitate the entrepreneurship. The content of the element is tailored on the basis of the situation in each country where the seminar is delivered.

- Graduate programs on entrepreneurship;
- facilitating systems at the government level (scholarships for young researchers, opportunities for projects);
- supporting programs at universities and research institutions;
- incubators;
- interest of industry;
- etc.

#### 4.6 Selected Aspects

This unit contains a selection of skill elements that are considered very interesting and relevant for the target audience of ResEUr, and which are implicitly part of all the other skill units and elements.

##### 4.6.1 Risk Consideration and Mitigation

Risk issues should be taken into account in the elaboration of all the skill elements. Focus should be set on:

- risk identification by their typology and by identifying their potential sources;
- risk awareness and evaluation;
- entrepreneurs' behaviour when they are confronted with risk (risk adversity behaviour);
- risk mitigation.

#### 4.6.2 Open Innovation

Innovative enterprises that are successful in the modern knowledge-based networked economy have succeeded to drive their innovation in knowledge networks rather than in hermetically protected research departments. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. The boundaries between a firm and its environment have become more permeable; innovations can easily transfer inward and outward. The central idea behind open innovation is that in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research, but should instead buy or license processes or inventions (e.g. patents) from other companies. In addition, internal inventions not being used in a firm's business should be taken outside the company (e.g., through licensing, joint ventures, spin-offs). This element introduces these key concepts of Open Innovation to the student.

##### 4.6.3 Dissemination and Feedback Collection to create Partner Networks

This element deals with key issues that are concerned with ways of disseminating entrepreneurial ideas in industrial and research communities with the target of getting feedback on it, as well as of building a partner network, which can then be mobilised in order to implement the idea in a solid and sustainable way.

##### 4.6.4 Use of Web 2.0

In all the skill elements the possibilities the Web 2.0 offers to promote, network and discuss an idea/research or business field should be taken into account. Various possibilities should be explained and discussed:

- social-networking sites (e.g., Facebook, MySpace, Hi5, StudiVZ);
- professional/business networking sites (e.g., XING, LinkedIn, BoardEx, Yahoo! Kickstart);
- professional/business discussion forums and user groups;
- creating own blogs and promoting them;
- writing Wikipedia articles about own idea/research, add a link to own website;
- using video-sharing sites for demonstrations of your research and ideas (e.g. YouTube);
- etc.

## 5 Qualification and Certification

### 5.1.1 Certification

The ECQA has setup a partnership of experienced partners in more than 20 European countries to create an extensible pool of knowledge for specific professions. Originally, professions have been primarily in the ICT area. The strategy is, however, to extend the scope of ECQA certifications to a much wider domain. This is already manifested in profession like ECQA Certified Innovation Manager, ECQA Certified Integrated Design Engineer [12], and ECQA Certified Lean Six Sigma Expert [13]. It has turned out that ResEUr can in fact be completely integrated into the system of the ECQA.

According to the Bologna Process it is important that training courses are internationally recognised, and that successful course attendees receive certificates that are valid in all European countries. The European Commission supported the establishment of the European Qualification Network (EQN), from which the ECQA has evolved, with exactly this target in mind. This has resulted in a pool of professions in which a high level of European comparability has been achieved by a Europe-wide agreed skill sets, a European test questions pool and European exam system, a common set of certificate levels and a common process to issue certificates.

Quality criteria have been developed, comprising criteria to accept new job roles in the ECQA, criteria to accredit training organisations and certify trainers promoted by the ECQA, as well as criteria and processes to certify attendees who have run through the training on a specific job role [14]. The existing skills assessment portals, which are have already been used by several thousands of students in different learning initiatives, are being extended to cover the new requirements of the ISO 17024 (General Requirements for Bodies operating Certification of Persons) standard. Among the international certification organisations that provide ECQA-compliant certification is the International Software Quality Institute (ISQI) [15].

Certification can thus be done in a modular fashion. There are two ways of getting certified for a particular skill element.

- Examination on the on-line exam portal based on a test composed of a random selection of multiple-choice test questions
- Assessment of evidences proofing competences in the concerned element(s) due to e.g. prior experience.

For professions linked to job roles in organisations, a Europe-wide valid certificate obtained in the lifelong learning process increasingly provides a competitive advantage in the labour market.

In the case of ResEUr, which is not linked to a particular job role, the certificate has another kind of added value, which is much more associated with the confirmation of personal entrepreneurial skills, which can boost motivation.

### 5.1.2 The Training Process

The Learning Process is depicted in Figure 2. Students study the training material per unit within the ResEUr e-Learning environment. They can contact trainers for questions, comments, etc via the forums which are associated with each learning element of a particular learning unit. As the training material is strictly focused on principles and core messages, students have to do practical exercises in order to show that they understand these principles, and that they are able to apply them. Exercises are also done as homework, and must be uploaded to the respective discussion forums, where they will be commented by trainers, and other course participants.

In order to explain exercises and trainer comments, students are put together in groups of up to eight participants, who meet via telecommunication facilities with trainers. After a summary-style introduction to the studied learning units done by the trainers, every student is asked to explain his/her exercise. Trainers and other students comment on this explanations and ask

questions. This facilitates knowledge and experience exchange among the complete group rather than only between the trainers and students. After this on-line discussion session, students are obliged to upload an improved version of their exercises.

The complete training process can also happen on-site, i.e., in the form of training seminars given in classical form. The complete ResEUr program can be delivered in five to ten seminar days, depending on the amount and level of detail of exercises. There can also be mixture of both, e.g., the exercise discussion sessions could be done on-site rather than remotely. Thanks to the modularity of the training units it is possible to tailor session schedules to specific needs.

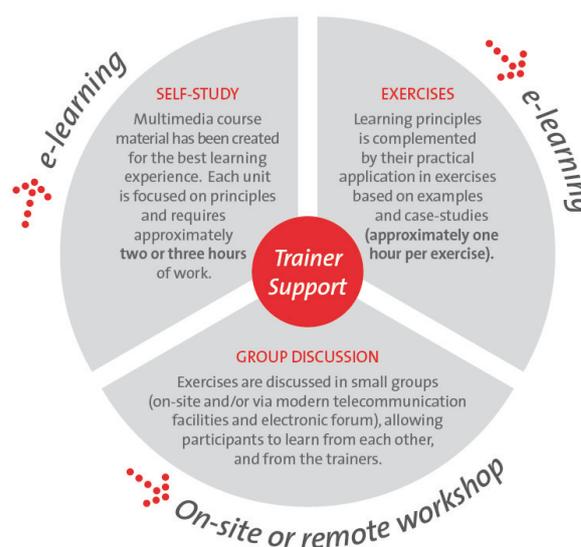


Fig. 2 The ResEUr Training Process.

## 6 Conclusion

Research, Innovation and Entrepreneurship are closely linked to one another, and they are considered as the keys to a wealthy and sustainable economy. The best way to turn research into innovations is to consider key innovation factors from the earliest phases of research all along the way to products and services. Creating successful and sustainable enterprises is then the logical next step, which can be leveraged significantly by the early sensitisation of creative minds for entrepreneurship.

The ECQA Certified Researcher-Entrepreneur training and certification program aims at covering all the key aspects that are associated with these considerations upfront the process of the creation of a new enterprise, as well as with boosting the innovation power of existing companies. The project is currently in its pilot phase, in which pilot trainings and certifications are delivered free of charge to interested parties. The target is to assess and adjust the ResEUr skill card and training material according to the feedback of trainees. Participants of IMProVe, as well as the whole AIP-PRIMECA community are invited to take part in such pilot trainings. The creators have also a big interest in introducing ResEUr as an accredited PhD course at universities.

## Acknowledgement

This project is the second in the long-term lifelong learning strategy of the EMIRAcle association. This

research is currently supported by the EU in the Leonardo da Vinci project ResEUr – ECQA Certified Researcher-Entrepreneur [6] of the Lifelong Learning Programme. Networking activities with the ECQA have been supported by the EU in the Leonardo da Vinci Key Activity LLP-1-2007-AT-KA3-KA3MP (EU Cert – EU Certification Campus). Broad dissemination of this program, as well as all other about 20 professions currently supported by the ECQA is supported by the EU in the Leonardo da Vinci Key Activity 505101-LLP-1-2009-1-AT-KA4-KA4MP (dEUCert – disseminating the EU Certification Campus).

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