

## WP3: SUSTAINABLE ENTREPRENEURSHIP

Antonio Laganà, University of Perugia, Italy  
Evangelia Varella, Aristotle University of Thessaloniki, Greece

### INTRODUCTION

Two important ingredients of the recent success for two years in a row of the ECHEMTEST<sup>+</sup> project of ECTN leverages the adoption of the EOL software described in the present issue of VIRT&L-COMM [O. Gervasi, A. Laganà, C. Manuali, University of Perugia, Perugia, Italy, EChemTest<sup>®</sup> Implementation on LibreEOL in ECHEMTEST<sup>+</sup>] and the implementation of the Prosumer scheme [A. Laganà, O. Gervasi, S. Tasso, D. Perri, F. Franciosa, Lecture notes in Computer science 10964, 533-548 (2018)] outcome of the activities of the Sustainable Entrepreneurship work group 3 (WP3) of the EC2E2N 2 project.

### THE PURPOSE OF WP3 OF EC2E2N-2

In the previous EC2E2N project, the possibility for Higher Education Institutions of the chemistry and Chemical Engineering Education Network to develop activities stimulating student training in entrepreneurship and promoting the acquisition of related skills was investigated. Tasks of that project were an analysis of the chemistry curricula of some member Institutions (in order to point out possible entries for entrepreneurship and self-employment best suited to foster innovation in production to market), the determination of possible best practice examples, suitable ways of networking already existing (or to be started) entrepreneurial activities, and the evaluation of how to identify a European umbrella organization able to take care of it. The main purpose of Work Package 3 (WP3) of the EC2E2N-2 project was to build a European umbrella environment promoting educational activities and to support training of younger generations of chemists to become entrepreneurs and be self-employed. Other purposes were to open new ways of channelling innovation into the production market and to offer to the few existing chemistry spinoff and start-ups of ECTN an infrastructure allowing them to compete on the European scene and efficiently target the related market.

Five highly innovative EU spinoffs/start-ups (Master-up srl, Krebs Inc, eXact-lab srl, Arctur d.o.o., Polymechanon whose coats of arms are given in Figure 1) met the requested requirements and registered as partners in the project as a SME cluster named DRAG.



Figure 1 – The coat of arms of Arctur, Master-UP, Exact, Polymechanon and Krebs Inc.

## THE NATURE OF THE FIVE SPINOFF/START-UP SMEs

The above mentioned cluster of five SPINOFF/START-UP did sign a MoU [A. Laganà, DRAG: a cluster of spinoffs for Grid and cloud services, Virt&l-comm 5.2014.16] to cooperate in:

- carrying out research based education using multimedia and networking, in general, and in particular the activities of the Virtual Education Community of the European Chemistry Thematic Network (ECTN),
- providing ICT services to Science and Technology communities, in general, and in particular to the Chemistry, Molecular, Materials Sciences and Technologies (CMMST) Virtual Research Community (VRC),
- participating to bids related to European Projects, Institutions and Companies addressed to spinoffs, start-ups and SMEs, in general, and in particular to the calls of Horizon 2020.

Their specific focus covers a wide range of ICT technologies and applications. Namely:

ARCTUR (<https://www.arctur.si/>) is a SME leveraging its own R&D department, registered with the Slovenian Research Agency (ARRS), to support several research institutes, universities and other R&D organizations. Main topics of the R&D activities pertain to advanced HPC and Cloud computing and the underlying XaaS paradigm. Related work is aimed at adapting HPC services to specific needs with particular focus on mobile solutions, on interlacing them with web and Cloud platforms, on 3D printing, data acquisition and 3D modelling associated with remote rendering and parallel computing. Arctur also contributes to a number of non-ICT projects, spanning from various societal issues to cultural heritage. In this Arctur providing both technical expertise in development and support of specific tools, as well as understanding technology related issues to enhance theoretical work in shaping strategies and roadmaps for future research and sustainability models.

EXACT LAB (<http://www.exact-lab.it/>) is a high-tech SME founded in 2011 by three researchers of the IOM-CNR (Institute Materials' Officine - National Research Council) multidisciplinary centre of excellence in Trieste with more than ten years experience in the field of HPC. The start-up provides solutions, training and on-demand HPC and data access covering approaches ranging from procuring access to mission-critical HPC systems by maximizing the effectiveness of existing systems at client premises to on demand Cloud HPC services through an owned C3HPC infrastructure. This pioneer SME specialized in defining the best HPC solutions fitting clients' specific HPC needs (both in governmental and private sectors) focusing on anywhere and anytime cloud computing services leveraging its deep experience in scientific software optimization and tuning, HPC workload analysis and characterization to propose customized solutions for running workflows on a proper infrastructure. Furthermore EXACT LAB can provide simulations run in an optimized environment, finding the right storage and network technologies to accelerate production tasks, storage, design, implementation and installation relying on the needed high performance and well-tuned file-system, codes optimization using advanced techniques. In addition, EXACT LAB can provide **professional assistance** in automating the computational pipelines and in converting codes to run on large scale HPC resources, cloud and grid infrastructure.

KREBS Inc ([heinz.krebs@tuwien.ac.at](mailto:heinz.krebs@tuwien.ac.at)) is a support structure of the Technical University of Vienna aimed to handle knowledge for deferred efficient access to ready to use chemical information. These databases, their maintenance and content management are dealt by KREBS Inc for professional and educational tasks. In this respect the Vienna structure has a specific predisposition for organic chemistry and University access. It is also the ECTN reference Agency for the German speaking area and provides for it particular support for Congress and abstract management, online abstract submission, preparation of conference proceedings (print and CDROM), registration of participants, management of specialized databases for chemists, consulting, administration and maintenance of database software, programming extensions, content rental and advertising space.

POLYMECHANON.eu ([www.polymechanon.eu](http://www.polymechanon.eu)) is a SME supporting the Aristotle University of Thessaloniki with particular predisposition for cultural heritage and conservation science subjects and the use of EChemTest for international contests. POLYMECHANON.eu supports the building afresh of new web sites (or the upgrade of an existing one) using for that purpose Joomla and Moodle software. More in general POLYMECHANON.eu supports automation of processes in various fields with the purpose of saving time and money by eliminating the need for repetitive work. Among these activities (either for local or web-based applications) there are those involving databases for product information and contact lists like Borland Delphi and relational Database systems (Apollo,

Advantage Database System, Absolute etc.) along with the use of components which give access to web based database systems and provide reliable solutions for any business to be implemented and integrated in commercial software products. For web applications MySQL is used to guarantee reliability, fast access and great support by the open community. In addition, a unique product (based on intelligent algorithms, dealing with the complex Greek accentuation rules, and on a vast database of approximately 750 MB) permitting an automatic accentuation of Greek words has also been developed. This product can deal with Ancient Greek, New Testament Greek, Katharevousa (Purist Greek), **and** Demotic Greek (Standard Modern Greek) and can produce impeccable polytonic Greek (even when ignoring the orthographical and accentuation rules of polytonic Greek) in **Unicode format** so that the text can be further processed using a word processor like Microsoft Word or any desktop publishing program which supports Unicode. The conversion of the text can be either fully automatic **or** interactive with the latter mode allowing disambiguation of homophones, as well as homographs which can be accented in different syllables, providing you with all the necessary grammatical information.

MASTER UP (<http://www.master-up.it/>) is a spinoff born out of the aggregation of some members of the Chemistry Department and the Mathematics and Informatics Department of the University of Perugia (UP) expert in molecular dynamics simulations and computer science. MASTER-UP's aims at designing, producing and marketing products and services for technological innovation by means of simulations and models of molecules and molecular processes. In particular MASTER UP: designs and develops molecular sciences and technologies e-learning tools, carries out Open Science editorial activities, supports Virtual organizations and research community activities for Molecular Sciences and technologies. In particular MASTER UP supports [Exam on Line \(Eol\)](#) a product aimed at providing to the teachers and to the evaluators a powerful tool for assessing the competencies and skills acquired by students during e-learning and/or blended learning courses and conventional classes. The student, once registered into the EOL web site, may enroll in the named exam and, once provided the password associated to the exam and notified by the teacher during the exam session, she/he can perform the assessment test. All questions are shown as a list; the student may respond to a given question, update a question, until the student considers the test completed and she/he send the responses to EOL server. After the students have completed their Self Evaluation Session (SES) , the teacher may review and publish the results. The exam session may be then archived for future reference and for collecting the statistical information about the subject. The other main line of activity is that of [GLOREP](#) (Grid Learning Object REPository) is a federation of Learning Object Distributed Repositories. Glorep consists of: a set of servers, each one bearing a Content Management System (Drupal), a set of clients requiring the services offered by the servers, a network (Internet) connecting the servers and allowing clients to use the available facilities after authentication. Further progress towards easy to re-use collaborative multimedia LOs is under way thanks to the development of new tools.

## THE SUPPORT TO E-TESTS ACTIVITIES

Some DRAG members actively support the distributed knowledge utilization for e-learning within the ECHEMTEST<sup>+</sup> both for the development of Learning Objects and the running of self assessment procedures. Of particular importance has been the support given to the implementation of the so called Prosumer model [see A. Laganà, O. Gervasi, S. Tasso, D. Perri, F. Franciosa, Lect. Notes Comp. Science 10964, 533-548 (2018)]. Within the Prosumer scheme the ECTN member Universities, through their teachers, infrastructures and spinoffs, act both as producers (host and manage the TCs, carry out Q&As production, revision, translations as well as dissemination and examining, etc.) and consumers (Academic SESs use for students' admission to the University, for students' dispersion lowering, for admitting students to mobility and internship, etc.). In this way most of the costs to be met to provide ECTN members with EChemTest consumer (academic) services to their own students are handled as debits that can be offset by credits obtained through service provision to either ECTN or other users with no money involvement. This prevents the whole process from becoming commercial (and creating difficulties to the public Universities) while still generating credits for them. Facilitators of this process (by providing technical support and dealing

with possible (residual) commercial aspects) are, indeed, ECTN itself and the members of the DRAG cluster which act as ECTN Agencies. This has allowed ECHEMTEST+ to achieve satisfactory results in delivering a large number of SES in the year 2017 and 2018 as shown in Table 1

## SES: 2514 (2017) vs 2622 (2018 provisional)

• BUDAPEST	627	384	(-243)
• MILANO	571	571	(0)
• KRAKOW	510	740	(230)
• VIENNA	310	447	(137)
• GENOVA	163	186	(23)
• KAZAN	123	98	(-25)
• AMSTERDAM	95	56	(-39)
• THESSALONIKI	48	60	(12)
• PERUGIA	48	54	(6)
• LJUBLJANA	11	-	(-11)
• NAPOLI	8	-	(-8)
• SIENA	-	25	(25)
• LA PAZ	-	1	(1)

**TABLE 1:** SESs run by the different TCs in the years 2017 (lhs column) and 2018 (central column).

However, the important role of the DRAG members is the possibility of handling incomes generated by paid activities (such as the Individual Proficiency Certificates (IPC)s) to feed a debits/credits offset mechanism (see Table 2).

	A	B	C	D	E	F	G
1	ECTN PROFICIENCY						
2							
3							
4							
5	CERTIFICATES		LEV3		GC2		GC1
6	PRICE/€	40	€	20	€	10	€
7	VAT	7,21311475		3,60655738		1,80327869	
8	NET PRICE	32,7868852		16,3934426		8,19672131	
9							
10							
11	TECHNICAL COST	7,5		7,5		7,5	
12							
13	%TAX MASTER UP	27,9					
14		2,35168033		0,82709016		0,06479508	
15							
16	TOT NET GAIN	22,9352049		8,06635246		0,63192623	
17							
18	MASTER UP SHARE	7,64506831		2,68878415		0,21064208	
19							
20	ECTN+TC SHARE	15,2901366		5,37756831		0,42128415	

**TABLE 2:** Decomposition of the incomes generated by the Individual Proficiency Certificates.

As shown by the last row of Table 2, in fact, out of the incomes of IPCs it is possible to set aside financial resources to pay for some activities of the TCs among ECTN activities and to cancel (or reduce) some debits associated with the services used by the Universities.

### TRANSVERSAL ACTIVITIES

Transversal background EC2E2N-2 activities carried out to the end of providing an appropriate operating ground for WP3 consisted in:

a) the design and execution (jointly with the European Commission/Joint Research Centre (JRC), the European Association for Chemical and Molecular Sciences (EuCheMS), and the European Chemical Industry Council (Cefic)) of a European Employment Survey for Chemists and Chemical Engineers. The European Survey for chemists and chemical engineers (4440 returned questionnaires (3830 after purging the ones containing irregular answers) with preliminary results published by R. Salzer in *Analytical Bioanalytical Chemistry*, DOI 10.1007/s00216-014-8191-z). This has led to the writing of the Guest Editorial paper in *Chemistry a European Journal* "The professional status of European Chemists and Chemical Engineers" co-authored by R. Salzer, P. Taylor, N.H. Majcen, F. De Angelis, S. Wilmet, E. Varella, I. Kozaris (<https://doi.org/10.1002/chem.201501364>). The paper provides a detailed analysis of the participation, of the structure of the questionnaire and of the evaluation method used for the data collected in the Survey. It provides also details on the level of education owned by the interviewed people, as well as on the job of their first employment, the country of work, the contractual forms, the employment sector, the requested qualifications, the job functions, the continuing education and the salary.

b) the co-organization of the Strategic Event "COST Actions – A Great Opportunity as Incubators for Molecular Science and Technology" held in Brussels on March 26-28, 2014 (jointly with COST and EUREKA) (<http://www.cost.eu/events/actionsincubators>). It was a high level brainstorming of the members of the ECTN Administrative Council and of the WP3 leader with COST and EUREKA experts. Such initiative focused on the analysis of the challenges to be faced and future strategies to be developed by SMEs in Europe leveraging on contributions of COST, Solvay Brussels School of Economics, European Industrial Research Management Association, BCNP consultants GmbH, and Eureka experts. Further indications on how to establish a start-up in a research environment and how to network companies within Eureka were provided by analysing some success stories, legal issues, Patent and venture capitals aspects.

c) the design of a post-master professional school combining skills directed to the mastering of chemical products most exposed to market and to financial and economic activities. The post-master professional school named "A sustainable entrepreneurship post-master professional school" was implemented as a module of the core course of the ITN Erasmus<sup>+</sup> Doctorate in Theoretical Chemistry and Computational Modeling (TCCM) and its programme was focused, at the same time, on the aspects of chemical knowledge best suited to foster innovation in production to market and on the basics on entrepreneurship and self-employment. In more detail the the three day long module was articulated as follows:

DAY 1 - Technological foundations for innovative entrepreneurship in computational services in chemistry and design of an enterprise offering innovative computational services in chemistry;

DAY 2 - Success stories of the DRAG innovative computational chemistry SMEs clustered by the project;

DAY 3 - Design, establishing and management of innovative start-ups and guidelines for the development and optimisation of the product of a SME.