

TOWARDS A WORLDWIDE EChemTest®: SERVICE

Antonio Laganà, CNR SCITEC UOS Perugia, University of Perugia, Italy, ECTN VEC Chair

ABSTRACT - The evolution of the EChemTest® ECTN project into a sustainable Higher Education service supporting the assessment of core chemistry competences through either in presence or on line Self Evaluation Sessions is illustrated. Its present Prosumer articulation and operational scheme, deliberated after the completion of the five year ECHEMTEST+ project, are described. This move has paved the way to the offering of the EChemTest® service to third parties including individuals and upper secondary schools.

1) ECTN AND THE DEFINITION OF A EUROPEAN DE FACTO STANDARD FOR CHEMISTRY COMPETENCES IN THE HIGHER EDUCATION SYSTEM

1995 - Establishing ECTN: The outcomes of the Erasmus Conference "Chemistry in Europe" (Lyon, 1995) led to the submission to the European Commission of a proposal to establish the European Chemistry Thematic Network (ECTN) [1]. The proposal was submitted by A.K. Smith, R.J. Whewell and J. Huet to the [SOCRATES/ERASMUS](#) programme and successfully gathered together over 130 Higher Education (HE) chemistry departments from all the Member States of the European Union, Norway, Iceland, Switzerland, Bulgaria and Romania. I was pleased to accept the invitation to join the ECTN project on behalf of the University of Perugia at which I was coordinating the Erasmus mobility and a European inter-university cooperation program.

1996/2000 - ECTN-1: Core Chemistry and practical skills - ECTN-1, the first ECTN project, started the design and the development of a valid *de facto* European standard for HE in chemistry through various work groups (WGs) of which the "Core Chemistry" one (WG2) chaired by P. Todesco (Bologna, IT) was of strategic importance. The WG2, in fact, after analysing the teaching contents of the Chemistry courses in more than 80% of the member EU universities worked out a proposal for the three year first degree (Bachelor) and the two year second specialization degree (Master) by defining the optimal balance of Organic, Physical, Inorganic and Analytical Chemistry integrated by the practical skills defined by the working group WG7 chaired T. Mitchell (Dortmund, DE).

2000/2003 - ECTN-2: e-learning and EChemTest® - ECTN-2, the second ECTN project, in addition to further extending the contents of the Core Chemistry with the Green and Sustainable Chemistry, Biological Chemistry, Remediation Chemistry, Chemistry and Cultural Heritage ones within the WG "Core Chemistry for the Future" (WG4), introduced the fundamental Work Group "Evaluation of Core Chemistry" (WG10) chaired by P. Mimero (Lyon, FR). WG10 designed several libraries of Questions and Answers (Q&A)s for use to assess the chemistry knowledge gained by the students. The Q&A Libraries were built at the four following levels (the names of the subject and of the coordinators given within the brackets in some cases have changed over time):

- Level 1** upper secondary school (General Chemistry 1 (**GC1**) K. Wähälä, Helsinki, FI),
- Level 2** university access (General Chemistry 2 (**GC2**) K. Wähälä, Helsinki, FI),
- Level 3** end of Bachelor studies (Analytical Chemistry 3 (**AC3**) M. Karayannis, Ioannina, GR; Biological Chemistry 3 (**BC3**) A. van der Gen, Leiden, NL; Inorganic Chemistry 3 (**IC3**) D. Cardin, Reading, UK; Organic Chemistry 3 (**OC3**) P. Gärtner, Vienna, AT; Physical Chemistry 3 (**PC3**) J.A.R. Renuncio, Madrid, ES)
- Level 4** end of Master studies (Synthetic Chemistry 4 (**SC4**) H.G. Schmalz, Cologne, DE; Computational Chemistry 4 (**CC4**) A. Laganà, Perugia, IT).

Assessments were carried out by running one hour long Self Evaluation Sessions (SES)s using the commercial software Question Mark (QM) at a subset of ECTN member Universities using for that purpose their computer rooms. A team of experts was coordinated by P. Mimero to

produce new ICT developments (H. Krebs, Vienna, AT), carry out Server Maintenance (C. Manuali, Perugia, IT) and design e-tools for Multimedia teaching and learning in chemistry (A. Laganà, Perugia, IT).

2) THE ECTN ASSOCIATION: EXTENDING THE EChemTest® SERVICE TO ALL THE MEMBER INSTITUTIONS

2003/2015 – FROM ECTN-3 ON – The ECTN activities continued in the next years through the projects “The New Generation of Chemists”, “Chemistry in the European Higher Education Area” and the extension of the Chemistry area to Chemical Engineering. In the meantime, however, in order to extend to the Chemistry community at large the key ECTN services to:

-implement, consult and/or supervise programmes for the assessment of skills and knowledge in science and engineering (with the emphasis on chemistry) by operating as a consultant or assessor in programmes concerning education and training and to provide as well a European framework for first-, second- and third-cycle degrees in chemistry;

-undertake education and training programmes, especially those concerning the use of innovative approaches and technologies to the end of providing certification of achievements whose assessments were carried out under appropriate conditions;

on December 5, 2002 the non-profit making ECTN Association was established by more than 120 member institutions and registered in Belgium. Then, the mechanisms for awarding the Eurolabels were immediately activated in a sustainable way (i.e. by charging fees for the evaluation process to pay for related expenses) by the “Labels standing committee”. Yet, the QM EChemTest® service continued to be offered for free to the same small subset of ECTN member institutions. The activation of a regular EChemTest® service for all the ECTN member institutions using the QM software would have implied, in fact, both significant man effort for re-organizing the infrastructure and huge costs. For this reason, it was decided both to keep alive the limited QM EChemTest® service of the ECTN projects and to work during their lifetime (about 10 years) to incubate the appropriate networking technologies.

2003/2015 – THE INCUBATION OF THE EChemTest® METALABORATORY - As announced in ref. [2] and further discussed in ref. [3] (in which an overview of the progress made thanks to the interaction with other EU initiatives on innovative computer assisted and grid empowered teaching and learning methods for chemistry education is given) the rapid evolution of distributed computing and semantic web allowed us to adopt the innovative web technologies which allowed us to open the EChemTest® service to all the ECTN member institutions. This occurred first within the D23 COST action Metachem [4] (17/10/2000-18/07/2005) whose main objective was *“the exploitation of the potentialities of meta and grid computing for developing computational applications, connecting the know how distributed among several research laboratories and sharing the related computer resources, which would not be possible otherwise, due to the complexity and innovative content of this task. The sharing of machines on the network has been boosted by the dramatic development of grid technologies in recent years and by the emphasis given by the 6th European Framework Programme. The further added value of D23 is to be seen in the use of grid computer systems to build the so called European Metalaboratories (clusters of geographically distributed Laboratories working in a coordinated way on a common project by sharing manpower, hardware and software), fostering innovative solutions for chemical applications and a new paradigm for collaborative research. This made it feasible to develop new a priori realistic simulations for several scientific, technological and environmental applications. As an additional benefit the emphasis given to e-learning has to be mentioned. Metacomputing in computational chemistry is still at its beginning. COST Action D23 has put the initial momentum into this development, which will become increasingly important in the future.”*

Along the above described innovative strategic lines, later in the year 2012, the Virtual Education Community (VEC) Standing Committee of the ECTN association was activated and its operational infrastructure, the **EChemTest® Metalaboratory**, was assembled. The EChemTest® Metalaboratory was articulated into National Test Centres (NTCs, or simply TCs) and their associate Accredited Test Sites (ATSS) under the coordination of the VEC standing committee. The TCs/ATSS of the ECTN Association members of the Metalaboratory were in charge of running the SESs either for their own use or for ECTN and third parties. They were also asked to contribute to design, implement, maintain and translate the relevant Questions and Answers (Q&A)s Libraries.

2003/2015 - EOL: NETWORK BASED TECHNOLOGIES FOR HANDLING AND ASSESSING CHEMISTRY COMPETENCES - The Metachem COST Action was followed first by Gridchem [5] (06/07/2006-05/07/2010) adopting Grid and Web technologies promoted by the European Union initiatives EGEE (Enabling Grids for E-Science in Europe) [6] and EGI (European Grid Infrastructure) [7]. Thanks to the collaborations established by the VEC with both initiatives, it was possible to exploit the unique expertise generated by the previous European and national Grid projects in terms of a common market of computing, round-the-clock access to major computing resources, independent of geographic location, integrate the computing infrastructures of the VEC with those of other communities, agree on common access policies for collaborative computer and data intensive e-Science, use of semantic web based thanks to the design and implementation of EOL [8]. Such key technological progress allowed the insertion of teaching materials, their association with self-assessment units and personal annotations in a truly collaborative fashion. A key advantage of EOL is, therefore, a full free sharing among the community members of the teaching and assessing materials with no limitation on the number of member institutions and users involved. Accordingly, in the web based scheme adopted by EOL, in principle, the user interface interacts with the content manager and with the on line assessment system without limitations. This means that from any of the local ECTN TC or ATS (without limits) the student after registering can access the desired material and run any SESs for the desired subject and language available and leave the session at the end (standard EChemTest® SESs are made of 30 randomly selected questions matching the chosen level of difficulty).

3) AIMING AT SUSTAINABILITY: THE ECHEMTEST+ SPECIAL PROJECT

2009/2015 - EChemTest® AT WORK ON EOL - In order to support the sustainability of the EChemTest® activities (the financial support of the EU was not going to be continued after the end of the EC2E2N projects), unsuccessful attempts were made to create a joint venture with an international publisher. Attempts were also made to reach an agreement with the Royal Society of Chemistry and the American Chemical Society with no success. Following the joint COST, EUREKA and ECTN meeting held in Brussels at the end of March 2013 it was decided, then, to stimulate the establishing of a cluster of computer based educationally oriented spinoffs. To this end Master-UP s.r.l. (a former spinoff of the University of Perugia) with the assistance of CEFIC signed a Memorandum of Understanding (MoU) with the ECTN Association to act as an Agency (on behalf also of other 4 spinoffs) both to develop services for the project and to promote the use of EChemTest® SESs by third parties. On the technological side, the problem was handled by signing an agreement between the ECTN Association and the Department of Mathematics and Computer Science (DMI) of the University of Perugia (as decided by the Administrative Council (AC) of the ECTN Association in Dresden in 2009). Following this, the DMI took over the process of both moving the use of EChemTest® on the cloud based product EOL and training people to its use. This allowed so far the coordination of both an unlimited number of TCs/ATSS and the running of an unlimited number of SESs. As discussed in more detail later, it became immediately apparent that while Lyon and Helsinki were the test sites

running at the beginning the largest batches of SESs, other test sites would soon take the lead in using EChemTest® (like Milan, Budapest, Krakow and Vienna with more than 300 SESs each run for students' admission), or in completing the Q&A libraries of Cultural Heritage and Computational Chemistry (like Thessaloniki and Perugia) or in translations (like Vienna for the German version of the General Chemistry 1 and 2 Libraries). Other very active test sites became soon Krakow (in promoting the use of the "Chemistry for everyday life" library for running students' international contests) and Amsterdam (in developing support material for on line laboratory sessions). In the meantime, however, some test sites, like Cologne, Leuven, Reading and Ioannina ceased their activities mainly because of the retirement (without replacement) of the local ECTN representative (despite the efforts paid by the Perugia team in providing technical support).

2009/2015 - THE IMPLEMENTATION OF THE PROSUMER MODEL: On the organizational side the problem was solved by adopting the Prosumer model discussed in ref. [9]. The Prosumer model relies on the fact that the same subject may act both as producer and consumer (or user). Within such scheme the ECTN Association (the owner of EChemTest® and of the relevant intellectual properties of its products) was managing, either directly or indirectly through the Agency Master-UP, the financial activities by collecting the relevant incomes and paying for the relevant expenses. It also took care, through the Chem Learn Portal [10], of offsetting Prosumers' debits (for services used) through credits (for services provided). The ECTN Association, in fact, was coordinating, through its VEC standing committee (formally instituted in the year 2012), the activities performed in each country (or linguistic area) by its members and monitoring the use of agreed procedures. Through a MoU signed by the TCs/ATs, ECTN leveraged on the adoption of a Prosumer model in which they were acting both as consumers and producers according to the following scheme:

- TCs play an active role as academic services providers (e.g. SES management and Q&As development and maintenance) in addition to being the primary users through a debit/credit offsetting mechanism (see for details ref. [11]);
- An unlimited number of TCs/ATS of the ECTN member institutions can be included provided that they sign the relevant MoU;
- Non academic third party (individuals, schools, companies, associations, etc.) services can be provided by the Agencies having signed the ad hoc MoU to sustain financially the various activities of the ECTN Association (for details see ref. [11]);
- Q&A Libraries, Learning objects, electronic publishing and multimedia support products can be created and maintained to improve the EChemTest® activities;
- The net gains associated with the EChemTest® services are partitioned for 1/3 to the Agency having procured the service and 1/3 to the TC/ATS having delivered it.

2012/2015 - THE BUSINESS PLAN OF THE ECHEMTEST+ PROJECT: The 5 year (2 of which for the starting period) Business plan of the ECHEMTEST+ project was presented and discussed on February 2015 before the ECTN Association AC in Brussels. On September 2015 a funding of 5000 euro/year was granted to the project for the period 2015-19. The AC rejected the proposal of the VEC of giving unlimited free access to all the ECTN Association members upon the payment of an additional registration fee of 350 euro. It opted instead (as repeatedly recorded in the minutes of the VEC and on the web page) for giving for free the first 100 SESs to all TC/ATS and setting the price of each of the next 50 ones at 10 euro, each of the further next at 5 euro and for the further additional ones at 3.5 euro (unfortunately an ambiguous formulation of such deliberate was reported in the ANNEX1 of some of the more recently signed MoUs). Services to third parties have, however, a different price referring to the Business Plan cost of a SES of 120 euro that cannot be discounted more than 50% (i.e. 60 euro).

4) SUSTAINABILITY ACHIEVED AN BEYOND

2019 – ECHEMTEST+ MISSION ACCOMPLISHED: At the end of the ECHEMTEST+ five year long project the set of active TCs/ATs was spanning from Kazan (Russia) to La Paz (Bolivia) (see Table 1 were the SESs declared as run by the TCs/ATs in the year 2018 is given).

TC\LIB	GC1	GC2	AC3	BC3	IC3	OC3	PC3	CH4	Total
AMSTERDAM		56							56
BUDAPEST			79	41	88	84	92		384
GENOVA		40	39		27	41	39		186
KAZAN		98							98
KRAKOW	360	174	52		58	60	36		740
LA PAZ	1								1
MILANO	63	2	128		126	126	126		571
PERUGIA			2		9	39	4		54
SIENA		12				13			25
THESSALONIKI	17	15						28	60
VIENNA		447							447
Total	441	844	300	41	308	363	297	28	2622

TABLE 1: Number of SESs declared as run by the TCs/ATs in the year 2018 divided by type.

The figures shown in Table 1 confirm the key role played by Krakow, Milano, Vienna and Budapest (all well over 300 SESs a year) in pushing the use of EChemTest®. They also confirm the role played by the General Chemistry 1 and 2 SESs (Levels 1 and 2) whose run SESs account for about half of the total (the other half is almost entirely concerned with Analytical, Inorganic, Organic and Physical Chemistry SESs of Level 3 used for admission to Master Studies). This result agrees with previous records and expectations. Unexpected, instead, was the total number of SESs declared by the TCs/ATs that was about 30% lower than that recorded by EOL. Further information was obtained from the detailed analysis of accumulated credits and debits by TCs and ATs while carrying out EChemTest® activities given in the next Table 2: Q1 is the number of SESs run by a TC/ATS for its own University (generating so far debits) while Q2, Q3 and Q4 are those run by that TC/ATS for another ECTN member, ECTN and a third party, respectively (generating so far credits). In the same Table 2 Q5 is the number of SESs run by a different TC/ATS (getting the relevant credit) on behalf of the reporting institution (charged with the corresponding debit). The reporting institution gets credits also for the Q&As created (Q6), the Q&As revised (Q7) and the hours spent in dissemination activities (Q8) given in the same Table 2 where the rightmost column shows either the resulting credit (in green) or debit (in red) resulting after including the bonus of the first 100 free SESs. Table 2 shows also, in the blue boxes, declared credits not met by the corresponding declared debits.

2020 – TRANSFER OF THE FINANCIAL MANAGEMENT TO THE SECRETARIAT: A couple of days before the September 2020 VEC and AC meetings a letter by G. Toth (supported by A. Michalak) summarized in Table 3 quoted a different detailed balance for the Budapest TC.

Reports for the year: 2018 (closed)	Q1. Number of own sessions run (with no errors)	Q2. Number of sessions run on behalf of other ECTN Members	Q3. Number of sessions run on behalf of ECTN	Q4. Number of sessions run on behalf of an external Institution	Q5. Number of sessions run by any other ECTN Member on my behalf	Q6. Number of hours spent for creating a new library's question	Q7. Number of hours spent for correcting an existing library's question	Q8. Number of hours spent for dissemination activities	CREDITS / DEBITS
NTC.HU	503	0	96	0	0	0	0	0	-1298.50
NTC.AT	546	0	0	0	0	0	0	0	-1561.00
NTC.NL	49	0	0	0	0	0	0	2	0
NTC.RU	123	0	0	0	0	0	20	0	-160.00
NTC.PL	181	411	0	0	0	0	0	0	74.5
NTC.SI	10	0	0	0	0	0	5	0	0
NTC.GR	48	0	0	0	0	0	0	2	0
NTC.SP	0	0	0	0	0	0	25	0	0
ATS.PERUGIA.IT	85	0	0	0	0	0	0	0	0
ATS.MILANO.IT	549	0	0	0	0	0	0	20	-1501.50
ATS.GENOVA.IT	39	0	0	0	0	0	0	0	0
ATS.NAPOLI.IT	0	0	0	0	0	0	0	0	0

TABLE 2: The offsetting of debits and credits for the different TCs/ATs in the year 2018.

NTC.HU balance calculation according to the signed MoU

calculated at 25th September 2020 by Gergely Tóth

year	type	details	price	SES/item	yearly balance	total balance
2017 from 07	free SESs	as NTC		50 free	154 SESs (539 EUR)	528 SES (1848 EUR)
	S1 SESs	AC3,BC3,IC3,OC3,PC3 end of BSc, entry to MSc	3.50 EUR/SES	204		
2018	free SESs	as NTC		100 free	85 SESs (297 EUR)	
	S1 SESs	AC3,BC3,IC3,OC3,PC3 end of BSc, entry to MSc	3.50 EUR/SES	503		
	S3 SESs	GC1, GC2 ECTN student competition	gives n free	96=96 free		
	compensation	extra person costs to EChemTest meeting at Prague (315 EUR) and dissemination work (350 EUR)*	n free=EUR/3	665 EUR = 222 free		
2019	free SESs	as NTC		100 free	315 SESs (1103 EUR)	
	S1 SESs	AC3,BC3,IC3,OC3,PC3 end of BSc, entry to MSc	3.50 EUR/SES	591		
	S3 SESs	GC1, GC2 ECTN student competition	gives n free	129=129 free		
	compensation	extra person costs to EChemTest meeting at Krakow	n free=EUR/3	140EUR=47 free		
2020 till 09	free SESs	as NTC		100 free	128 SESs (448 EUR)	
	S1 SESs	AC3,BC3,IC3,OC3,PC3 end of BSc, entry to MSc	3.50 EUR/SES	228		

*Preparation work of article Virt&L-Comm_2018_14_5. One week work calculated at Hungarian salary level (net 700 EUR/month for an assoc. prof + all overheads).

Remarks: A - year 2017 is not included. It was stated several times that 2017 is a test year when counting is started only to build the system.

B - The balance was announced to be theoretical. It was stated several times by A. Lagana (last time 2019 Krakow) that the balance will not be converted to an invoice.

C - MoU does not state anything on VAT. In my opinion balance in EUR contains VAT, if it will be converted in the future to an invoice.

D - Number of SESs does not include technically unsuccessful trials, failed starts (e.g. wrong test was started) and technical trials.

E - I was not able to compare it to the complicated chem-learn site, where data provided cannot be seen in a readable form and old data are disappeared

TABLE 3: The Table of the Letter of G. Toth summarizing his remarks

During the discussion some deviations of the data reported by the TCs/ATs from those derived from the established rules (see also ref. [12]) were singled out and brought back to the ambiguity of the text of the ANNEX1 to the Budapest TC MoU and to the missing in advance approval of the claimed credits. However, by following the recommendation of the ECTN Association General Secretary A.K. Smith, in order to pave the way to a completely new and fully centralized management of the EChemTest® project, it was decided to revise the ANNEX1

text before the end of the year 2020 and to transfer the management of the financial procedures of EChemTest® to the ECTN Secretariat starting from January 1, 2021 by automating its relevant procedures through the portal Chem Learn.

2021 – THE IMPLEMENTATION OF THE NEW FINANCIAL EChemTest® PROCEDURES:

The process of modifying the management of the EChemTest® project by adopting the new ANNEX1 to the MoU and increasingly centralizing and automating the financial procedures came into operation at the beginning of the year 2021. Accordingly, the TCs/ATSs have to get their annual plan approved by the VEC before starting any activity. They are allowed to run for free up to 100 SESs, while the running of additional SESs generates a debit of 3.5 euro per SES. If the SESs are run for ECTN or another TC/ATS, the corresponding debit will be passed on to them. The cost for a test taker having passed the SES as part of the institutional activities of the TC/ATS of an ECTN Association member when requesting the issuing of the relevant Individual Proficiency Certificate (IPC) is 40 euro. In the case of a SES delivered (in presence or on line) to third parties (including individuals) through the support of a TC/ATS, a cost of 60 euro applies to that service. Such amount, to be paid by the test taker in advance, is credited for 1/3 each to ECTN, to the TC/ATS and to the Agency having promoted the activity. In this case, the IPC created for the passed SES is free (the SES can be repeated once for free in the case of failure during the first attempt). Among the third parties, of particular value is the role of the Upper Secondary Schools: they may act as ECTN Agencies after signing the ad hoc MoU establishing at the School a Local ECTN Advisor (LEA) who is tasked with the training and assisting the students wishing to get ready for taking a SES [13, 14].

5) CONCLUSIONS AND ACKNOWLEDGEMENTS

The evolution of the EChemTest® ECTN project [1] into a sustainable HE service is the result of the implementation on the cloud of a Prosumer model [8] applied to chemistry knowledge. The need for such evolution became apparent when the model based on the externalization of the centralized service of managing the SESs using a commercial software (adopted at the beginning of the EU funded ECTN project) showed not to be sustainable because expensive and insufficiently flexible to be adapted to the needs of the Universities members of the ECTN Association. As a matter of facts, the establishing of an educational Metalaboratory for the assessment of chemistry competences formulated within the D23 COST action [3] and its implementation according to the Prosumer scheme tested during the ECHEMTEST+ project using EOL [7], allowed to combine together not only producer/consumer activities (with the consequent debits/credits offsetting) but also internal/third-party services fostering so far a tighter University/upper-secondary-school interaction. The net result of both combinations has shown to lead not only to the sustainability of the EChemTest® services but also to a worldwide affirmation of an EU de facto standard and to a prospect of fruitful collaboration between Universities and upper secondary schools (which are, after all, the institutions feeding freshmen to HE).

ANNEX 1

TABLE OF FEES AND COMPENSATION RULES

Glossary:

ITC – ECTN Member Institution running a TC

SES – EchemTest Self-Evaluation Session (1 person, 1 test)

S1. SES run by an ITC for its own academic use

S2. SES run by an ITC for academic use of another ECTN member

S3. SES run for ECTN purposes (e.g. testing/validating libraries or platforms, EU competitions, Agency activities, etc.)

S4. SES run for any other case (presently undefined but that could possibly occur in future)

TC – Test Center (either NTC (National Test Center) or ATS (Accredited Test Site)) run by an ECTN Member or an Agency

QA – Question and related answers for any ECTN Library

EChemTest operating rules and licensing policy:

- 1) ITC can run for free for academic use at its own TC up to N^{free} ($N^{free} = 100$) SESs annually;
- 2) Further use of EChemTest for S1 and S2 sessions requires purchasing a license from ECTN according to prices given in the Table below;
- 3) The organization of S3s and S4s has to be authorized by ECTN after agreeing on the related non Academic license conditions;
- 4) ECTN member Institutions not running a TC have to use an existing TC to the end of running the needed SESs for academic use and purchase a license from ECTN (at the prices given in the table below to be paid for to ECTN) prior to organizing SES;
- 5) License costs can be offset in terms of service provision as specified below;
- 6) ECTN can limit (or refuse) to sell licenses when it cannot guarantee to satisfy the SES request.

Yearly Licence price per SESs for ICTs:

Number of SES purchased	Price per SES
1-49	10.00 € (regular price)
50-99	5.00 € (50% discount)
above 100	3.50 € (65% discount)

Offset/compensation rules (for ITC only):

- 1) for n S2-type SES (for another ECTN member) run in TC:
 - free licences for $n/3$ SESs
- 2) for n S3-type SES (for ECTN purposes) run in TC:
 - free licences for n SESs
- 3) for n S4-type SES run in TC:
 - to be decided case by case by ECTN
- 4) for other expenses afforded by ITC (not related to the costs of the SES organized in TC facilities):
 - free licences for $n/3$ SESs for expenses of $3.5n$ €
- 5) ITC can apply for a licence in exchange of services/expenses after carrying/affording these services/expenses or based on a plan of annual activities accepted by ECTN
- 6) licence purchased/granted can be used in any time in future

Examples:

NB: Numbers given below are examples. Particularly large numbers of SESs (eg. 600) will be organized only when technically feasible. ECTN can refuse selling licenses

- 1) Example 1: an ITC wants to run 600 S1 (without any other activities). It has to purchase the licence for 500 SESs (600-100) and pay 1750,00 €.
- 2) Example 2: an ITC organizes 600 S2 (without meeting any expenses) on behalf of a non ITC ECTN member. The member has to pay 1750.00 €. The ITC gets for free a licence for 200 SESs (600/3)
- 3) Example 3: an ITC organizes 600 S2 on behalf of a non ITC ECTN member, by meeting expenses non reimbursed by ECTN for 150 €. The member has to pay 1750.00 €. The ITC gets for free a licence for 250 SESs (600/3 + 150/3)
- 4) Example 4: an ITC organizes 65 S3/S4 for ECTN purposes. The ITC gets for free a licence for 65 S1
- 5) Example 5: an ITC maintains, generates or translates QAs for an EchemTest library, by meeting expenses non reimbursed by ECTN for 315 €. The ITC gets for free a licence for 105 SESs (315/3).
- 6) Example 6: an ITC sends a unit of its personnel to attend an EchemTest event by meeting expenses non reimbursed by ECTN for 270 €. The ITC gets for free a licence for 90 SESs (270/3).
- 7) Example 7: an ITC that has provided the previous year services worth a licence for 99 SES and wants to run next year n SESs it will have to buy no licence if $n < 200$, 16 licences if $n = 215$ (at the overall cost of 160 €) and 100 licences if $n = 300$ (at the overall cost of 350 €).

NOTES and REFERENCES

- 1] <http://ectn.eu/about-us/what-is-the-ectn/>
- 2] O. Gervasi, F. Giorgetti and A. Laganà: Distance Assessment System for Accreditation of Competences and Skills Acquired Through in-Company Placements (DASP), announced at INET99: the Internet Global Summit, S. Jose, CA (USA), 1999,6,23-26, <https://web.archive.org/web/20100311063146/http://www.isoc.org/isoc/conferences/inet/99/proceedings/posters/216/index.htm>
- 3] A. Laganà, C. Manuali, N. Faginas Lago, O. Gervasi, S. Crocchianti, A. Riganelli, S. Schanze, "From Computer Assisted to Grid Empowered Teaching and Learning Activities in Higher Level Chemistry Education" in "Innovative Methods of Teaching and Learning Chemistry in Higher Education", I. Eilks and B. Byers Eds, Royal Society of Chemistry, 2009; ISBN 978-1-84755-958-6.
- 4] <https://www.cost.eu/actions/D23/>

- 5] <https://www.cost.eu/actions/D37/>
- 6] <https://eu-egee-org.web.cern.ch/index.html>
- 7] <https://www.egi.eu/about/>
- 8] O. Gervasi and A. Laganà, EoL a web-based distance assessment system. Lecture Notes on Computer Science . 3044, 854-862 (2004)
- 9] A. Laganà, O. Gervasi, S. Tasso, D. Perri, F. Franciosa, The ECTN Virtual Education Community Prosumer model for promoting and assessing chemical knowledge, Lecture Notes Computer Science 10964, 533-548 (2018)
- 10] C. Manuali, A. Laganà, CHEM-LEARN: the new EChemTest® accounting system, this issue
- 11] <http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/200>
- 12] <http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/194>
- 13] <http://ectn.eu/communication/newsletter-2/>
- 14] D. Maggiore, E. Latta, EChemTest® at upper secondary schools, this issue