1. OVERVIEW OF THE ACTIVITIES AND ACHIEVEMENTS

Outcomes and results are described below by the tangible products R_1, R_2, R_3 and R_4, their applications during the project and by their analyses, as follows:

R_1. The Virtual EMS Factory, the virtualized, web-based version of the equipment, their parameters and operation principles, and the processes, which are now used in a typical Electronics Manufacturing Service Factory. The **Virtual EMS Factory** was implemented and put to use at the beginning of the project by establishing a direct link to the ETT-VLAB website (www.ett.bme.hu/vlab/) from the www.elect2eat.eu website of the project and the ELECT2EAT training system. In this way the coverage of the Virtual EMS Factory was extended into the wide area of electronics technology, which is larger than assembling. The **project website** became the most important communication channel between the ELECT2EAT training system and the users, as well as between the system and the project partners. The domain name of elect2eat.eu was purchased for additional three year to ensure the accessibility of the **EAT e-learning program with three modules (PCB, DfM, and AIT)** as well as the **Virtual EMS Factory** after the completion of the project.

R_2. EAT e-learning program with the most important topics of **Electronics Assembling Technology** including Components and Printed Circuit Boards (**PCB**), Design for Manufacturing (**DfM**) and CAD, and Assembling & Test Technologies (**AIT**) modules. The system is separated into 17 chapters, from which 4, 5 and 8 belong to the PCB, DfM and AIT module, respectively. Each chapter contains **Elementary Teaching Entities** (ETEs) with 4-9 slides. Each ETE is a specific web-cast with free navigation possibility, and access to more written and oral explanations, movies and videos, a photo library, self-assessment possibility, etc.

The 3 modules of the system consist of altogether 50 ETEs with more than 300 slides and access to ca a thousand of photos, movies and videos. Written and oral explanations belong to each slide, in all the 4 languages (English, Hungarian, Romanian and Slovak), so altogether there are ca 1200 slides, 1200 text files and 1200 audio files in the system.10-15 photos, 6-8 videos and movies, 10-12 definitions of the definition matching quiz, 10-12 pictures of the picture matching quiz, and 6-8 Internet links belong to each ETE. The visual items (pictures, videos and movies) are in their original (usually English) language; however, the titles of all items as well as the quizzes have been created on all the four languages of the project.

Printable form **User Manual** of the EAT e-learning program was also edited, issued and distributed in all the four project languages.

R_3. EAT Certified Assessment Option was planned to use the self-assessment tools of '**definition matching quiz**' and '**picture matching quiz**' of the e-learning program to examine the knowledge of the trainee, who would like to acquire a certificate of the successful fulfillment of the training. The self-assessment option was completed, it is available for all users of the EAT e-learning program. Experiences showed, however, that the self-assessment process should be surpassed.

For the Train-the-Trainers courses, which were provided altogether 7 occasions in the 3 countries, a more **complex certification process** was developed by the Certifying Committee, which was established for this aim, The Certifying Committee is chaired by an independent (not belonging to the project) professor of UPB Bucharest, and committee members are professors from the three countries of the project. The certification process has three parts, namely (1) the fulfillment of the quizzes; (2) the trial lecturing and consulting of a part of the course by using the e-learning system; and (3) answer questions in writing. For the successful completion of the course and the certification process, the participant is awarded by a certificate signed by Chair and the Members of the Committee.

Moreover, according to the reviewer's advice, an officially acknowledged **Life-Long Learning module was created and obtained accreditation** from the Hungarian authorities. The curriculum of the course also includes a certification process similar to the above one. Although, possessing the accreditation is not a proviso for running the adult training activity or the implementation of the e-learning program, yet with the expert approval of the content, the institution may ensure the uniform high professional level during the

approved period of the accreditation. Furthermore: the sustainability of Elect2eat project outcome will be guaranteed in this way.

R_4. Statistics of indicators and impact factors is a report on the continuous monitoring of the progress of the innovation transfer and the application of the products. Indicators were used to get measurable results on the impact of the e-learning system. **The report** is compiled from feedbacks and interviews with people concerned. Feedbacks were provided by filling out questionnaires, which included questions concerning the training, its precedents, contents, the methods, the quality of the material, that of the slides, usability etc. The overall feedback of course participants was positive, the lower marks obtained for some questions and especially a few remarks provided great help for the continuous improvement of the course contents as well as the presentation methods during the second year of the project.
Finally, a general strategy was planned and some measures were taken **to ensure sustainability of the results** beyond the project life. From these, the transfer & receipt the accreditation of the LLL module and the application for projects sponsored by the Structural Funds and the SEE initiative of the EC are worth mentioning.

2.2 Result/Product R_2: EAT e-learning program – Electronics Assembling Technology E-learning Program

Description of the permission for use

EAT e-learning program with three modules (Design for Manufacturing and CAD; Components and Printed Circuit Boards; and Electronics Assembling and Test Technology), including 17 Chapters and 50 ETEs (Elementary Teaching Entities) contains the most important topics of Electronics Assembling Technology. Each ETE is a specific web-cast with free navigation possibility, and access to more written and oral explanations (in four different languages), movies and videos, a photo library, self-assessment possibility, etc.

The transferred materials were originally developed by two Partners of the Elect2eat Project, namely BME-ETT (P1) and UPB-CETTI (P4), as it is described in the next paragraph. Both Partners have been provided free Internet access to these learning materials for their students and all interested visitors, however through the Internet only, the slides and the animations have been protected against modification and downloading. BME-ETT and UPB-CETTI do not intend to distribute these e-learning materials on CD-ROM or in printed format, with the exception of a printed Manual. Therefore the Internet access and the Internet based use of the EAT e-learning program do not need any kind of permission.

Description how the result has been transferred

The learning materials which were transferred to the EAT e-learning program have two basic origins, as follows:

1. The accredited adult education program 'Technology of Electronics Products' developed by BME-ETT (Partner 1) in HUN. The original Program contains 6 Power Point supported courses, basically 4 lecture hours of each, which can be provided on-demand and with extended content. The following three of these courses are included in the **EAT e-learning program**:

- **EAT-DfM**: Design for Manufacturing of boards and selection of components
- **EAT-PCB**: Manufacturing technology of Printed Circuit Boards and substrates
- **EAT-AIT**: Assembling and Inspection Technologies: processes and manufacturing equipment

2. In the 'Train-the-Trainers' program of the Eurotraining IST Project UPB-CETTI (Partner 4) developed and lectured an intensive short course in ENG, entitled 'Design and Complex Characterization of High

Performance PCB Structures'. The slides of the course are also available in RUM. The **EAT-DfM** course is based on the content of these results of UPB.

3. The third source was the virtual laboratories of ETT-VLAB, which is the basis of the Virtual EMS Factory. The EAT e-learning program with its ca 50 ETEs (Elementary Teaching Entities) has a special connection with the Virtual EMS Factory: one can study the process and equipment operation principles by navigating from one of the systems to the other. The e-learning system has the special advantage that provides written and oral explanations of the processes in four different languages, in English, Hungarian, Romanian and Slovak, while the Virtual EMS Factory presents the equipment in an almost real manufacturing environment.

Title of result	**EAT e-learning program** – Electronics Assembling Technology E-learning Program
Product Type	website, learning and teaching materials
Marketing Text	Accessible through the elect2eat.eu website EAT e-learning program with two modules (Design for Manufacturing and Electronics Assembling Technology), including 19 Chapters and 50 ETEs (Elementary Teaching Entities) contains the most important topics of Electronics Assembling Technology. Each ETE is a specific web-cast with free navigation possibility, and access to more written and oral explanations (in four different languages), movies and videos, a photo library, self-assessment possibility, etc. The transferred materials were originally developed by two Partners of the Elect2eat Project, namely BME-ETT (P1) and UPB-CETTI (P4). Both Partners have been provided free Internet access to these learning materials for their students and all interested visitors, however through the Internet only, the slides and the animations have been protected against modification and downloading. Therefore the Internet access and the Internet based use of the EAT e-learning program do not need any kind of permission.
Description	Accessible through the elect2eat.eu website The learning materials which are being transferred to the EAT e-learning program have three basic origins, as follows: 1. The accredited adult education program 'Technology of Electronics Products' developed by BME-ETT (Partner 1) in HUN. The original Program contains 6 Power Point supported courses, basically 4 lecture hours of each, which can be provided on-demand and with extended content. The following three of these courses are included in the EAT e-learning program: - EAT-DfM: Design for Manufacturing of boards and selection of components - EAT-PCB: Manufacturing technology of Printed Circuit Boards and substrates - EAT-AIT: Assembling and Inspection Technologies: processes and manufacturing equipment 2. In the 'Train-the-Trainers' program of the Eurotraining IST Project UPB-CETTI (Partner 4) developed and lectured an intensive short course in ENG, entitled 'Design and Complex Characterization of High Performance PCB Structures'. The slides of the course are also available in RUM. The EAT-DfM course is based on the content of these results of UPB. 3. The third source was the virtual laboratories of ETT-VLAB , which is the basis of the Virtual EMS Factory. The EAT e-learning program with its ca 50 ETEs (Elementary Teaching Entities) has a special connection with the Virtual EMS Factory: one can study the process and equipment operation

	principles by navigating from one of the systems to the other. The e-learning system has the special advantage that provides written and oral explanations of the processes in four different languages, in English, Hungarian, Romanian and Slovak, while the Virtual EMS Factory presents the equipment in an almost real manufacturing environment.
Target group	All people who seek for jobs; employees and unemployed professionals, entrepreneurs, distributors, trainees and teachers of vocational education schools; institutions, associations, bodies of LLL, etc. From the point of view of R_2, a primary and a secondary target group can be defined, which include people who are potential trainers of the e-learning material and the others, who are potential users of the knowledge, respectively.
Result	EAT e-learning program with two modules (Design for Manufacturing and Electronics Assembling Technology), including 19 Chapters and 50 ETEs (Elementary Teaching Entities) contains the most important topics of Electronics Assembling Technology. Available at the elect2eat.eu, the access is free.
Area of Application	To learn the design, assembling and test process of electronics products. The visual content is available at elect2eat.eu , the access is free.
Homepage	elect2eat.eu
Product Language	English, Hungarian, Romanian and Slovak

Type of evaluation and testing

Results R_1, R_2 and mostly R_3 have similar Internet based feature, their evaluation were carried out in the same testing procedure, as follows:

Demonstration days were organized for an audience of general interest, and trainings were provided for both the primary and secondary target groups. The participants' opinion gave feedback for improving the contents and the methodology, in the following ways:

- The activity and the visible satisfaction or discontentment of the participants especially of the primary target group gave very good indication where and how to improve the quality.
- Questionnaire was developed and had it filled up by the participants to get more exact feedback and measurable indicators on the usability of the material. In the questionnaires the participants were asked how satisfied they were with the aims of the training, the amount of the contact lessons and the knowledge they received during the course, whether the explanations, tasks and exercises helped their learning, if they liked the method of independent studying, etc.The evaluation of the questionnaires played active part in the quality management of the project.
- Threefold assessment method was developed, which included trial teaching (of the members of primary target group only), on-line quizzes, written tests. The results of the assessment and the satisfaction with the certification process gave also useful feedback.

How was the evaluation and testing carried out?

According to the three types of evaluation, the methods had also three types, respectively as follows:

- The level of activity and the visible satisfaction were estimated by talking to and discussing with the participants. The members of the primary target group were mostly qualified adults: active teachers, trainers, industrial engineers, who were very good partners to freely tell us their helping opinions.
- The questionnaires provided measurable indicators for the improvements.

- The results of the assessment indicated where to improve the content.

Findings, conclusions and lessons of evaluation and testing

In general, the participants were quite satisfied with all parts of the e-learning material.

It is important to see that the result R_2, i.e. the **EAT Electronics Assembling Technology E-learning Program** was in the focus of the transfer regarding its content and extent as well, therefore the evaluation of R_2 is the most important for the qualification of the whole project. Its evaluation according to the aspects above is as follows:

- The activity and the visible satisfaction of the participants were extremely good. Especially the secondary school teachers – the members of the primary target group – in all the three involved countries, in Hungary, Romania and Slovakia, showed very high interest and activity to acquire the knowledge and obtain the capability to teach their students with the use of the EAT e-learning program. They gave very useful feedback where and how to improve the quality of the content and methodology of the system. They stated that the e-learning system can give a very useful practical background for the everyday public education. The secondary technical school teachers also became partners in organising pilot courses for the secondary target group, where they were the trainers actually. The members of the secondary target group were also very active to acquire the knowledge that was found interesting for them, because in this way they got realistic impressions about the manufacturing process of their possible future work.
- The evaluation of the answers of questionnaires provided correct feedback and measurable indicators on the usability of the material. In the questionnaires the participants were asked how satisfied they were with the aims of the training, the amount of the contact lessons and the knowledge they received during the course, whether the explanations, tasks and exercises helped their learning, if they liked the method of independent studying, etc. After summarizing the results we could state that the students were satisfied with the conditions and methods of training and also with the material itself. Depending on their age and previous knowledge they found the course difficult at a different rate. It should be mentioned that almost all of the Hungarian participants indicated that some parts of the CAD & DfM module were too difficult for them. Although the Slovak and Romanian participants also found this part hard to learn by the use of the Internet, in their opinions it was the most interesting part of the course. The possible reason of this difference was the difference in the teaching methods: the Slovak and Romanian colleagues delivered the course in laboratories, which were equipped with suitable CAD software; therefore the participants can use the learnt design method in practice, and can enjoy the design process.
- Especially the threefold assessment method was developed on the request of the participants and also to meet the requirements of the accreditation. The assessment included – in addition to the on-line quizzes – written tests and trial teaching (but for the members of primary target group only). The secondary school teachers were very active in preparing themselves to make a trial teaching for their colleagues. They were motivated by the special certification, which was awarded for the successful teaching. The satisfaction with the certification process gave also useful feedback for us and acknowledged our efforts.

Partners involved

Carrying out the transfer as providing partners: BME, UPB-CETTI, TUKE

Receiving and applying the transferred e-learning content: DRKK, ERAK, ARIES, SPSE

Delivering the courses as trials for the primary target groups: DRKK, ERAK, ARIES, SPSE with the help of BME, UPB-CETTI, TUKE

Delivering and helping to provide the courses for the secondary target groups: DRKK, ERAK, SPSE