Marconi Electronics and Communications Technology (ECT) Project in Secondary Schools

Andy Breckon

Chief Executive,
DATA

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Abstract

Information and communications technology (ICT) dominates many aspects of most companies and plays a significant role in education, or at least has significant resources focused on it. No one doubts the growing influence of ICT in the world, however our education system has made little significant effort to educate young people in the basic skills that under pin ICT. At the core of ICT systems is electronic communications and at last there is now an ambitious attempt to address the need for educating a significantly larger number of young people in ECT to develop, service and maintain the increasingly complex electronic highways which this country needs. This paper sets out part of the rationale for the scheme and how it is being addressed in the trial phase.

Introduction

This project seeks to address a major crisis that has emerged in the electronics and communications industry where there are far too few people with interest, skills and capability entering this vital area of work. The future of the United Kingdom as a knowledge-based society at the leading edge of 'e-based industries' will not be possible without a high quality technical workforce that has confidence in designing, developing, manufacturing and maintaining electronically functioning systems. This project goes to the heart of the problem, which starts in schools, where compulsory education has the opportunity to engage and interest young people in this work. However, without the materials, training and support, this will not be feasible. The programme has financial support from Marconi and the DTI, as well as great interest and support from the DfEE, Ofsted and QCA. DATA will be taking the lead in managing the project but will be working very closely with TEP to ensure the effective development of materials.

The activity is called the Marconi ECT Project because it seeks to build on the successful Marconi Days programme that has run for two years, but whose unit cost was prohibitively high. That programme was managed by the Institution of Electrical Engineers (IEE) and run by Dr Peter Branson (who will play a key role in the new developments). Marconi, with the agreement of the IEE, has asked DATA to take over the management of a revised more cost-effective programme. To reduce costs DATA will seek to use the Internet as a key part of the provision. Although initially aimed at teachers and their students in schools, once the web-based provision is fully operational there is no reason why it should not be extended to a much wider audience including supporting those interested at home and in industry. There is a parallel here with DATA's work on CAD/CAM. The Marconi ECT Project will be placed on the DATA web site and this will be linked to other web sites for teachers and to company web sites for case studies that are relevant to the educational sector.

The Skills for the Information Age – Final Report from the Information Technology and Communications and Electronics (ITCE) Skills Strategy Group states this is one of the most dynamic sectors of the UK economy. It goes on to point out that people are the key to the sector's prosperity. The report states that there are significant shortages of staff with appropriate skills and it points out that in electronics, the output from the education system has risen by much less than other areas, despite the demand. Clearly one of the most effective methods of increasing the number of skilled people in this vital field is to ensure there are learning experiences in schools which stimulate and encourage young people to want to continue their studies or to work in this field. Peter Branson, in his article in *Electronics Education* published by the IEE, headed his article 'Modernise or die!'. He stresses the need for more systems and control and the use and application of modern electronic devices such as PICs, smart cards and electro-luminescence. This modernisation of electronics education will be central to the Marconi ECT Project and we will seek to reflect practice in other 'high-tech' countries.

Background to the project

GEC/Marconi have been funding the training of teachers in electronics for two years, through a series of pilots in different parts of the country. GEC/Marconi have invested £200,000 in this work. This has been highly successful in retraining existing teachers to effectively introduce and teach electronic systems and communications technology in schools. Marconi, as a brand associated with new technology in schools, has been very positively accepted by teachers. The original two-year programme was called Marconi Days, which reflected the high level face-to-face training, but to reflect the new phase of development we have decided to call it the Marconi Electronics and Communications Technology (ECT) Project. The training of teachers in ECT is critical if the new industries are to have the workforce they will need, as good teachers can open the door to students at a critical phase in their life. The main reasons for developing the Marconi ECT Project are:

- Less than 20% of schools are able to offer the opportunity for students to study electronics systems at GCSE because of lack of staff expertise, DfEE statistics 1999 and DATA *Survey of Provision* 1999/2000. This results in approximately 2.7% of the cohort of young people studying the subject by choice in the 14 to 16-year age group. When offered in schools it is a popular and demanding course. The numbers studying this area of activity diminish to an even smaller number of young people post-16 taking A' Level or the equivalent, hence the low number applying for this area of study in higher or further education.

- The new services that will dominate the early part of this century will be Internet focused through 'e' in e-commerce, e-design, e-manufacturing, e-health and e-education, etc. These are dependent upon electronic systems and communications technology. The vast majority of products used by us in everyday life are also controlled in some way by electronics from heating, lighting and air conditioning systems, to cars, mobile telephones and household appliances.

- If the predictions are correct, then there will be more and more 'e' systems. There is no doubt that **we need a highly skilled, technically capable work force**, who can design, build, install, develop, maintain, service and replace these electronic and communications technology systems and networks.

The statistics show that we are not providing sufficient numbers to address this – without the specialist teachers we cannot address the issue. There is also a major question for society – should the vast majority of young people (90%) leave school totally ignorant of how electronic systems work? Surely it is crucial that well educated citizens leaving school have some knowledge and know-how about the principal technology of our time. In addition, many companies such as BAE Systems, Marconi, Jaguar, BT, Dyson and NTL are finding it difficult to recruit at all levels in these area and it is our intention with the help of the DTI to encourage them to support this programme in future years.

Evidence base and basis for next phase

The evidence clearly shows that where good courses are run in schools by knowledgeable teachers, students show real enthusiasm and interest in designing and making using electronic systems. Sadly we have very few quality teachers with the relevant subject knowledge and expertise. We have difficulty recruiting in the first place and those that are successfully trained often leave the profession to work in better paid employment associated with the electronics and communications technology industry.

The Marconi Days pilots have shown that we can take existing teachers and retrain them to meet the need and to provide quality teachers in this vital area. The assessments of teachers in the Staffordshire pilot have been assessed on four areas of competence: systems; components; design and make activities and using ICT in electronics. These were initially measured at the start of the course, again at the end of the course and then one-year after the completion of the course. There was a highly significant growth in confidence of teachers in all four areas by the end of the course and 12 months later that confidence had been maintained and had grown in most cases. This is crucial because the confidence had continued to grow when teachers were teaching new courses, a factor that is not common in technical subjects. In all cases, the teachers had started a new GCSE course in electronics which were proving very valuable. In all but one case the courses were over subscribed and in three schools two groups were needed to meet the demand from students. The Salford, North Wales and Coventry pilots of 1999/2000 have shown similar growth in confidence from the start of the training to its completion and all the teachers are planning new GCSE courses for this September, or started it last September.

Marconi ECT Project development

The aim of the Marconi ECT Project is to create and use web-based materials to train and support teachers in up-to-date electronics and communications technology. The web-based materials will be combined with some face-to-face training and tutor support to give teachers confidence to work in this exciting, yet rapidly changing, area of the curriculum. Once established the materials will also be available to students taking courses in ECT. The objective is to ensure an adequately trained cohort of teachers is created so that every secondary school can offer a course in ECT or related electronics subjects to its students. Once established a series of ECT clubs and networks can be formed to continue to stimulate interest in this vital area of work.

The project in 2000/2001 financial year will develop the web-based materials and trial different training models, with a view to a more comprehensive roll out programme in 2001 onwards.

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Web site development

The development of the web site is critical to the success of the project. Initially the web site will be for teachers, but significant parts of the web site will be opened up for pupil use. There are many ways of organising this from a rather simplistic set of information based on concepts, processes or kits to a series of activities that will use ECT to solve particular challenges. It will have a wide variety of audiences from 'starter' teachers and experienced teachers to pupils and parents. Thus it is necessary to provide access from a variety of starting points. The Marconi ECT Project will only be able to develop modules using certain kit – clearly it will not be able to use any company's materials. However, the project will list other products that could be used and the project will make available the framework to companies so they can write materials to the same format. The project will house those materials on the project web site providing they are of sufficient quality. In some areas of work there will be differentiated activities for teachers and students. The web site will have the following:

- an ECT datafile

- an ECT index

- a series of contexts will be used with suggestions to give opportunities for using ECT. The opportunities will be explained so that teachers and pupils can choose elements for their own challenges. The contexts will be: business/industry, entertainment/sport, environment, home, school and transport.

- case studies which illustrate ECT at work in a range of contexts

- teacher activities and assignments

- pupil activities and assignments.

Initially there will be eight areas of study, which make up the site, although they can be added to at any time. The areas of study are not intended to be equal in size. Within each area of study there will be various modules.

The areas of study will be:

1. **ECT in society**
   There will be modules on:
   - business/industry (sponsor companies will provide illustrative materials for this area)
   - entertainment/sport
   - environment
   - home
   - school
   - transport.

2. **Designing ECT systems**
   There will be modules on:
   - systems design
   - systems building blocks and functions.

3. **Modelling, testing and evaluating ECT systems**
   There will be modules on:
   - Crocodile clips
   - PCB Wizard
   - Control Studio
   - PIC Logicator.

4. **Using technologies in ECT systems**
   There will be modules on:
   - using kits
   - integrating kits
   - smart card control
   - PIC control
   - integrating new materials.

5. **Manufacturing ECT systems**
   There will be modules on:
   - this module is currently being researched.

6. **Designing, developing and maintaining ECT networks**
   There will be modules on:
   - this module is currently being researched.

7. **ECT and the Internet**
   There will be modules on:
   - designing web sites
   - software engineering.

8. **Pedagogic issues in ECT**
   There will be modules on:
   - teaching and learning styles
   - progression, differentiation, breadth, relevance etc.
   - resource management
   - developing and managing projects.

The manner in which the areas of study and the modules within each area are linked together and with the ECT datafile and ECT index will be vital if we are to have a successful web site.

Module structure

The modules will have a similar structure that will be used by all contributors. Figure 1 is an example of a possible structure using smart card technology for illustrative purposes.

The training programme

Experience shows that without some face-to-face training, impact will be limited. Marconi Days with 10 days of face-to-face training was successful, however with the web-based materials we clearly have to try a series of

Area of work	Using technologies in ECT systems.	*Figure 1*
Module title	Smart card Technology.	
Introduction	What is smart card technology? Who is using smart card technology? Where is smart card technology used? How is smart card technology used?	
The technology	Access link to ECT datafile, this will explain the principles behind smart card technology and the full technical specification and relevant applications. (Note the ECT datafile will be built from the technology modules.)	
Teacher/tutor	Teaching notes in both PowerPoint and printed handout format. Objectives for teaching smart card technology Notes on progression in using smart card technology. Notes on student activities using smart card technology. Notes on assessing work using smart card technology. FAQ in using smart card technology. Links to resources available for using smart card technology.	
Student notes	Know how notes on smart card technology for student use. Student activities in progressive order using smart card technology. FAQ in using smart card technology. Links to resources available for using smart card technology.	

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models with reduced face-to-face training to keep down costs and these pilot programmes will seek to identify the effects of the different models. The programme will seek to train 60 teachers with this funding, although the complete training may not be completed until July 2001. The schools will be selected from a range of backgrounds although our intention will be to have a focus on inner city schools in or close to regeneration areas and in some cases linked to Education Action Zones.

The 12 hours face-to-face groups

- Identify schools through advertising and personal contact, the aim will be to get a cluster of schools in a given area to help local networking.

- Letter to head of school setting out the scheme and the commitment expected by the school to the scheme, at a minimum level that will be a GCSE course in electronics.

- Identify specific teacher that is required for training.

- Send some pre-reading tasks.

- Introductory 12 hour minimum course. Purpose of course:

  - introduction to scheme
  - taster modules
  - needs assessment
  - personal action plan
  - monitoring and support structure
  - accreditation.

- Action Plan agreement and signature from head teacher 21 days after the course.

- Tutor support programme.

- Monitoring.

- Assessment.

The 24 hours face-to-face groups
The second group will have the same as above, but will have an additional second level of support. This will include a 12-hour practical course which will include an assignment to be done prior to the course and two practical assignments on the course. However, it will not have the capacity for a tutor visit.

A teacher's training outcomes will include accreditation by DATA, with a certificate of competence in ECT, hopefully endorsed by the DfEE and other key players such as the IEE. The competences will cover a range of areas of work and will hopefully become part of a teacher's continuing professional development portfolio. DATA will also set the criteria which will allow schools to sign up to be an ECT school with logo branding and certification for the school. This should raise the profile of the scheme with schools and governors.

The 2000/2001 programme will have the following objectives for the pilot development phase of the programme

1. Establish a national advisory steering group with representation from the Government, its agencies, industry,

including EMTA, and chaired by Paul Watts from Marconi.

2. Establish a robust management structure for the project and create mechanisms for school contracts for those participating in the project.

3. Hold a high profile launch for the new Marconi ECT Project.

4. Develop through the pilot a new framework for a teacher training programme, which places major emphasis on using the Internet linked to the DATA web site.

5. Development of modules for teaching ECT systems on the Internet.

6. Develop wider industrial support for the project to enable the project to continue in 2001 and beyond.

7. Trialling the new framework for training with 60 teachers using the materials and identifying resources that will be needed.

8. Evaluation of the modules and training the teachers.

9. Establish accreditation for schools and teachers.

Milestones for the future development of the programme

The milestones reflect the aspirations of the programme after the pilot phase development. Clearly it will be highly dependent upon the training model chosen and the level of funding made available from the DfEE. The milestones seek over the four year programme to make the training available to all schools in England with an identified need, although we may find that some schools teaching existing programmes may wish to take part to update their skills and knowledge. The best estimate is that the training programme will take in approximately 2,800 teachers over four years.

Milestones for financial year 2001/2002
*   700 teachers trained.

*   Modification and refinement to the ECT resources.

*   Introduce web site support for students.

*   Establishment of accredited trainers.

*   Updating offer to existing schools with trained teachers to join scheme.

*   Work with examination bodies to establish specialist courses in ECT.

Milestones for financial year 2002/2003
*   700 teachers trained.

*   Introduce new specialist courses including GCSE in ECT.

*   Launch ECT clubs initiative.

*   Establish regional network with accredited tutors.

*   Establishment of master classes for young people based in school and universities.

Milestones for financial year 2003/2004
*   700 teachers trained.

*   Prepare guidance for National Curriculum revision to incorporate ECT more prominently.

*   Revision of the ECT resources provision for teachers.

*   Introduce online assessment for students in ECT.

Concluding comments
It is somewhat unusual to publish a paper at the start of a major initiative which currently only has funding for the pilot phases and which will require substantial DfEE funding if it is to be successful. However, many major projects have papers written that show impact after the working is fully underway, this paper reflects the rationale used to obtain Marconi and DTI pilot programme funding, and may be of interest to those seeking to develop future programmes. A series of papers are filed at DATA which show the different papers that were written to various bodies for funding, including major proposals that were unsuccessful to bodies such as the New Opportunities Fund. The interactive process of presentations and writing papers to gain funding for such work should not be underestimated. As the programme develops, it will undoubtedly change as we learn and as new technologies emerge.

References
Branson, P. (2000) 'Modernise or die!' *Electronics Education* Summer 2000, London: IEE

DATA (2000) *Annual Survey of Provision 1999/2000*, Wellesbourne: DATA

DfEE/DTI (1999) 'Towards a National Skills Agenda – Skills for the Information Age' Final Report from the Information Technology, Communications and Electronics Skills Strategy Group, London: DfEE Publications

DfEE (1999) *Statistical First Release Ref 35/1999 Examination Statistics* Summer 1999, London: DfEE

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