Between Technology and Creativity, Challenges and Opportunities for Music Technology in Higher Education

Carola Boehm, Centre for Music Technology,
University of Glasgow, carola@music.gla.ac.uk

Abstract

A presentation at Bath Spa College University in June 2001 gave me the occasion to rethink the existing Challenges and Opportunities of Music Technology within Higher Education today. To integrate an interdisciplinary field, such as Music Technology, into an academic discipline-segregated structure, such as that existing in our Universities, provides, in many ways, more challenges than opportunities: in research as well as teaching and administration. This report will present an overview of this situation, fed by my personal and professional experiences working with or in various academic institutions. Several working groups and workshops, such as the EC funded CIRCUS project (Content Integrated Research into Creative User Systems)[1], the invited EPSRC Music Technology workshop[2] as well as the invited EC "creativity and technology"[3], have addressed relating issues of teaching creative and music technology courses in HE, with the result of giving it an even broader perspective. Although this is within a European context, most issues are possibly restricted to the British continent. In this light, this report tries to provide a deeper understanding into the inherent problems and the immense potential in which this discipline is currently standing: a potential which many universities are managing to exploit to a great academic benefit. The report will cover an initial attempt of defining the area of "music technology" within a realistic academic context, and subsequently look at some challenges of teaching this discipline within HE institutions. The changing face of research funding opportunities are sketched and described, and a conclusion based on this discussion is given.

1. Between Technology and Creativity: Music Technology, an interdisciplinary new discipline?

1.1. Our Students – Music Technologists of the fourth generation

The discipline of Music Technology, if it is such a thing as a "single" discipline, has already acquired a relatively long history. Seeing our students in HE institutions as a part of this history shows how much we, as teachers and learning facilitators, still need to learn in order to teach this new academic discipline within our own institutions.

Our students could be considered the “fourth generation” of music technologists. Oversimplified, the first generation of Music Technologists could be called the "Experimenters" of the 50s and 60s, with individuals such as Pierre Schaeffer, Karlheinz Stockhausen, Herbert Eimert, John Cage, Robert Moog, Donald Buchla, Max Mathews, Lejaren Hiller, and many more. For the first time a critical mass of technologists and musicians looked at music and technology and tried to develop their own methods of combining aspects of previously different disciplines into one.

In the danger of continuing this oversimplification, the second generation of the 70's and 80's built on the basis of the first generation, and with a fast developing commercialisation as well as academic endeavour in this area, the speed with which music technology was developed, produced and utilised in works of art accelerated. Centres were created and individuals like Pierre Boulez , J.C. Risset, Barry Vercoe, Trevor Wishart, Miller Puckett, Gottfried Michael Koenig, John Chowning and Morton Subotnik, provided a wide variety of activities within this discipline.

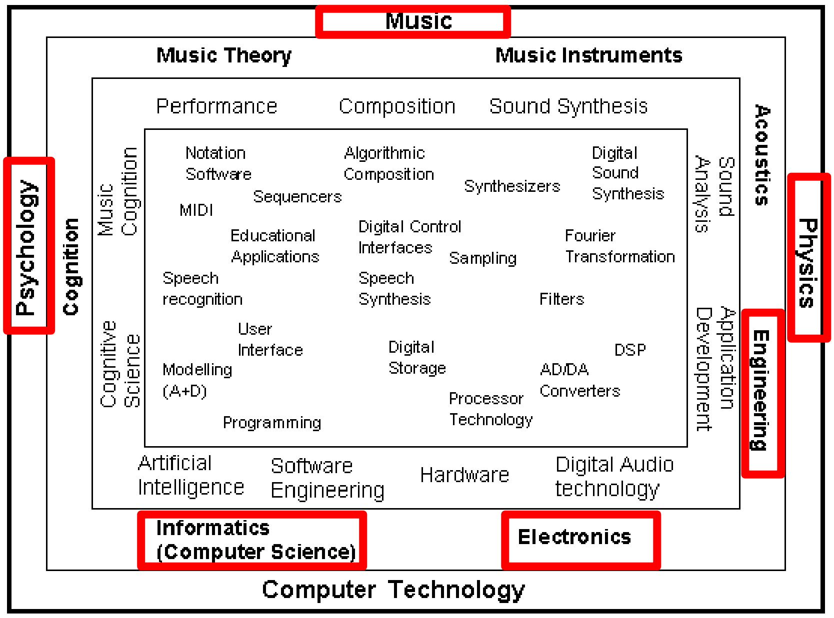
The third generation of the 90s and 00s was able to position first lecturers of music technology into academic institutions. Music technology was slowly becoming an academically viable discipline of education and research. More well-known individuals of this generation such as Roger Dannenberg, Stephen Travis Pope, Todor Todorov could be named, among many. For the first time a critical mass of individuals, who had studied more than one discipline and who had a background in more than one field, existed to push this area forward. (My fellow lecturers and I belonging to this generation.)

The fourth generation can be seen to be our current student body: students of interdisciplinary music technology degrees, such as BMus in Music Technology, or the BEng + Music as taught in the University of Glasgow. These are the first body of students who are studying music technology as one discipline or as one degree.

These degree curricula are of a multidisciplinary nature, but are still given as if they fit seamlessly into our traditional, discipline-based academic structure. Sometimes we, the lecturers, course developers and degree managers, forget that these are degrees which do not have a long standing tradition on which practices can be based, and that we are ourselves are still in the process of learning how to best facilitate the provision of these new degrees. Glasgow University is best placed in this

[1] Content Integrated Research into Creative User Systems. EU Working Group 1998 – 2001. http://www.circusweb.org Last accessed 13/06/01.
[2] EPSRC - Engineering and Physical Sciences Research Council. Workshop on “Funding of Music Technology”, Harrogate, Febr. 2001.
[3] European Commission - Workshop, FhG Darmstadt, May 2001: "Technology platforms for cultural and artistic creative expression”

respect, as it has one of the oldest music technology degrees in Britain: the BEng + Music. Nevertheless, the challenge exists concerning how best to integrate an interdisciplinary field into a disciplinary framework.



Philipp Ackermann, Computer und Musik, Springer Verlag, New York, Wien 1991

This challenge exists on all levels of academic endeavour: from the running of these courses and its administrative frameworks, to the teaching and facilitation of learning, the disciplines' pedagogies and specific vocabularies, and its research with its own particular methodologies.

1.2. Music Technology, defining an academic Discipline

To teach or facilitate the learning of music technology within HE, a corpus needs to be a defined: a taxonomy of issues belonging to this subject, and a definition of the borders of this discipline.

Interdisciplinary subjects such as music technology are almost impossible to rigidly press into a specific corpus, resulting in the disadvantage of not allowing change or development. In addition to its current developing nature there are varying views of this discipline, which allow for a variety of academic degrees to emerge: the engineer's point of view is facilitated by a B.Eng.+Music, the Musician's View possibly by a B.Mus. in Creative Music Technology, and so on. Nevertheless, if this discipline is to exist successfully within current HE institutions, there is a need for institutions to explicitly formulate teaching-content responsibilities according to faculties, departments or schools, and it requires those involved to lay down and quantify the amount of knowledge, i.e. create a corpus and thus define a discipline.

Above is Philipp Ackerman's visualisation of the discipline[4]. Many such visualisations of taxonomies exist, amongst them the simplified version of Richard Moore of "Arts, Science and Technology", and his more detailed visualisation of a music technology pentagram[5] with Engineering, Computing, Music, Psychology, and Physics.

One of the most detailed taxonomies is the one edited by Stephen Travis Pope[6] with subsequent additions and changes from contributors. This has become the classic taxonomy to be used in education of music technology, due to its comprehensiveness. Below are listed the first two levels of this taxonomy.

1. Music theory, composition, and performance
    1.1. Music theory, sociology, and aesthetics
    1.2. Composition of electroacoustic music
    1.3. Algorithmic and computer-aided composition
    1.4. Performance situations and interfaces

2. Musical acoustics, psychoacoustics, perception, and cognition
    2.1. Musical acoustics and psychoacoustics
    2.2. Music perception and psychology
    2.3. Music understanding and cognition

3. Musical signal and event representation and notation
    3.1. Models of signals and events
    3.2. Musical event description languages
    3.3. Musical signal description languages
    3.4. Music notation and printing tools

4. Digital control and sound signal synthesis and processing
    4.1. Sound synthesis methods
    4.2. Time- and frequency-domain signal processing
    4.3. Sound spatialization and localization
    4.4. Machine recognition of signals and events
    4.5. Real-time processing and scheduling
    4.6. MIDI and control processing

5. Hardware support for computer music instruments and tools
    5.1. Hardware for DSP and digital audio
    5.2. Computer music workstations
    5.2. Input/Output devices for music

6. Computers in music education, and computer music education
    6.1. Computers in music education
    6.2. Computer music education

---

[4] Philipp Ackermann, Computer und Music, Springer Verlag, New York, Wien, 1991, p2.
[5] F. Richard Moore, Elements of Computer Music, Prentice Hall, New Jersey 1990. p 24
[6] Stephen Travis Pope, Foreword, in Computer Music Journal, 18:1.

7. Computer music literature, history, and sources
   7.1. Bibliographies/diskographies
   7.2. Studio reports
   7.3. Descriptions of compositions
   7.4. History of electroacoustic music

Figure 6: Extension of Pope's proposed taxonomy to two levels

All of these lists and visualisations of taxonomies enable us to define what exactly should, needs, and could be taught within academic degrees of music technology. This discipline is a very fast moving field and its corpus may, for many years to come, be a moving target. Its interdisciplinary nature allows it to locate itself within new combinations of old disciplines, binding them together into a new opportunity of gathering insights to new knowledge, and providing the opportunities to feed back into the knowledge of traditional disciplines. The challenge lies in the successful integration of such an interdisciplinary subject as "Music Technology" within a discipline-based educational framework.

2. The challenge of Institutional Frameworks

Music Technology has traditionally been placed within Music Departments, especially in Britain, where the tradition of "computer music" became a strong influence in contemporary music, taking up the momentum where the German "Elektronische Musik" left off. Music in itself, of course, has had its place traditionally in Arts/Humanities Faculties,and in a few Universities, Music has been able to exist within its own Faculty.

2.1. Music Technology within the framework of Arts and Humanities

The academic discipline of "Music" within British Universities has the tradition of being a practice-based discipline. This characteristic is not shared with the majority of European countries, but has greatly contributed to Britain’s high attraction for overseas and European students, and has probably contributed to its successes in the music trade: Britain has a market share of 10 – 15% of the world trade of records[7]. The notion of "learning by doing", with performance and composition being methods of attaining a higher level of understanding of music styles or music activities, has more in common with other vocational disciplines, such as design, practical arts and also the "lab-based approaches found within engineering and computer science studies.

Thus, the fact that Music Departments in Britain generally tend to be located within the Humanities can provide a point of friction, where methodologies between the more historical and analytical disciplines clash with more vocationally driven disciplines. Especially in times when universities' financial resources are stretched, the tendency to adopt the “German Approach” of ‘Musicology at Universities’ vs ‘Music in Conservatories’, seems to be an acceptable solution. A very fractured understanding of the disciplines themselves can and will undoubtedly result, as will a very divided community of "theorists" and "practitioners". This is something which Britain has managed to avoid almost completely, to the success of its own music communities and academic endeavours. For such a new discipline as Music Technology, the fracture represented in the "German Approach" becomes critical, with "Theoretical" music technology ("Musikinformatik") being generally located within Universities under "Systematic Musicology" and Electro-acoustic Composition being located within conservatories.

This division, as existing in Germany, tends to have the effect that universities are left with the degree of musicology - not music - with its academic traditional historical, analytical and theoretical (but not practical and creative) approaches to the field: these approaches being well understood within the humanities. Music Technology, which is heavily driven by creative processes, tends to be ill-placed in this environment as it is solely used as another tool for analysis of music or musical activities.

The need for joining theory and practice in music education has been a classic requirement, explicitly discussed and mentioned throughout history, and can be traced as far back as the Greeks. (Strangely enough, as soon as a computer is involved in academic activities, most disciplines think it useful to utilize "learning by doing" methods, but this thinking does not transfer itself to other instruments of learning, such as musical instruments or composition.)

Practice-based disciplines, such as the British music degrees, are often located within a faculty in which not only the understanding of its practice-based approaches might be missing, but moreover, where financial constraints can force departments to adopt more conventional (and low-cost) approaches to its own discipline: contrary to the British tradition of practice-based music degrees. Consequently, the attraction that British degrees have on a European scale can be lost.

Within Britain it has finally become standard practice to accept musical activities, such as performance and composition, as valid outputs of research (see the newest RAE specification), but nevertheless, institutions still tend, in to often mistake method with the learning objectives of practice-based aspects of this discipline.

As you would expect in conservatories, performance and composition is aimed towards delivering professional quality. However, in the degree courses often existing in universities, the involvement of performance

[7] Figures taken from the British Government's Department of Culture, Media and Sport, http://www.culture.gov.co.uk/creative/index.html Last accessed 21/06/01.

and composition is also used as a tool to attain a higher level of understanding of the material being dealt with. If this vital difference is not understood it can be difficult to justify the more costly activities of performance and composition within Universities, which often do not have the remit to train future performers and composers. The notion of "learning by doing" is conveniently forgotten in the light of cost-saving decision making processes. Not illogically. These issues are understood and accepted much more within engineering and computer science contexts than in the Humanities: furthering the difficult positioning of Music within an Arts and/or Humanities framework. Consequences of this can be seen in the phenomena of discussing the closing down of Music Departments in the light of Conservatories existing within the same city.

For Music Technology as a discipline often situated within Music Departments or Music Faculties, several additional issues present themselves. The practice-based elements of its academic activities are understood, as described above, however the methodologies for research into music technology are very different from music, and as such can be very difficult to understand if coming from a point of view used to traditional music research approaches.

Music Technology research methods have always been closely related to, and adopted from, the science-based disciplines such as engineering and computer science. Characteristics of this research include:

- emphasis on teamwork and collaborative projects
- multi-institutional R&D projects
- commercialisation aims and industrial collaboration
- involvement in technology developments with international consequences, such as standards development, basic research, long-term research
- involvement in a wider diversity of funding schemes
- ability to draw on a wider variety of funding bodies
- ability to attract more industry sponsorship
- more opportunities for large scale projects
- more possibilities for industry-bridging activities for universities

These approaches do not necessarily remain only within research areas, but as can be expected and desired, feed back into teaching, utilising teaching methods such as:

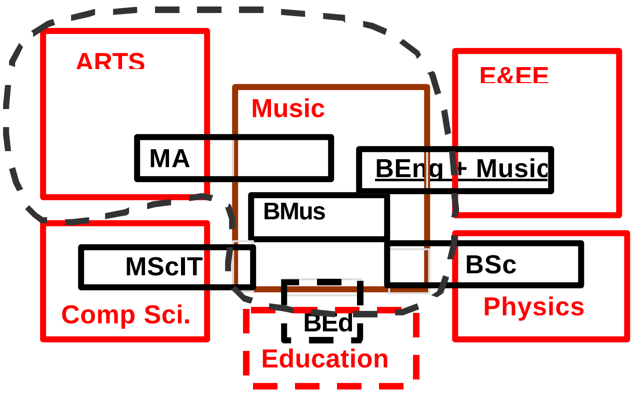
- large team projects,
- industry relevant assignments,
- industry placement,
- industry funded/supported projects
- etc.

As a result, difficulties can occur when needing to assess research and teaching within one set of criteria, such as for RAE (Research Assessment Exercise) and QAA (Quality Assurance Agency).

Lastly, but possibly one of the biggest challenges existing for Music Technology today, is that the introduction of music technology into many music departments has created, what has been called a "Trojan Horse" complex. The rising interest of music technology has been met by a general decline of financial support for arts-based subjects in the last decade or so. This means that Music Technology within a Music department can be seen as resource-hungry: a costly but very popular activity - further fed by the music industry's need for specialists in this area. This results in a situation in which many Music Departments have had to decrease the size of their total teaching body, but increase the number of staff active in music technology. With the ratio of "music technology staff to musicology staff" rising, inner-departmental long-term strategies might not be able to be set without conflicting interests and tensions arising from having to distribute the limited amount funding.

2.2. The Trials of Institutional Frameworks, an example: University of Glasgow

Taking the University of Glasgow as a working example of teaching Music Technology at Undergraduate and Postgraduate level, most of the above described issues can be demonstrated.



There are several degree programs that have incorporated smaller or larger parts of Music Technology into their curriculum. If only taking the Honours degrees into account, the list of available courses with Music Technology modules integrated into them is:[8]

- **BEng + Music**, a 4-year degree with 1/3 Music and 2/3 Engineering, collaborating Faculties of Arts (Music Department) and Electronics and Electrical Engineering (Electronics Department). Similarly the **MEng + Music**, which adds a further 5th year to the normal BEng + Music, with slight changes in the fourth year to add emphasis of Business management and Business studies. The BEng and MEng + Music provides knowledge and understanding of the theory and practice of music technology and provides students with the opportunity to develop

[8] Numbers are taken from estimates of the sessions 1999 – 2001 and are averaged

transferable skills particularly useful to professional engineers within music technology related industries.

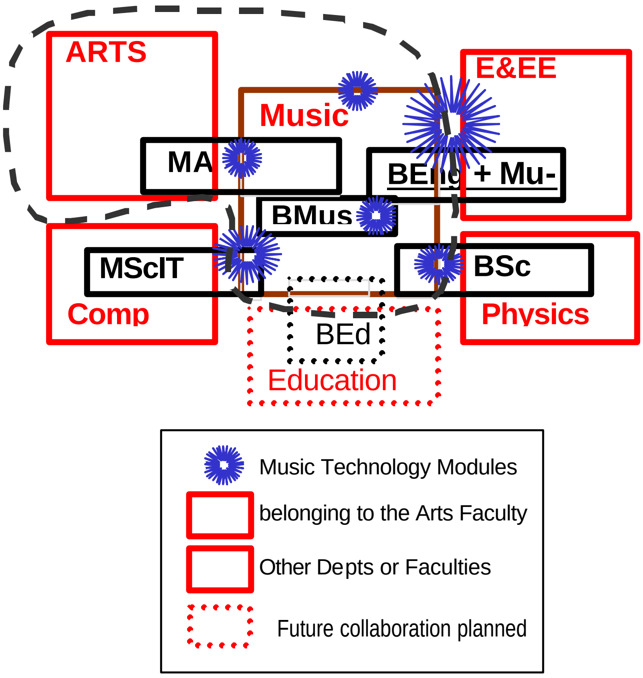
- BEng + Music in all four years are ca 90 - 100 students, (FTE 30 – 33)
  - o of which all take Music Technology Options = 100%
  - o Music Technology within the BEng + Music accounts for ca 120 credits of total of 560 credits= 21%
- MEng + Music in the 5th year are ca 5 - 7 students,
  - o of which all or most of them take a Music Technology placement with Music Technology supervision = 100%
  - o Music Technology within the whole MEng accounts for 180 credits of total of 680 credits = 26.5%

- **BMus**, a 4 year degree programme based100% within the Music Department, provides a broad vocational course of study as preparation for the musical profession in the broadest sense of the word
  - BMus in all four years are ca 50 students (FTE 50)
    - o of which ca 1/3 take music technology options in their degree = 30%
    - o Music Technology courses within the BMus accounts to ca 60 credits of a total of 480 credits = 12.5%

- **MA (and Physics + Music)**, a 4 year degree between the faculty of Arts and the Music Department, provides a flexible modular programme for those who wish to study Music within the context of an inter-disciplinary degree
  - MA in all fours years are ca 130 – 150 students (FTE 65-70)
    - o of which ca 1/3 are allowed to take music technology options (quota) = 33%
    - o Music Technology within the MA accounts for ca 60 credits of a total of = 220 to 340 credits (depending on joint or single honours) = 27.3% to 17.6%
  - MSci of Physics and Music accounts for only ca 5 – 7 students in all fours years and is included in the numbers above

- **MScIT**, a one year postgraduate degree in Information Technology based in the Department of Computer Science with specific single modules coming from other departments such as Music. It includes a 6-month project at the end of this one year period.
  - MScIT students who were allowed (quota) to take a Music Technology option (from 1999/00) = 10
    - o of which all of these took only Music Technology courses within the Music Dept = 100%
    - o Music Technology modules within their MScIT degree makes up 1 unit out of a total of 13 units = 7.6%
  - MScIT students who were allowed (quota) to choose a 6 months Music Technology related project (from 1999/00) = 2
    - o of which both took Music Technology supervision and courses = 100%
    - o Music Technology modules (incl. supervision of project) accounts for 4 units of a total of 13 units = 30.76%

Music in the University of Glasgow is located within the Humanities/Arts Faculty. Collaboration between the Education Faculty and the Music Department due to relocation can be expected in the near future.



As most of the Music Technology courses are under heavy constraints due to a limited number of available staff and available resources, quota or entry restrictions are in force for the majority of modules. The quota for the BEng+Music intake is currently set at 25 per year, and the entry restrictions for Music Technology courses for MA and BMus are currently set to allow a maximum class size of 30. Quotas and restrictions can pose difficulties for educational objectives. Certain skills, such as computer based music notation and basic digital editing and sequencing, should actually be taught in the first years of the BMus/MA course in order to act as supporting tools for further activities within the music department. However, due to the need for keeping numbers lower than the existing interest, such skills are only able to be taught to a fraction (1/3 MA and 1/2 of BMus) of the students, and only to 3rd and 4th year students. A fact that has been criticized by students and staff, but resources simply have not permitted any other solution.

In most of these interdisciplinary course activities, music technology acts as glue (in the diagram above depicted as blue fuzzy balls), drawing different disciplines together. Only the MA, as a degree between Arts and Music, has a substantial amount of non-technology musical activities. Most other disciplines, such as Computer Science, Physics and Electronics & Electrical Engineering have a much higher demand for music technology courses, which can also result in a conflict of interests, described below.

A general tendency is currently evident of a nationwide decrease of students coming into the Electrical Engineering courses, and departments have problems of attracting students into their pure engineering degree courses. The more attractive courses seem to be Applied Engineering and similar degrees with a multi-disciplinary element, such as Multimedia, IT, Business Studies, and audio, video or music related courses. Within the University of Glasgow, for instance, the BEng + Music is a highly successful course which attracts a high number of students.

Engineering is one of the Departments with the largest research income, and with a relatively low undergraduate staff/student ratio: in effect the opposite of the Arts Faculty, with a high number of students but a low research income. The normal income gained from Under Graduate teaching in faculties such as Engineering cannot balance the cost of staff, and numbers have to be balanced across faculties which have a higher income from UG teaching, for instance the Arts. As the Arts Faculty itself has its own strategic plan concerning undergraduate expansions which might not include expansion of faculty-external degrees (as the BEng+Music), and similarly, as the Music Department is constantly in the position of needing to balance the demand for musicology, compositional activities and music technology activities, expansion into music technology cannot be done without considering the balance of sub-disciplines within Music and the balance of resources across departments within the Arts Faculty. Thus an expansion of, or building upon, the BEng degree can be difficult: although it would be logical from the Engineering Faculty's point of view, it is not of direct interest and might be contrary to the long-term strategic plans of the Arts Faculty, and possibly that of the Music Department itself.

This absence of the flexibility to expand into a successful area creates a deadlock situation in which Engineering Departments can only create their own interdisciplinary courses, not able to collaborate with other Departments dealing in this discipline. A big potential for teaching and research is missed.

The above problems can be seen to be reflected, with some negative consequences, within the Music Department at Glasgow University in the last few years. Consequences such as:

- inability to continue to offer the Music Technology Module for the Computing Science Dept.'s MScIT course
- inability to offer supervision for interdisciplinary projects between Computer Science and Music
- lack of expansion on the potential of the Physics + Music degree
- setting of restrictions in order to have a quota on Music Technology courses for MA and BMus, leaving fundamental computer-based music skills out of the current curriculum
- setting of a quota on BEng+Music intake and postgraduate supervision from Music

As may be expected, this can lend a strained and tension-fraught environment to a highly attractive and in-demand discipline: causing general discontentment, and resulting in:

- Teaching staff leaving or taking early retirement, further aided by their skills and expertise being headhunted by industry companies
- Good technical and administrative staff feeling undervalued and unable to remain for long in these positions
- Students leaving within their 2nd and 3rd years
- Research not being able to flourish and being forced to keep a small profile
- General dissatisfaction in working and studying life reflected throughout departments

The potential in staff and resources in such an environment lies dormant: all this in an area which, in industry is the second largest in Britain, and which has one of the highest commercial, research and teaching potentials. For a discipline such as MT to find itself in such a framework is detrimental to its own development as a discipline and probably detrimental to all those involved.

Only a very supportive Faculty or/and Department, might be able to compensate for the deficiencies that this type of structure in an institutional framework can create, generating a direct conflict of interests which seems difficult to be resolved.

3. The opportunities within institutional frameworks – Education and Research

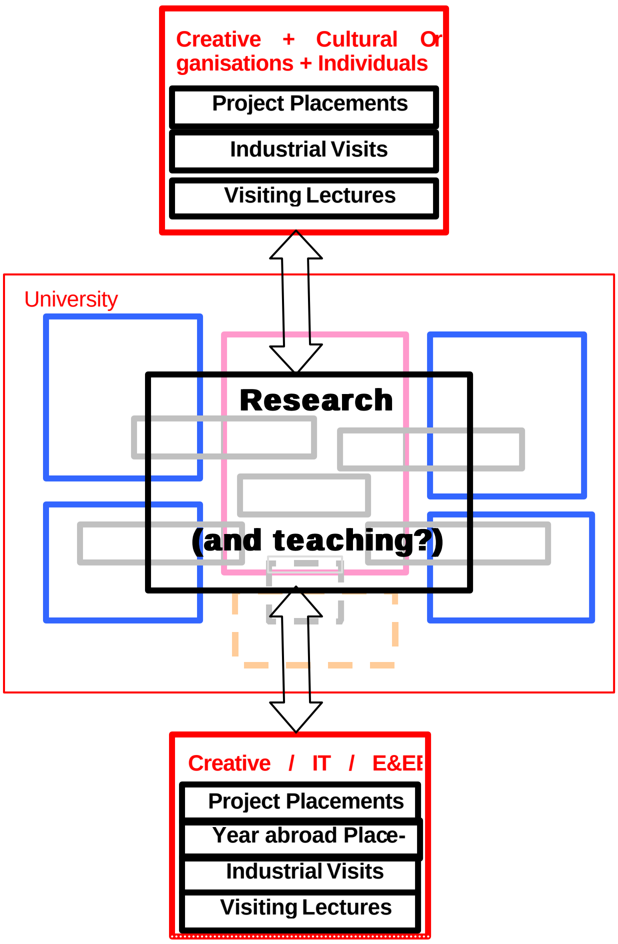
Having covered some of the basic problematic issues of music technology within traditional HE institutional frameworks, one could attempt to formalise a range of possible solutions. To place a discipline, which has both creativity and technology as its central driving forces in a larger institution will probably provide a constant challenge. Larger institutional frameworks will always have the need for stable and permanent long-term structures in order to work efficiently, whereas creative disciplines, in general, stand opposed to institutionalised frameworks, and technology-driven disciplines tend to move too fast to stay efficiently stable for larger HE sectors. This has always been a problem, especially when it comes to equipment funding allocation.

Other institutions have tried solutions such as:

- the regrouping of disciplines to make faculties smaller and create smaller groupings of more similar disciplines. “Schools” seems to be fashionable these days, but the regrouping from faculties into schools can logically only be of benefit if the schools themselves replace the faculty structure, and not impose yet another layer of bureaucracy
- the creation of Music Faculties
- the creation of Centres of Study

The creation of centres is an interesting type of solution as it offers many possibilities that other frameworks are not able to supply:

- a centre might be made up of individuals from different departments with an interdisciplinary aim or objective
- a centre might include external organisations, such as companies and creative and cultural organisations, exploiting possibilities of project-placement, industrial visits, visiting lectures...
- a centre might interact with a number of departments and faculties with a higher level of independence and not restricted to departmental or faculty strategic plans.



"Vertical centres", or centres which include organisations outside of the university as well as different departments from within, offer many types of collaboration. Collaboration which not only provides a fantastic basis for developing the research field of music technology, but can also provide the overall need for formalisation of university-industry bridging, as emphasized by the EC in its newest 6th framework (See chapter 4.2.). Having adequate bridging is positive for students and staff in many areas of HE activities, but is vital for industry to exploit the newest developments in a field.

As there are more opportunities for research than teaching in our traditional HE framework, it becomes clear that there is a high importance placed on research feeding back into Undergraduate and Postgraduate teaching. In addition to this, in a fast moving field such as music technology, research becomes vital in order to stay close to state-of-the-art developments, as the status-quo is moving much faster than in traditional Arts/Humanities disciplines. This calls for a higher interaction between future technologies and the students’ curriculum. If centres are able to include teaching provision into their remit, then there is a higher amount and diversity of interaction between teaching and research, profiting the students in their acquiring of knowledge in this fast moving field.

Interactions of research and teaching can occur and can be supported in many ways and on many different scales:

- Assignments/Projects can be influenced or formulated by research/industry/external factors (see example below)
- Research Projects, PhD students and research staff can feed into the curriculum
- Industry/Organisation student placements in summer or for final year projects
- Industry/Organisation/individual visiting for lectures in a specific topic
- Larger student projects based on collaboration with external organisations/industry bodies
- etc.

3.1. Music Technology Education in Practice

To demonstrate interaction between research and teaching some examples from the BEng + Music course at Glasgow University are described. Below can be seen a schematic diagram of the BEng + Music and the MEng + Music degree programme at the University of Glasgow. This course is taught in both the Music Department and the Electrical Engineering Department. The Courses in Engineering encompass traditional electrical engineering subjects[9]. The courses within the Mu-

[9] E&EE1 (EE1, Math1) , E&EE2 (Digital Systems, Electrical Circuits, Electronics, Design Project, Mathematics, Programming), E&EE3 (Communication Systems, Electro-

sic Department encompass music technology subjects as well as non-technical music options, such as performance, music history and integrated musicianship.

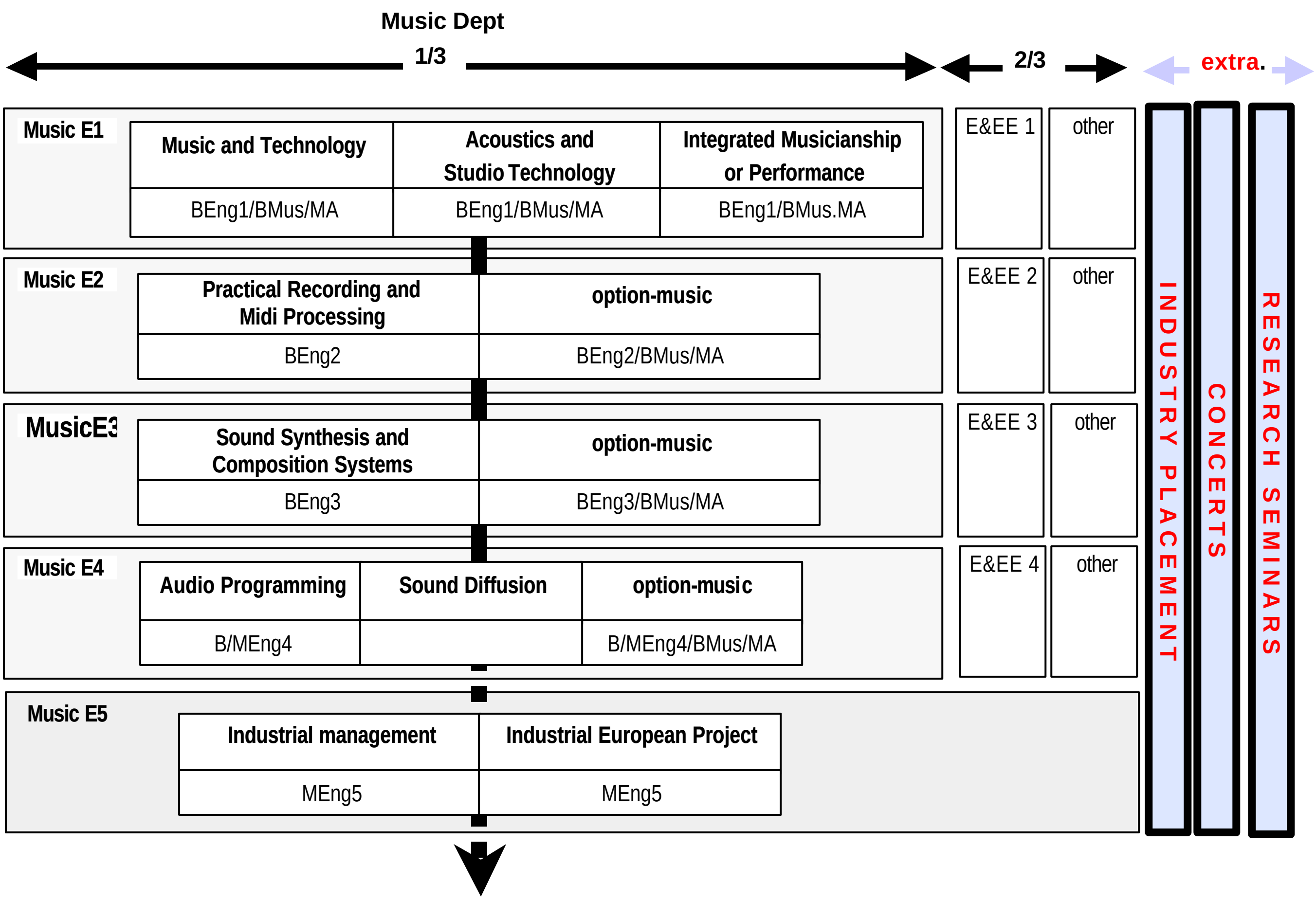
In the first year, "Music and Technology" gives a good overview over the whole subject, introducing this area to students and training them in the basic tools for their further study. This includes sequencing, digital editing and music notation, but also covers repertoire of electro-acoustic music, basic HCI, software evaluation methods and other relevant aspects. "Acoustics and Studio Technology" provides a basic grounding and good general coverage in Acoustics, without going into depth in any specific area. The 20 hours of lectures and practicals cover aspects of room/concert hall acoustics, instrumental acoustics, sound production and wave theory, hearing, psychoacoustics, tuning and temperament, etc. This is followed by a basic Studio Technology course, building upon the acoustics knowledge gained. In this, the students are able to apply their knowledge of instrumental acoustics with new knowledge of microphones and placement, editing collages with recorded analogue sounds, acquiring basic knowledge of studio equipment, such as effects, multi-tracking, recordable media, etc.

In year two, this knowledge is deepened by "Practical Recording and Midi Processing", which is basically a more advanced studio technology course. At this stage students are required to record live concerts and produce session recordings, besides acquiring knowledge of the design and the use of state-of-the-art studio equipment.

In year three, "Sound Synthesis and Composition Systems" enables the involvement with synthesis techniques using Csound and PD and other compositional tools. In the fourth year, a deeper understanding of spatialization theory and techniques, using works from "SSCS", is acquired in "Sound Diffusion" and "Audio Programming" allowing students to acquire high- to low-level programming skills for audio applications in C and C++.

MEng students continue on into a 5th year, which includes Business Studies and a placement abroad at a European institution or company placement. For MEng + Music students, the placements are music-technology related, such as placements at IRCAM in Paris, Sony in the UK, and so on. Supervision is shared between the Departments and the placement institution.

Throughout their fifth year extra-curricula activities are encouraged but not officially supported or required. The



magnetics, Circuit Design, System Design, Mathematics, Team Design, Project, Real Time Computer Systems),

E&EE4 (Final Year Project, Acoustics other courses) amount of which depends on individual staff input as well as the interest of students. These can include summer placements in music relevant industry or organisations, visiting regular concerts at the University, taking part in recording projects by staff or other students, attending research seminars, or becoming active in continuing projects, music groups, or clubs related to this field, such as student radio or television station, Big Band, orchestra or choir.

Only small changes were needed in the past few years, such as switching "AP" and "SSCS" in their respective years, or, as planned in the new year, to put MT and AST into one larger course together (starting 2001). In general, the curriculum is thought of, by students and staff, as highly relevant to their future job prospects. It is a highly successful and attractive course, with more students wanting to come onto this course than can presently be accepted. Staff teaching on this course has established a tradition of having a close relationship between research and teaching. In the past, when the course was co-ordinated by Dr. Stephen Arnold, courses such as "Music Technology" offered a modular approach that could allow newer technologies to be integrated slowly but continuously. Thus, in 1998 for the first time there was a three-week module on music databases, including database design and web-gateways for databases. A relevant issue as music has very special needs in terms of its information management. This module had a large input from the simultaneously-running SmaTBaM projects, which investigated systems for storing musical data.

Another example of a common-use external project becoming part of curricula activities can be found in one of our compositional modules. Dr. Nick Fells, having organised a electro-acoustic-visual-media concert in 2000, planned its dates to coincide with workshops of his compositional courses, thus being able to let the composers participate in the workshops heightening the awareness and understanding of such pieces of work for students, and enabling relevant feedback to be exchanged by students and composers.

For a more detailed example of a 1st year and a 3/4th year course, "MT" and "SSCS" are again used. Between November 1999 and August 2000, a project was underway within the Music Department called "Direct software evaluation of Music Notation Packages for an Academic Context". This was funded by JISC/JTAP/UCISA, and evaluated music notation software packages on the basis of multi-user, multi-platform, multi-computer, networked system context [10]. In short, this evaluation considered aspects which are specifically relevant to educational institutions, especially in the HE sector, when considering what notation package to chose. The project was scheduled so that planned workshops and questionnaires for music notation users would fall into the 2nd term of the "Music&Technology" course, allowing a four-week module within this course to be used to

- cover basic issues around human computer interaction and evaluation techniques
- train basic skills in using different kinds of notation packages
- integrate into the coursework the music notation workshop with questionnaires of 1st time users as well as intermediate users

After the 4-week module, the students were given the project assignment (reduction from four page project and task description):

Class Project 1: Computer Based Notation Packages
(Evaluation of music specific software, Notation)
The Scenario

Imagine you are a technical consultant hired to evaluate different notation packages. Your client is a Music De partment in which 25 computers, which will be available for students and staff, have to be equipped with notation packages. These notation packages will be used for

- notation of composition classes and other music stu dents in need of professionally looking scores
- training of the use of notation packages for the music industry
- professional creation of editions of Scottish music within funded departmental projects teaching, learn ing and training of the engineering aspects of devel oping music systems

Not only were students able to acquire knowledge in HCI and evaluation techniques for music software (which has its own specific needs), but also the results of the workshops with students fed-back into the Evaluation project, bringing direct benefit to both staff and students with this high interaction between research projects and educational module.

A further example (of many) is the second project of the "Software Synthesis and Composition Systems Course", which is basically a synthesis problem solving project. This project was assigned for the first time in 1999. The idea for this project came from a group of research projects running in the Computer Science Department under the co-ordination of Dr. Stephen Brewster. This group, which has had a long background in sonification of interfaces, had started on the creation of a standard set of guidelines for the creation of sonificated interfaces[11]. These guidelines have been further applied to

[10] For more details on this project see carola Boehm, Pauline Donachy, "Direct software evaluation of Music Notation Packages for an Academic Context" http://www.music.arts.gla.ac.uk/projects/NotationEval/ Last accessed 15/06/01.

[11] Brewster, S.A., Wright, P.C. & Edwards, A.D.N. (1995). Experimentally derived guidelines for the creation of earcons. In Adjunct Proceedings of HCI'95, Huddersfield, UK
Guidelines for the creation of earcons, A. Walker, M. Crease, Stephen Brewster (DCS)

in one of their projects by designing a talk-mail service using musical melodies to signify status of the user's location run in collaboration with IBM.[12]

Within the Sound Synthesis class, the opportunity arose to apply both aspects of this projects to a synthesis problem solving projects:

Class Project 2: Software Synthesis and Composition Systems
(Synthesis Problem Solving - IBM Call Centre)
The Scenario

Imagine you are the person responsible for designing the sonic environment for a telephone talkmail service. This sonic environment includes discrete sounds as well as continuous sounds, all having to convey certain navigational or user-interface functionality.

The service is structured hierarchically, through which the user navigates via pressing buttons on a telephone. Thus he/she has no visual information, any information about the status of her/his position is purely through voiced and sonic information. Your client, or the producer of this talkmail service, wants to add audible cues and sounds to convey

- the navigational status
- the status of an event (i.e. is there much to rewind, how many more messages are there to be played, how many messages are there to be received.
- events in case of errors or misuse

Using the guidelines developed by the HCI group from Computer Science, the students created sonified interfaces using sound synthesis techniques. Thus the assignments and the comments of the process within the project reports, were used as first feedback for using the guidelines to create sonified interfaces. On another level, the single assignment outcomes fed back into the IBM project, by looking at the feasibility of using sound synthesis techniques to realize a sonified talk-mail service, apart from the melody-based interface which it was presently using.

In this way, the skills of the BEng+Music students in Sound Synthesis Techniques enhanced directly the project in Computer Science, which normally does not offer courses in sound synthesis techniques. In the same way, the existence of an IBM talk-mail project with a prototype interface available from the computer science department, including the guidelines, created a very interesting and industry relevant project for students. Feedback from this course demonstrated that the variety of projects, and specifically this project, was found to be not only interesting but fun, and that students thought of it to be highly relevant to their future careers.

3.2. Music Technology Research – Bridging the Gap between HE and industry

As mentioned above, research within HE institutions provides, to a high extent, the freedom within institutional practices that UG teaching cannot provide. Considering the potential of this subject, it would be in the interest of institutions to support such research, as it is highly commercial viable in many areas and means that industry-bridging should actually be very easy, although it is not often done. Research within music technology, can not only be applied to the second largest industry in Britain: record sales, but offers integration into the telecommunication industry, broadcasting industry, culture industry, the education industry and related areas such as film-making and other creative industries.

Although this potential is relatively obvious, there has been a problem of university-industry bridging in the past. Music technology research seems to have been channelled primarily into two directions:

- either music technology research outcomes, if coming from music departments, have traditionally been channelled mainly into the culture industry, into compositions and performances
- or music technology research outcomes, if coming from the engineering departments, has been channelled mainly into the telecommunications industry.

There seems to be a hurdle of transferring outcomes from academic research into industry: non-profit cultural or profit-based industry. Universities in general seem to be become more and more detached from industry, which has been noted and addressed by the European Funding Programs[13]. This gap is characterised by a surplus of technology, left without being integrated into products or systems. It follows that one of the main aims in the 6th framework of the EC is "technology integration" in order to "force" the needed university-industry bridging for technologies to become a societies' tools.

Within the music/audio industry, this can be said to be true, especially if comparing to the video/visual industry. This area seems to have bridged the gap from research to products much faster, for instance in anima-

---

http://www.dcs.gla.ac.uk/~stephen/earcon_guidelines.shtml Last accessed 15/06/01.

[12] Brewster, S.A., Leplatre, G. and Crease, M.G. (1998). Using Non-Speech Sounds in Mobile Computing Devices. In Johnson C. (Ed.) Proceedings of the First Workshop on Human Computer Interaction with Mobile Devices, (Glasgow, UK), Department of Computing Science, University of Glasgow, pp 26-29.
Leplatre, G., Brewster, S.A. (1998). An Investigation of Using Music to Provide Navigation Cues. In Proceedings of ICAD'98 (Glasgow, UK), British Computer Society. Adobe PDF
Leplatre, G. and Brewster, S.A. (2000). Designing Non-Speech Sounds to Support Navigation in Mobile Phone Menus. In Proceedings of ICAD2000 (Atlanta, USA), ICAD, pp 190-199.

[13] See documents of the 5th and 6th Frameworks

tion/effects techniques, despite it being younger than the music industry.

Within music there are areas which tend to pick-up innovative technologies very fast, such as synthesiser technology, but these seem to be far and few if looking at the whole area of audio/music related industry.

3.1.1. Music Departments and industry collaboration

There is probably a number of interconnecting reasons for this gap between industry and research to occur, but one answer could be the location of music technology within frameworks which are not used to handling industry-bridging activities. As the visual/video technologies have traditionally been located within the computer science departments in Britain (and Europe), the developed technologies and research outcomes were well placed in a framework used to marketing their own results and providing the needed interaction between industry and university.

For music technology, the traditional positioning within music departments resulted in the developments of more artistic goals, not having the aim of commercialisation of technologies, nor having the experience or tradition of industry collaboration. For the cultural products this had a very beneficial effect, and one could say that music technology centres have created a large number of tools for composition which no other creative digital discipline can match in quantity, quality or diversity. Nevertheless, this also created some unnecessary gap between industry and university research.

Based on the above reasons, some centres have opted to be placed wholly or partly in the science departments (engineering or computer science), and have done so very successfully. But the ideal would be a centre "in the centre of these subjects", as the drive for technology innovation can only be supported in a major way by artistic creative considerations as well as industry-relevant ones.

3.1.2. The Size of Music Technology Centres

The location of centres within smaller departments is another issue to consider. Smaller centres and smaller departments are often disadvantaged in large institutionalised frameworks, summarised through:

- not having a critical mass of research active staff
- not having a critical mass of administrative and technical support

Both of which have an adverse effect on music technology research, and some strategic decision will always be necessary in order to compensate the disadvantages that a small size may bring.

3.3. Strategic Considerations for Music Technology Research

The need for vertical centres which sit apart for the institutional departmental and faculty structure has been emphasised, and should be emphasised again considering the above factors of discipline, location and size. Horizontal Research Centres, which sit apart from departmental and faculty structure and include individuals and subjects fed from several different faculties and departments are one of the keys to success in a healthy research environment. Vertical Research Centres, which include outside organisations as well as the above Horizontal Research Centres, provide the added impetus for industry/organisation bridging activities.

For smaller centres to survive, and for medium-to-large centres to work efficiently, the following research strategies can help to support a healthy research active environment.

3.3.1. Low Administrative costs / application development

Administrative costs, such as budget control and monitoring, project reporting, etc. need to be kept as low as possible. Similarly, the efforts going into acquiring new funding through application development should ideally be minimum effort for maximum reward.

- <u>Aiming for longer and larger projects:</u>
  A logical objective for research active groups or individuals to reduce the amount of administrative effort and maximise on human resources is to apply for longer and bigger projects. This is sadly contrasted by the tendency of funding bodies to support a decreasing amount of long-term actions. Three-year R&D projects have become very rare, especially in areas of creativity, culture and education. Projects less than three years have the consequence that PhD students cannot be sought out for these projects and an influx of short-term contract research staff has become the norm. This, consequently, has its own problems.

  Another upshot of shorter projects lies in the heavier burden of effort needed for application development. As the quantity of work is often the same for both shorter and longer projects, shorter projects are disadvantaged considering aspects of searching for, contracting-in and training new staff, and also considering administering costs related to the project and providing technical and administrative support.

  The benefits of being able to run one or even several long-term projects is high, with a constant and stable research environment not too over-burdened with the continuous pressure of acquiring new funds and staff through project application development.

- Interconnect with working groups to access funding for networking:
  Funded working groups have several advantages which may not be immediately obvious. The main funding available for working groups is for travel and subsistence, meetings and working conferences/workshops and the administration of this, i.e. networking.

  This networking is vital for developing new projects with a minimal application development effort. Although it may seem strange to use visits to a workshop with a specific deliverable as a platform for meeting prospective future project partners and working out the funding application details at the meeting, it is in generally seen to be rather good practice by funding bodies and a very efficient use of their money.

  As most funding bodies today are stormed with interdisciplinary project applications it can be difficult for them to see a whole picture of development emerging, as single applications might represent a small puzzle-piece from a large puzzle with many gaps still to be filled. Funding bodies tend to avoid duplicating their efforts as they do not want to fund research twice. In general, they know that competition within one funding body's remit should be avoided and that collaboration should be supported.

  Thus, it is in their interest to have communication platforms that will enable more collaborative applications to take form: resulting in having less project applications with more participants of an expert field, and less similar project applications incorporating more input from expert individuals.

  Besides the benefit of working groups providing a platform for application development, they also have the advantage of being seen in an advisory capacity to funding bodies, as well as other parties in decision making levels. This implies that the participation of working groups closes the circle of:
  a) being within a community of active researchers,
  b) applying for funding from funding bodies who create themes and calls to support specific-needed research,
  c) and providing the knowledge to back funding bodies regarding research that is needed and required.

  One last small, but crucial, benefit that working groups have is their role as dissemination platforms. In these forums, already completed research can be disseminated and/or taken up by partners of working groups, and quite often this canbuild the basis upon which working group themes are built.

3.3.2. "Soft Funding" and "Hard Funding"

"Hard funding" in this terminology can be defined as funding bound to tasks, specific resources and deliverables. A large part of funding for research and development projects falls under this category, as within application processes, deliverables and outcomes that have to be specified to a more or less specific degree.

"Soft funding" is generally much more difficult to acquire, as it often needs long-term collaboration of industry and research organisations. Sponsorships through funding of equipment, benefactors, or similar funding may not be bound to specific outcomes or deliverables. In order to acquire such funding an often non-explicit understanding between sponsors and beneficiaries of the overall positive influence that this specific area of research can provide needs to be in place. This positive influence can be in form of:

- graduates knowing the skills required of a sponsor's industry
- teaching and research profiting from sponsorship and provision of professional equipment specific to certain sectors of industry
- support of continued staff and student placement schemes, allowing the bridging of knowledge and experience between industry and university

In general, it is much harder to acquire this kind of soft funding as it is often a non-competitive process of establishing long-term relationships between academic departments and industry. Again, science departments have long been used to processes that can acquire soft funding. Arts-based departments, traditionally, have not. Music Technology Centres have the potential to develop "soft funding", however in the case of the University of Glasgow's Centre for Music Technology for instance, such potential has not been exploited at all.

3.3.3. "Enabling technologies" and "Technology integration"

Although it might sometimes be hard to differentiate enabling or basic technologies from the technologies built on top of them, in general it can be highly efficient to specify research projects based on results of former projects. This is seen positively by funding bodies, as well as pushing the research results forward in a fast and efficient manner.

For centres running several projects concurrently it is of advantage to keep a healthy ration of projects developing enabling technologies and technology integration projects, thus creating new and exploiting mature technologies simultaneously. Although this may seem obvious, keeping a watchful eye on the ratio of enabling technology projects to technology integration can help discover new research opportunities.

3.3.4. The new "funding diversity" for Music Technology

There is a new funding diversity for music technology. Most of the science-based as well as the arts-based funding councils accept some or the majority of music technology research as valid research, and allow it to be funded within its own remit. Although there is a danger of interdisciplinary subjects "falling between chairs", usually interdisciplinary centres can exploit this diversity more than uni-disciplinary ones. Some of these funding bodies, as described in more detail below, even address specific themes around the area of music technology, such as "creative pull", "creative productions" and "music technology".

3.4. Music Technology Research in Practice - an example

An example for the tight integration of technology enabling and technology integrating projects can be seen in the list below. This listing highlights a selection of projects that I and the Centre for Music technology have been involved over the last five years. Colour coding further emphasises the close integration of the interrelationship of the projects.

In general the research groups have four major research themes:

a) Information Management Systems for Music and time-based Media (IMS)
b) Music Information Retrieval and Representation, Standards
c) Music Education, including Web based teaching of music, using ICT for music education
d) Creative Productions, creative pull applications, creativity and technology

With this list, one can easily point out all projects running in one field of research, as for instance PADS, SMaTBaM, PADS/SMIC all being within Music Information Management (IMS) or MPEG7, MuTaTeD'II and MuProNet all being within Music Information Representation & Retrieval.

In the last column, TI and ET signifies "enabling technologies" and "technology integration", whereas TR specifies any travel grants, WG any Working groups.

It can also be seen from the arrows how these projects built up onto each other, the first MusicWeb Den Haag project specified the basic technologies needed for a development of a music educational system, and all consecutive (but individually funded and co-ordinated) projects of MusicWeb, such as MusicWebHannover and MusicWebConnect built upon this first project. Similarly, SmaTBaM built a prototype system for serving massive and a critical mass of time-based media over

techn. integration

- **CP** Creative Productions, Creativity & Technology
- **ME** Music Education

enabling technologies

- **MIR&R** Music Information Representation, Retrieval, Standards
- **IMS** InformationManagement, Databases, Webgateways

Name	Funding Body	End date	Amount accrued to Dept	Totale Amount	Principal Investigator at Institution	Centre's Role	Field	enabl. & intgr. Tech.
OpenDrama	EU	2004	£199,000.00	£1,248,735.86	Italy	PI@Institution	CP	TI
MuProNet	EPSRC	2004	n/a	£58,811.00	London	PI@Institution	MIR&R	WG
MusicWeb Connect	EU	2001	£12,000.00	£100,000.00	Den Haag	PI@Institution	ME	TI
MuTaTeD'II	Re:Source	2001	£35,000.00	£35,000.00	Carola Boehm	PI	MIR&R	ET
MPEG7	John Robertson I	1999	£1,500.00	£1,500.00	Carola Boehm	PI	MIR&R	TR
Notation Evaluation	JISC/UCISA	2000	£9,000.00	£9,000.00	Carola Boehm	PI	ME	TI
Mutated1	JISC	1999	£9,000.00	£9,000.00	Carola Boehm	PI	MIR&R	ET
Artism LtD	Consultancy	2000	£27,000.00	£27,000.00	Carola Boehm	Consultant	IMS	TI
Travel Grant RSE	Royal S. Eng	2000	£600.00	£600.00	Don MacLellan	PI for travel	MIR&R	TR
CIRCUS	EU	2001	£30,000.00	£2,000,000.00	Working Group	PI@Institution	CP	WG
Revelation		2001	£0.00	£665,000.00	M. Atkinson	on Mngmnt. Group	CP	TI
PADS	JISC	-	n/a		Stephen Arnold	RA/Databases	IMS	TI
MusicWeb Hannover	Niedersachsen	1998	£20,000.00	£20,000.00	Prof Hempel	Programmer	ME	TI
PADS/SMIC	SCRAN	1998	n/a		Stephen Arnold	RA/Databases	IMS	TI
SMatBAM	SHEFC	1997	£32,000.00	£32,000.00	Stephen Arnold	RA/Databases	IMS	ET
PADS/Imagination	BUFVC, BFI	1998	£9,200.00	£9,200.00	Stephen Arnold	RA/Databases	IMS	TI
MusicWeb Den Haag	Netherlands	1996	£25,000.00	£25,000.00	K. De Jong	Programmer	ME	ET
COMES	Germany	1995	n/a		Wankmueller	RA/Programmer	MIR&R	ET

wide-area-networks, and PADS used this prototype system to set up its digital library service.

4. The New Funding Diversity for Music Technology in Britain

During the last six months there have been a number of workshops organised by funding bodies and funding councils with the goal of acquiring feedback from the research community about the needs and requirements for funding within specific areas. These workshops provided valuable information about where the funding bodies are moving, and how the funding tools will be changing according to the changing face of economic, industrial and educational factors. Two of these workshops are used as example to demonstrate the changing face of funding for music technology within Britain and Europe.

Using EPSRC and the EC as the examples means omitting one of the major funding councils for the creative activities, the Arts and Humanities Research Board. It, in itself, has not been in existence for very long and thus does not have the need to redefine its remit. The AHRB was set up to specifically cater for the needs of creative, cultural and humanities-relevant research. To the author's knowledge, no research community workshop has been organised, however the fact that the AHRB is the funding council closest in its remit to creative, performative and compositional research activities within music technology, makes it the most widely known: at least within the creative and artistic user communities. Although issues surrounding the position of technology development within a creative potential of works are unspecified and easily discarded as being within the remit of more science-based funding councils, the AHRB has shown an immense interest in supporting creative productions, with or without a technological basis.

4.1. EPSRC - Engineering and Physical Sciences Research Council

EPSRC is the Engineering and Physical Sciences Research Council, and it is the largest of the 7 Research Councils within Britain. In February 2001 it held a two day workshop on the "Funding of Music Technology within EPSRC" (Harrogate, Feb. 2001). Fifty individuals from various academic institutions were invited, representing an attempt to have experts covering most areas within music technology.

Nigel Birch, who co-ordinated the workshop as a representative of EPSRC, mentioned in his introductory talk the problems which a funding body such as EPSRC presently faces:

- a rising number of music technology funding applications, representing few and small pieces of a large puzzle
- growing problems of bridging universities and industry (and marketing)
- a lack of enough projects with the emphasis on technology integration, resulting in a surplus of technologies which are not utilised by industry or are not distributed to user communities

With these problems in mind the workshop concentrated on the following aims:

- to map the discipline of music technology (from the ESPRC point of view)
- to identify enabling technologies and secondary technologies
- to identify priority research areas
- to identify capable funding tools

The results of this workshop were extremely interesting. A detailed "knowledge map" of the research field of music technology was provided, which, unlike existing taxonomies, concentrated on the development of technologies as a starting point. This allowed a good overview of the research scope, and the addition of specifying primary and secondary technologies (enabling technologies and technologies based on enabling technologies) resulted in realising priority areas as well as research "holes" in which technology outcomes are missing: hindering further progress in a specific research area.

For EPSRC this contextual map of priority areas is meant to have a sort of "roadmap" effect for further funding strategies.

One of the direct results of this workshop was that EPSRC will allow the development of technology based on creativity support as a valid research activity within their funding remit, as long as technology development makes up 51% of the overall activity. Also, the notion of accepting the potential in experimental approaches (accidental inventions, exploratory approaches, basic research) was also accepted and will be supported by EPSRC in the future.

In terms of funding tools, it was announced that traditional project funding would be continued, but supported by "Networks of Excellence". These networks would be of a distributed nature, unlike the French model of centralised physically located centres of excellence. Support would be in the form of administration, travel, working group meetings and events.

4.2. The European Commission

Similar to the EPSRC meeting, the European Commission invited to a workshop at the FhG Darmstadt in May 2001 called: "Technology platforms for cultural and artistic creative expression". In its inviting letters the commission stated that:

> *"The discussions will be used to help us establish future priorities in this area, which*

could be supported within the framework of our IST Programme as part of a new Cross Programme Action (CPA) to be introduced in the IST Work Programme of 2002."[14]

Representatives presented the problems in which the EC find itself, which, although within a more general remit of creativity and cultural activities, are similar in nature to EPSRC.

The last two funding frameworks (4th and 5th framework) resulted in a surplus of technologies which have not been integrated into industry or distributed to the user of the "information society", as specified in the current framework. This surplus of technology is generally seen as an unexploited resource, and its integration needs to be supported, specifically within the SME industries.

Another problematic area is that the last, fifth, framework found itself swamped by projects concentrating on art preservation, and although the calls specified cultural and artistically creative productions, most applications and successful projects were of a preservative and archiving nature. The EC sees this as a potential hazard meaning that, at some point, no new works of art - specifically digital art - will be created, making technology innovation solely for the purpose of preservation of traditional art and cultural objects.

Within these two major problems the workshop aim was set to:

- Survey existing activities + identify major technology shortcomings
- Identify key issues to be addressed within 5 to 10 years from now
- Identify key players and, if needed, the additional actors
- Develop a strategy for the articulation of such an action with respect to the 6th Framework Programme, currently in preparation

The one-day workshop had surprisingly refreshing results for creative & technology research:

- Creative Productions will be emphasised and part of Framework 6
- Acceptance of the concept of Creative Pull (see next chapter)
- Emphasis on Generic platform for creative processes, available to a wider user community

Considering funding tools, the stress on medium-to-long-term exploratory action was mentioned, as was the creation of networking centres of excellence, and integrated projects with a large amount of technology integration.

[14] Letter of invitation to the workshop at the FhG Darmstadt in May 2001 called: "Technology platforms for cultural and artistic creative expression"

For areas such as music technology, in which serendipity, creative and exploratory approaches may lead to something new and innovative, the acceptance of such processes is a "sigh of relief" regarding having to phrase project proposals with outcomes already known: a notion going against many kind of approaches for basic research as well as creative processes. The support for networks of excellence again implies support for individual creative users which, until now, were not able to participate within research projects as they were not bound to academic institutions. This left a large creative potential unexplored. The notion of acceptance of creative pull (further described in the next section) will free the creative user or artist from the role of service-provider to that of an individual whose expertise needs to be involved form the design to the implementation stage.

4.3. CIRCUS working group - Content Integrated Research into Creative User Systems

CIRCUS is a working group funded under the last calls of the fourth framework of the European commission. It started in October 1998 and will run until October 2001, in the last weeks of which a conference on the issues of creativity and technology will be held in Glasgow.

Its aim is to advise the EC on the integration of content and technology in terms of creative pull vs technology push. It aims to gain a fuller understanding of the relationships between content, medium and technology in user contexts ranging from data creators to data users, from entertainment through education to fundamental research.

This group of ca 50 active individuals, representing ca 16 different European institutions involved in creative productions, including artists, film-makers, designers, musicians, composers and authors, has identified major issues and problems which will need to be addressed by the next funding frameworks in order to exploit the potential of creative production to the fullest.

In the centre of these problems stands the challenge of content, medium and technology: the needed balance of "Creative Pull" vs "Technology Push". The concept of creative pull has more complex implications of

- integrating the creative user from the start of a application developing process, instead or attaching him as a service or as an end user
- providing frameworks for letting the interaction between creativity and the development of technology happen throughout all phases of project development
- providing production methodologies or business models to cope with situation in which creativity pulls the development of technology along with the

inherent dilemma best described as "building the camera while making the film" [15]

- providing the framework in which individuals artists can participate in research projects, without the need of their belonging to an academic institutions.

CIRCUS has found that some of the detrimental effects of the lack of creativity pull within digital art can be seen in the fact that 90% of artists are still using traditional tools. In addition to that, production from digital tools seems not to support creative processes, but rather to provide a temp late way of thinking and producing: more appropriate for mass production than works of individual art. Within our current creative environment of digital art production artists, surprisingly, still manage to be creative, but it is the opinion of CIRCUS that this is not because of the tools but despite the tools.

Issues which need to be addressed before this situation can change are:

- The lack of integration of the creative user with creativity seen as a service, to be able to be brought in, rather than integrated into, a process
- Current Systems have not proven to be adequately permanent. Digital Art needs to be resistance in time and space, for at least 20 years in order to be considered for use by the critical mass of artists.
- There needs to be a balance between funding Art Creation (Tools development) and Art Preservation/Consumption
- There needs to be support for style development, (Manner, Expression) and similar processes in digital creative productions

Within these main points, CIRCUS has published a list of its research themes that can be used as a more or less comprehensive list of issues needing to be addressed by future research. These include:

DESCRIPTION OF CULTURE: ARCHITECTURES OF INFORMATION

- Metadata for creative use contexts
- Cultural and Connectionist Metadata
- Standards supporting creativity
- Open standards in creative use contexts
- Data Structures for digital creative production systems
- Style, Manner, Expression and processes in digital creative productions

THEORY AND METHODOLOGY OF DIGITAL CREATIVE PRODUCTION CONTEXTS

- Theory relevant to practice
- Best Practice examples
- Strategic Citing of experimental work

INTERACTIVITY AND THE FUTURE OF THE CREATIVE PRACTICE

- Technology Push - Creative Pull Applications
- User interfaces and interfaces extensions to support creative processes
- Creative empowerment - applications supporting style development and style
- Best practice in education for creative users
- Experimental interactive creative environments
- Taxonomies of interactivity

INSTITUTIONAL SUPPORT FOR INNOVATION OR CREATIVE PULL

- Implications for Education and Training
- Production methodologies for the creative industries
- Vertical Markets in the Creative Industries
- Business Models supporting creative processes
- Methodology for reflexivity within interdisciplinary practice

5. Conclusion

This report has attempted to provide an overview of the current opportunities and challenges with which the discipline of music technology within Higher Education Institutions is faced. In its interdisciplinary nature, its integration within institutions with discipline-specific structures will undoubtedly always be difficult, especially in UG and PG teaching. But there are opportunities:

- Institutional Frameworks still offer a challenge for teaching of interdisciplinary disciplines such as music technology
- Most opportunities lie in research, and these opportunities are growing in number and diversity
- Research can be used to improve teaching

As demonstrated, although it is one of the newest fields to be adapted for teaching within the HE sector, the potential for music technology is immense, and the need for graduates as well as researchers is predicted to rise.

Within a research this potential can be exploited to the fullest if one keeps a remit of

- continuing to provide a basis, through standards involvement, working groups and development of enabling technologies
- supporting the integration of existing and ma ture technologies, through having the courage to built bigger systems, utilizing a diversity of technologies
- supporting creative processes and balancing technology push with creative pull

A final solution for a successful framework structure addressing most problems mentioned in this report lies within **Centres for Teaching and Research**, which lie detached from the discipline-specific departments or faculties, and yet can draw on the expertise held within various internal and external organisations and different fields, and can build upon the interaction of these disciplines to create a successful and highly promising future for music technology research and study.

[15] Phrase coined by Dr. John Patterson, University of Glasgow, in the beginning of the CIRCUS working group, 1998.