2010

Barrow Engineering Project

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Executive Summary

Introduction and Context

The Barrow Engineering Project (BEP) is now nearing the end of its second year of operation. REAP¹’s continued evaluation focuses on achievements in 2009-10 and the longer term impact and sustainability of the project.

The key aims of the BEP mirror the strategic priorities of the Royal Academy of Engineering (RAEng). The key aims are to:

• raise the overall project of Engineering in the local area
• raise awareness of the valuable contribution of Engineering to our society
• enrich the attainment and skill levels of local learners within the project – both through the existing curriculum and extra-curricular activities
• In addition, the BEP aims to:
• motivate more local learners to take STEM (Science, Technology, Engineering and Mathematics) related studies at FE and HE
• stem the outward flow of talented young people from the local area and, thereby, to increase the employment of local talent within the local Engineering sector.

Participating institutions include the five secondary schools (namely Dowdales School, Furness Academy, St Bernard’s Catholic High School, Ulverston Victoria High School and Walney School) and the two post-16 colleges (Barrow Sixth Form College and Furness College) from the Barrow-in-Furness area participated in the second year of the project.

This qualitative evaluation study reports on: BEP achievements during 2009-10, staff perceptions and evidence of impact during its two years of existence as well as comments on the future sustainability of the BEP. This external evaluation uses an evaluation framework based on the enabling, process and outcomes (EPO) methodology (Helsby and Saunders, 1993).

Project Achievements

Outcomes: From statistics collected from participating institutions, and collated by Brian Wood, approximately 3177 students participated in BEP funded activities in the academic year 2009-2010 which included 1507 (47.5%) females and 1670 (52.5%) males. All five schools have established extracurricular clubs relating to Engineering. From statistics collected and collated by Brian Wood from participating institutions, 327 primary school pupils (166 females and 161 males) participated in BEP funded activities in the academic year 2009-2010.

Enabling dimensions: In addition to funding and project management there are three enabling dimensions that influenced the BEP achievements to date and will impact on

¹ REAP (Researching Equity, Access and Participation) is a research and development group based in Lancaster University’s Department of Educational Research.
future embedding and sustainability. They are: ambassadors and staff involvement, the
school and college BEP co-ordinators and the role of an overall BEP co-ordinator.

**Process dimensions**: There are obvious signs of progress in modifying process dimensions
relating to data recording, planning, communication, networking between schools and with
external stakeholders. In addition there is evidence of developments arising from the
continuing professional development opportunities created as a result of the BEP.

**Embedding STEM**

As a partnership the specialist status of the BEP schools covers all four STEM subjects as
well as Sports and Performing Arts. The post 16 providers provide progression
opportunities for students to all STEM subjects at Advanced level, Advanced Diploma level,
Young Apprenticeships, and for those wanting to study locally at a higher level HNC and
BEng in Engineering are also available. Embedding STEM within schools and colleges is
reported under 4 main headings:

**Institutional issues** shape the context in which BEP co-ordinators operate, the way STEM is
organised within the school or college and the possibilities for embedding and sustaining
STEM in the future.

**Curriculum** is recognised as the major vehicle by which the BEP will embed STEM and make
changes that will impact on students’ awareness and attitude towards Engineering as well
as their attainment, capacity and interest to pursue progression routes leading to
employment in STEM related careers. There is already evidence within BEP institutions of
recognition and commitment to embedding Engineering within the curriculum and
activities associated with educational pathways and accreditation.

**Careers education and development** is a cross cutting issue that impacts on both students
and staff, it is an area which can help raise student aspirations and change stereotypical
images about ‘what an engineer does’. There is evidence of BEP institutions making use of
STEM ambassadors as role models and including specific reference to a range of
Engineering careers suitable for students pursuing vocational and academic pathways. In
addition BEP co-ordinators and teachers outlined examples of professional development
opportunities arising from the BEP that benefitted them personally and professionally.

**Partnership** is a core issue for embedding changes arising from the BEP. Partnership within
BEP influenced development in a number of ways including: communication about
activities; information and resource exchange to maximise learning and use of resources;
extended provision for the primary sector as an aid to developing a more coherent
progression pathway; and interaction with local, regional and national stakeholders who
provide funding and offer complementary activities.

**Sustainability of the BEP**

The foundations for sustainability are dependent on the extent to which activities are
embedded in BEP schools and the way in which the enabling and process dimensions
associated with ways of working are adopted. Evidence of sustainability is reported under three headings, funding, collaboration and parents / carers. There are some specific practical issues regarding sustainability which will be discussed with the BEP Co-ordinator.

**Funding and longer term investment** is a key issue, there is already evidence of schools and colleges beginning to use BEP funding creatively as well as their own financial resources, with longer term goals in mind. Although schools and colleges talked about the impetus BEP provided as activities become embedded, it is more difficult to disentangle what they might have done in the absence of funding.

**Sustaining collaboration** is important for proposals relating to curriculum development, sharing resources and continuing professional development. The two activities which are currently dependent on BEP funding and are therefore at greatest risk with respect to continuation in the future are co-ordination and external visits or high impact activities.

**Parents and carers** represent a key influencer on young people’s career decisions and educational pathways. In some respects they are crucial for the sustainability of ideas for their son or daughter and for wider changes in views about Engineering within the town. Increasing their involvement, and raising their awareness about career opportunities and educational pathways for girls as well as boys, is important as a longer term goal.

**Recommendations and overall assessment of BEP**

A list of 19 recommendations together with an overall assessment of the value of a dedicated co-ordinator, partnership working and emerging impact of sustainability in schools that could be built upon is provided in section 5. Recommendations are also discussed in situ within the report.

The focus of the 2010 evaluation on institutions provides evidence of continued progress by the BEP with examples of how individual institutions are changing how they develop and deliver the STEM curriculum. Motivation and commitment to the goals of the BEP remain and ideas generated from BEP co-ordinators and teachers suggests there is not only awareness of how ideas may be embedded, but practical suggestions and support for revising the curriculum and developing cross curricular links. The involvement and ongoing support of external stakeholders in providing STEM ambassadors and resources is valued and important for the longer term sustainability of the BEP.
1. Introduction

1.1 Barrow Engineering Project (BEP) Context

The Barrow Engineering Project (BEP) started in autumn 2008 and is the first of the ‘Local Engineering projects’ based on the Royal Academy of Engineering’s (RAEng) successful ‘London Engineering Project (LEP). Lynda Mann from the Royal Academy of Engineering (RAEng) manages the BEP and Brian Wood co-ordinates the project providing an effective link to individual school and college BEP co-ordinators. The BEP includes a local Steering Group that connects with the Furness 14-19 Partnership and links with local industry and other organisations involved in funding or delivering STEM related activities (see appendix A for partners/stakeholders).

Aims

The key aims of the BEP mirror the strategic priorities of the Royal Academy of Engineering (RAEng). The key aims are to:

- raise the overall project of Engineering in the local area;
- raise awareness of the valuable contribution of Engineering to our society;
- enrich the attainment and skill levels of local learners within the project – both through the existing curriculum and extra-curricular activities.
- In addition, the BEP aims to:
  - motivate more local learners to take STEM (Science, Technology, Engineering and Mathematics) related studies at FE and HE;
  - stem the outward flow of talented young people from the local area and, thereby, to increase the employment of local talent within the local Engineering sector.
- These BEP aims are also consistent with the aims of other partners and local stakeholders who are committed to improving attainment, extending educational pathways, widening participation, regeneration, and as one commentator noted “retaining talent from the Barrow area” (URS, 2008).

Participating Schools and Colleges

Five secondary schools and the two post-16 colleges from the Barrow-in-Furness area participated in the second year of the project namely:

- Dowdales School - a specialist school in Performing Arts – dance, drama and music;
- Furness Academy - a split site academy that formed in September 2009 from three schools that participated in the BEP in 2008-09 (Alfred Barrow School, Parkview School and Thorncliffe School), its two specialist subjects are Sports and Applied Mathematics;
- St Bernard’s Catholic High School - a specialist school in Science;
- Ulverston Victoria High School - a specialist school in Mathematics and Computing;
- Walney School - gained specialist school status for Engineering in 2009;
- Barrow Sixth Form College – who Ofsted note have outstanding use of ILT and VLE in teaching and learning, and outstanding employer engagement and partnerships;
- Furness College – delivers Engineering courses from level 2 to level 6 (BEng).
Throughout its second year, schools and colleges continued, and in some cases extended, their involvement with a number of the RAEng national projects, notably the Young Engineers, the Engineering Education Scheme (EES), and Go4SET. In addition, the BEP connected with other local, regional and national initiatives including Barrow Education Business Partnership, Rotary Club Challenge, Cumbria STEM Centre Ltd., and Aimhigher Cumbria. Finally, the BEP schools and colleges offered activities for feeder primary schools in the area, engaged with local universities, began to strengthen links with local industry and benefited from the contribution of STEM Ambassadors trained by Cumbria STEM Centre Ltd.

1.2 National Context

The 2009 BEP Evaluation Report outlined the context for the introduction of the BEP (see Houghton, Marsden and Davies, 2009 for further details) and the importance of the role played by the RAEng who provide the national focus for the Engineering strand of STEM developments. The RAEng aim is:

*To enhance the UK's Engineering capabilities, to celebrate excellence and inspire the next generation, and to lead debate by guiding informed thinking and influencing public policy.* (RAEng, 2009)

Targets of the Higher Education Funding Council for England’s national STEM programme complement the RAEng work through: outreach, enhancement and enrichment delivered to schools and further education colleges; equality and diversity for under-represented groups; collaboration to ensure appropriate careers information; workforce development and lifelong learning, as well as evaluation and enhancement of the undergraduate curriculum.

Changes in the national context since the formation of the BEP and the 2009 evaluation report include:

- a change from New Labour to the Coalition government who have begun to make decisions about funding and proposals impacting on education such as the abolition of BECTA and the QCA;
- the replacement of the Department of Children, Schools and Families (DCSF) with the Department for Education (DFE), which follows earlier replacement of the Department of Universities, Innovation and Skills (DIUS) with the Department for Business, Innovation and Skills (BIS);
- introduction of compulsory careers education, information, advice and guidance (IAG) (DCSF, 2009) and revised plans for an all age careers service, the implications of which are not yet confirmed.

1.3 Evaluation

This qualitative evaluation study reports on: BEP achievements during 2009-10, staff perceptions and evidence of impact the BEP during its two years of existence as well as
comments on the future sustainability of the BEP developments. It is the second evaluation report undertaken by the Researching Equity, Access and Participation (REAP²) team and complements a quantitative study of students’ views undertaken by Cambridge University.

The evaluation draws on evidence obtained from:

- face to face interviews with all BEP co-ordinators in participating schools and colleges undertaken during visits made between May and July 2010³;
- additional face to face interviews in six of the eight participating schools and colleges with other staff including senior managers and teachers who have participated in STEM related activities, and two focus groups with pupils from one school;
- documentary evidence including scorecards with details collated by Brian Wood (BEP co-ordinator), school and college newsletters, websites and materials relating to activities;
- a face to face interview with Brian Wood together with meeting notes, press releases and other documentary evidence about the project;
- a review of selected recommendations and observations reported in 2009 that relate to issues under consideration and which highlight a change in attitude or point of comparison.

The interviews were digitally recorded, transcribed and analysed by the REAP team according to the brief that prioritised achievement, evidence of impact and factors for longer term sustainability. Contextual information arising from an evaluation of Aimhigher Cumbria (by REAP) offers a further source of triangulation regarding the wider perceptions of BEP within the Barrow area and opportunity to comment on the value of partnership working.

**The Enabling, Process and Outcomes model**

This external evaluation uses a framework based on the enabling, process and outcomes (EPO) methodology (Helsby and Saunders, 1993). The EPO model uses the following headings:

- **Enabling dimensions** – that need to be established or already exist, e.g., policies, space, time, people and resources;
- **Process dimensions** – that relate to actions, ways of doing things, styles, behaviour and practices;
- **Outcomes** – referring to ‘end points’, goals, desired products, numerical targets.

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² REAP (Researching Equity, Access and Participation) is a research and development group based in Lancaster University’s Department of Educational Research.
³ Due to availability of school staff feedback from one school involved a telephone interview and documentary evidence.
**Terminology**

For the purposes of reporting all school and college co-ordinators are known as **BEP co-ordinators**; other staff in schools including technicians, teachers and Connexions advisors are referred to as **teachers**, where a member of staff holds a senior leadership role they are referred to as **senior teacher**; staff involved in providing activities or working in industry are known as **providers** or **industry**, with all others known as **commentators**.

**Structure of this report**

The 2009 report offered one configuration of the multiple factors associated with the BEP project. The 2010 report focuses on a narrower set of issues but examines three cogs (activity, schools and colleges, and the future) in greater depth.

![Figure 1: An overview of the interconnecting cogs within BEP](image)

The report findings are divided into three sections that report on the achievements, embedding and sustainability of the BEP. Each section begins with a summary that provides a context and overview of key issues and concludes with a list of key points with respect to awareness of Engineering in the local area, awareness of Engineering’s contribution to our society and its enrichment of the attainment and skill levels of local learners. The final section 5, lists the recommendations and provides an overall assessment of the value of a dedicated co-ordinator, partnership working and emerging impact of sustainability in schools that could be built upon.
2. Achievements

2.1 Summary

The BEP achievements are reported under the three EPO categories. Starting first with activity outcomes, evidence is presented relating to: learning opportunities provided progress with Engineering Clubs, issues of gender, and collaboration with Primary Schools. The three enabling dimensions discussed are: use of ambassadors and other staff, the role of school and college based BEP co-ordinators, and the overall BEP Co-ordinator who continues to facilitate cross organisational collaboration including interaction with a wider group of stakeholders. The process dimensions illustrate BEP responsiveness to recommendations made in 2009, continued commitment to the project and recognition of additional benefits such as continuing professional development (CPD).

2.2 BEP Activity Outcomes

.1 Learning opportunities

From statistics collected from participating institutions, and collated by Brian Wood, approximately 3177 students participated in BEP funded activities in the academic year 2009-2010 which included 1507 (47.5%) females and 1670 (52.5%) males. Please note the scorecards did not differentiate between participants which mean some students may have taken part in more than one activity. For a breakdown of numbers for different types of activity see Appendix B p47.

* students may have attended more than one event, hence the number represents the number of opportunities provided

Figure 2: Breakdown of single and multi-school/college activities
BEP funding provided and enhanced the delivery of a wide range of activities during 2009-2010. **In-school/college activities** included:

- purchasing equipment for Young Engineers Clubs;
- hiring a Planetarium used by a whole year group (and some local primary school pupils);
- resourcing an alternative energy study.

**External visits** identified as valuable for raising pupils’ awareness and a source of motivation for extending in-school/college activities included visits to: a local quarry; Glasgow Science Museum; the Big Bang Fair, and industry visits. Without the BEP funding these activities would probably not have been organised.

**Centrally organised events** involved 934 opportunities that represent 32% of the learning opportunities delivered during 2009-10. These multi-school/college activities often received match funding, they included:

- Girls in Aerospace;
- Science at the Dock;
- secondary collaborative STEM challenge days;
- Greenpower and Champion-ships – although multi-school/college activities, the details of participants only represents 2 organisations.

### .2 Engineering Clubs

Within the BEP one of the activities all schools are required to undertake was the creation of an Engineering Club. In the 2009 report it was noted that initial starting points varied and that this impacted on initial developments and progress achieved. In 2010 all five schools have established extracurricular clubs relating to Engineering.

Schools are still exploring how best to run their Engineering clubs and integrate them into school programmes of extended learning opportunities. For example, one school reported changing the time of their club to respond to a drop in numbers, another BEP co-ordinator mentioned the constraints of time in planning and developing a programme. A group of year 7 pupils talked enthusiastically about their experience and explained that they find the club ‘more fun than Science lessons’ because of the ‘practical focus and that [there is] no writing’ required.

A total of 49 (37.7%) female pupils and 81 (62.3%) male pupils participate in these clubs which offer more intensive and interactive opportunities.
.3 Gender

The gender difference is consistent with the gender profile associated with Engineering and suggests that there is still scope for thinking about how ideas are presented to pupils. This is an important issue in helping to engage all to recognise that Engineering is a valuable contribution to society.

Factors arising from a study by Smart and Rehman (2009) about engaging girls included career ambition and self perception. BEP funded events such as the Girls in Aerospace offer opportunities for enhancing self-perception; although very popular it would be useful to enable girls to identify how Engineering might be relevant to possible careers as well as the lives of women. When discussing gender specific activities one BEP co-ordinator was keen to point out it was not ability that prevented girls from taking part in Engineering activities and described an all girls activity that showed ‘girls getting on and doing things which was great, really capable as they are, with no reason to be shy’.

Increasing the participation of girls in BEP activities was recognised as an ongoing issue, in addition to the practical advice for the inclusion of girls recommended by the London Engineering Project we recommend 1 use of the new Equality and Diversity careers toolkit (DfE, 2010) and continued use of female role models (see online ‘Inspirational women’ from the WISE 2007).

.4 Primary

From statistics collected from participating institutions and collated by Brian Wood, 327 primary school pupils (166 females and 161 males) participated in BEP funded activities in the academic year 2009-2010. This more even balance probably reflects that the whole of a class or year group participated. Based on interviews we believe that there was more primary activity undertaken than was formally recorded via the scorecards.
Staff from Furness College worked with some local primary schools using Goblin kit cars (part of the Greenpower project) and with other outreach activities. The Goblin Kit cars address progression, transition and motivational issues by introducing skills that can subsequently be extended in secondary school and college. In 2009-10 Walney School involved year 5 and year 6 pupils in National Science and Engineering Week (NSEW) and their Planetarium event in July 2010. This heightened primary school awareness of NSEW provides a base on which BEP schools and colleges can build. Motivation and value for money were increased by inviting primary schools to attend their planetarium event.

### 2.3 Enabling Dimensions

Perhaps the most obvious enabling dimension is the additional funding arising from the BEP, which funds centrally organised activities and a budget for each school / college to spend to enhance STEM provision in their institution. It was clear that without the funding incentive many of the activities would not have happened. It is worth noting the ongoing working relationship between the manager Lynda Mann and the overall BEP co-ordinator, Brian Wood that continues to provide a clear and focused direction.

In addition to funding and project management there are three enabling dimensions that influence the BEP achievements to date and are likely to impact on future embedding and sustainability. They are: ambassadors and staff involvement, the school and college BEP co-ordinators, and the role of an overall BEP co-ordinator.

#### 1. Ambassadors and staff involvement

From statistics collected from participating institutions and collated by Brian Wood, 42 STEM ambassadors (16 females and 26 males) supported BEP activities (see section on role models and STEM ambassadors, p32).

Scorecards also captured the number of staff involved in supporting the BEP activities this totalled 71. The numbers of staff ranged from 2 to 25, with one organisation not providing this information. From our discussion with BEP co-ordinators we anticipate that this variation does not fully represent the reality and suggest it is more likely to reflect individual interpretation of the question and accuracy of recording. See recommendations relating to the scorecard and recording data (p13).

Teachers in schools and colleges provide a valuable role supporting learning within STEM activities. It was evident that teachers and senior teachers did not always know which
events are funded by the BEP and tended to see them as STEM events. This either suggests BEP activity is embedded within the school / college activity or more likely that teachers like pupils are often less interested in the background to an activity and more concerned with the activity.

.2 School and College BEP Co-ordinators

The BEP co-ordinators continued to play a pivotal role in how a school or college used the BEP funding to deliver activities and opportunities to enhance existing provision. The manner in which staff fulfilled their role as BEP co-ordinator was dependent on their position within the school / college, the number of competing demands on their time, the specialist status of the school and its’ mission, as well as their personal experience and enthusiasm. Due to the formation of the Furness Academy, the inclusion of Ulverston Victoria High School and staff changes within Walney, the BEP co-ordinators meetings included three new members. This combination of existing and new members provided new ideas and a balance of continuity that was supported by the overall BEP Co-ordinator. The section on ‘School / College level’ (p18) includes further discussion of the factors influencing the embedding process.

.3 BEP Co-ordinator

As reported in 2009 the role of the overall BEP Co-ordinator was universally identified as a key enabling dimension. They organised the central activities and facilitated several important processes which ensured the project responded to recommendations in the 2009 report relating to planning, communication, networking and data recording. They also provided an important link with RAEng, external providers and industry and facilitated a series of general meetings that involved discussion of plans, and opportunities in which organisations could collaborate now and in the future. As one BEP co-ordinator noted:

trying to get things done is massive, you'd think it would be so simple to get a few schools together but it's not, so that's one thing I find invaluable.

2.4 Process Dimensions

In its second year the BEP responded to a number of recommendations made in the 2009 report and continued to develop procedure relating to data recording, planning, communication, networking between schools and with external stakeholders. In addition there was evidence of developments within the continuing professional development opportunities created as a result of the BEP. There are obvious signs of progress in modifying these process dimensions, which serve the purpose of generating evidence for accountability and laying the foundations for ways of working which will ensure the sustainability of STEM activity and provide a legacy from the BEP.
.1 Data recording: Scorecards

Section 2.4 of REAP’s 2009 BEP report listed several detailed suggestions for collecting data about BEP events. In response to recommendation 4 in the 2009 report the BEP participants agreed to implement the idea of a “scorecard” system (see Appendix C). Each school recorded information about the number, year group, and gender of students participating in BEP funded activities. Information was requested about involvement by STEM ambassadors with BEP funded in-house activities, and the numbers of employers and school/college staff engaged in BEP activities.

This scorecard system yielded some useful data but, as is common with systems of this kind, the level of detail included meant that sometimes the scorecards lacked information, for example, about year groups involved in BEP funded activities. From our interviews we also suspect that schools have not recorded all activities. For instance, one school did not record any of their pupils attending the Girls in Aerospace activity; however, we know that 10 girls attended. Some pupil numbers are acknowledged as approximations, and it is difficult to give an accurate number for the number of pupils involved in BEP activities as this recording system may have resulted in double counting for pupils who participated in more than one BEP activity.

Despite these caveats the scorecards remain a potentially valuable process dimension which we recommend (2) are retained and modified to try and enhance the accuracy of the information collected. Ideally data for each event would be entered onto a shared document located on the moodle as soon as possible after its completion. If this is not yet logistically possible we would as a minimum recommend (3) revisions for a standardised spreadsheet / or paper scorecard (operating as a register for subsequent collation) that reduces the ways it is interpreted.

If the BEP is keen to make judgements about the impact of particular activities, or identify if there are added benefits for students participating in the more intensive activities (for example, Young Engineers Club and attendance at inter-school BEP events), then it will be necessary to capture student names. Without this detail this type of impact evidence is not possible. It is recognised that for any data collection system it is necessary to consider the costs and benefits of investing time to this process dimension.

.2 Planning and organisation: Project Calendar

Following recommendations made in 2009 and drawing on experience gained from the first year, the planning for centralised activities and the bidding process took place earlier in the academic year. Information was circulated and made available to schools, colleges and partner organisations in meeting notes and the moodle. This development was beneficial and is a process dimension on which BEP can build in the third year (see discussion on the curriculum p21).
It was evident that schools built activities around the National Science and Engineering Week and this is a clear example of impact at the institutional level. Some senior teachers and BEP co-ordinators suggested that if more far reaching changes involving a greater connection with the curriculum are to happen, planning needs to be even earlier. This is because there is competition for time on individual school / college calendars; consequently the general message appears to be earlier is better. It is worth noting that within interviews about 2009-10 there was evidence that planning ahead and entering dates on the calendar did not always guarantee involvement. It is possible that this is because of divided loyalties, that one senior teacher highlighted: “basically, staff feel their jobs are linked to GCSE success in their subject therefore there is little room or time for extra-curricular activity.” Individual BEP co-ordinators spoke about the importance of regular reminders and in some cases it was evident that the overall BEP Co-ordinator spent time “chasing and chivvying” to make sure things happened. We recommend (4) that bids are prepared for 2010-11 schools and colleges are asked to indicate how they will embed the activity with their existing provision. If funding or collaboration is continued into academic year 2011-12, we recommend (5) bidding and planning happens during the summer term to enable events to be recorded on school / college calendars.

.3 Communication: Individual versus Collective

The main mechanisms used for individual contact were email or telephone, and for collective communication, moodle or meetings. Email remained the most effective mechanism and was used to remind BEP co-ordinators about events, meetings, or requests for information.

The moodle was introduced and used to post copies of meeting notes and other documentation. The potential of using the moodle was not fully exploited either because of time, lack of familiarity / habit with using the moodle for this purpose. There was a preference for more individual and immediate communication.

The moodle appears the most obvious process mechanism for collective communication and it is clear there is room for developing how it is used in future years. We recommend (6) that the BEP co-ordinators discuss and agree what and how to use the moodle as a source of information and begin to explore its potential for sharing resources and providing a forum for discussion.

.4 Networking: BEP co-ordinator and General Meetings

Meetings provided opportunities to discuss, plan and make collective decisions. In addition they became a valuable and welcome opportunity for informal exchange of ideas (see continuing professional development p15). In the academic year 2009-10 separate meetings were held for the BEP co-ordinators and the wider network of interested stakeholders. Notes summarised the main decisions and provided news of other activities. This decision reduced the number of meetings and potential duplication of information for
BEP co-ordinators. It also continued the process of exchanging information and maximised opportunities for collaboration. As one senior teacher noted about links made by Brian:

“If he wasn’t chairing and organising the meetings then the project wouldn’t run because it needs somebody to pull people together, it needs a driver, it needs an organiser”.

Whilst an overall BEP co-ordinator is in post the system of separate network meetings is an effective use of time and represents value for money. However, it is recommended (7) that both groups consider how best to exchange information in the future. Possible processes might include greater and more explicit use of the moodle, or a named (or rotating) representative from each group (BEP co-ordinators and STEM stakeholders) attending the other network meeting and providing feedback.

.5 Continuing Professional Development

During 2009-10 there was evidence within the BEP of a range of both incidental and more obvious professional development opportunities.

- The BEP co-ordinator meetings and attendance at activities delivered by external providers are perhaps the most obvious examples of incidental learning;
- School / college adoption of ideas from other schools / colleges not only saved development time but included a professional exchange of approaches and mutual problem solving;
- Network meetings of subject teachers provided a more focused exchange;
- Professional development in the form of ‘pre activity briefing’ at Cumbria STEM Centre Ltd events;
- Establishing links with colleagues was mentioned as useful for future curriculum development planning and one of those unplanned but beneficial outcomes from a project such as the BEP.

Time and competing demands were given as reasons for not pursuing some additional CPD. The examples given tended to focus on CPD that was embedded within a regular network meeting or closely connected to a specific activity. For example, one teacher described CPD from Cumbria STEM Centre Ltd embedded within a network meeting for Science and Maths teachers:

Tony gave teachers a preview of a table tennis ball firing activity at linking Science and Maths BEP funded meeting, STEM teachers from different disciplines were working together and there was an exchange of ideas about what topics could be taught through this activity.

Another teacher described how the student activity gave them “First hand opportunity to speak to professionals ... and update [their] knowledge which can then be used in subsequent lessons”. The idea of gaining CPD from closer links with industry is worth further investigation, schemes for work shadowing offer staff the potential to learn more
about Engineering within an industrial context or university. The idea was also highlighted in 2009 by a commentator who felt they were ideally placed to offer students and tutors insights into the latest technology by delivering “staff development for tutors” which would help maintain their enthusiasm and increase their awareness of the changing world of industry. One BEP co-ordinator felt that there was also a case for funding for teacher training in specific technical areas which would increase the long term impact of BEP, for example in the area of knowledge about new “smart materials”.

In 2009 a BEP co-ordinator suggested that:

As the project becomes established, support with writing external bids, funding!! which would give time to plan and explore resources.

A teacher at one school described their application for funding to Astra Zenica Science Teaching Trust, to establish a Science Summer School for Primary school teachers. The aim was to increase primary colleagues’ confidence and develop their practical skills to teach Science outside the classroom, which would complement the current arrangement whereby the secondary school provided Science activities three times a year for pupils in years 5 and 6. Although Science focused this proposal has potential for adapting to have an Engineering focus and one that could involve other BEP schools.

It is recommended (8) that the BEP consider ways of using CPD development as an incentive for individuals and stimulus for cascading new ideas into schools and colleges. Given other feedback, discussion with existing networks about ways of using Engineering activities as a vehicle for encouraging cross disciplinary collaboration may prove a useful way of embedding this type of cost effective CPD.

2.5 Key Points Relating to Achievements

.1 Raising awareness of Engineering in the local area

Activities have raised pupil and teacher awareness of Engineering as a subject and possible career focus. Teachers are making an explicit connection between STEM subjects, using BEP Engineering activities to demonstrate the application of other curriculum subjects such as Mathematics, Science and Technology including Design.

.2 Raising awareness of the valuable contribution of Engineering in our society

Whilst awareness of the value of Engineering may be recognised, its contribution to society is not emphasised or explicit in the activities. For pupils a more explicit approach would be required, or more focused exploration of their views to gather evidence to demonstrate they have grasped the benefits. Consideration of gender issues in selecting pupils to participate and in developing girl friendly activities is helping to raise awareness of the relevance of Engineering for all members of society. Where links with local companies

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4 For details of a scheme offered in 2006 by the Institute of Career Guidance [http://www.icg-uk.org/article185.html](http://www.icg-uk.org/article185.html)
exist these have been helpful in raising awareness, however, further work on extending the links to a wider range of companies is needed to highlight the wide ranging contribution of Engineering to all aspects of society.

.3 Enriching the attainment and skill level of local learners within the project

Increased engagement in extra curriculum activities provides pupils with opportunities for enhancing their attainment and skills. Pupils reported the benefits of opportunities to reinforce skill development in a ‘fun way’, which also enhanced their motivation. The standard curriculum has been enriched through BEP activities. XX pupils have attained a CREST award.

Teachers reported positive impact on pupils learning but said it was too early to demonstrate enhanced attainment in core assessments such as GCSE for pupils who participated in BEP activities. As noted in 2009, a more detailed tracking system would need to be in place to measure this.

BEP was seen as making a definite contribution in supporting teachers CPD and curriculum development which we believe will have an impact on the attainment and skill level of local learners.
3. Embedding STEM into schools and colleges

3.1 Summary

As a partnership the BEP schools’ specialist status covers all four STEM subjects as well as Sports and Performing Arts. The post-16 providers provide progression opportunities for students to all STEM subjects at Advanced level, Advanced Diploma level, Young Apprenticeships and, for those wanting to study locally at a higher level, HNC and BEng in Engineering are also available. Institutional missions influenced the initial starting positions and the ongoing response to the BEP project including the way teachers engage with the project and the connections with the existing curriculum. Walney School’s recognition as a Specialist School for Engineering at the end of 2009, and the choice of Applied Mathematics as a specialism by Furness Academy, are the most obvious shift towards embedding STEM.

Evidence of embedding STEM within schools and colleges is however more complex than specialist status. In 2009, several interviewees mentioned that schools and colleges had got into the habit of viewing initiatives as “another flash in the pan” and consequently did not necessarily view any particular initiative as something that would eventually become embedded within their day to day curriculum. It is in the context of multiple demands on teachers, ever changing sources of funding and priorities that staff working on the BEP seek to embed STEM into schools and colleges.

The evaluation considers evidence of impact under four broad areas that are: institutional, curriculum, careers and partnership. As figure 4 shows each broad area contains a number of related issues, some of which overlap or connect with another broad area.

![Figure 4: Overview of evidence of embedding STEM](image-url)
3.2 Institutional Context and Change

Institutional issues shape the context in which BEP co-ordinators operate, the way STEM is organised within the school or college and the possibilities for embedding and sustaining STEM in the future. As one senior teacher explained:

*Last year it was very much activity based focused on individual groups of pupils, mini project based, a way of enhancing what we were doing already* (Senior Teacher)

.1 Ethos and Context

The importance of the BEP co-ordinators was reinforced again in this 2010 evaluation. There was variation between their location and position within their organisation which influenced their access and support from management teams and the strategies they used to involve colleagues. It is possible that this may have influenced the numbers of staff involved discussed earlier in section 2.3.2.

Within the BEP there were some commonalities in how the BEP co-ordinator operated. One model of BEP co-ordinator was that of the ‘lone ranger’ who, for different reasons, was responsible for delivering the bulk of the activities and who was reliant on ‘good will’ and their ability to persuade others to get involved. The commitment of current BEP co-ordinators means the specific requirements of BEP are delivered but there are perhaps missed opportunities or additional challenges associated with embedding STEM at an organisational level and ensuring wider curriculum change which several mentioned was crucial for sustainability.

Other BEP co-ordinators with a senior leadership role or where a senior leader played a more active role used a ‘devolved model’ that appeared to involve greater number of staff each of whom undertook responsibility for organising or taking forward specific activities. This is perhaps one reason for a greater sense of engagement and enhanced profile for STEM. However, it is worth noting in these devolved models that staff did not always make the connection with BEP. An advantage of this approach appears to be greater flexibility about use of funding and wider involvement of staff.

Whether a ‘lone ranger’ or senior leader there are some potential dangers of relying on key individuals to stimulate and direct the project. These include a lack of time because of competing responsibilities which interview feedback suggests can be personally frustrating, or lead to missed opportunities. Reliance on individuals also endangers continuation of BEP activities if the individual leaves, is ill or given other priorities.

It is recommended 9 that each participating school/college reflects on the management model used to allocate BEP funding, in order to achieve the optimum use of this funding stream for long term benefit.

To capture evidence of BEP impact at an institutional level it was recommended that all participating schools share relevant references from their School Development and
Improvement Plans. Although this information was requested in 2010 it was not uniformly available sometimes due to its draft status or the extent to which the BEP co-ordinator was involved with this type of document. It was therefore necessary to triangulate the views expressed by staff operating in different capacities within the BEP with other evidence provided.

.2 Raising the profile of BEP within the school

A first step towards embedding is raising the profile and several schools talked about notice boards that helped celebrate and raise the profile of Engineering and BEP activities. Notice boards provided a focus for pupils as one BEP co-ordinator explained the school displays information about activities for pupils so that ‘they know what all their mates are going out of school for which raises awareness’ of the Engineering activities.

Schools also showed or sent copies of newsletters which talked about achievements and included photographs of pupils enjoying themselves and talking positively about the events. These resources were often sent home which is one way in which schools are able to challenge stereotypes about Engineering and raise awareness, of adults who may influence future career decisions, about the breadth of jobs and types of work that are possible.

Schools and Colleges: Managing their budgets

In 2009, one commentator summed the situation up by describing BEP as “a way of working rather than just a one off project” and thought that BEP would only succeed if schools did not “just use BEP as a source of short term funding”. There was clear evidence in 2010 of schools and colleges thinking more strategically about how they spent their budget. This included:

- purchase of resources that could be reused in future years;
- consolidating the resources from the previous year to ensure the school / college was able to adopt a more holistic approach to a specific topic;
- following up recommendations from other schools / colleges when selecting external providers to deliver an activity;
- considering how they might adapt an activity and thinking about the resources they would need to deliver an activity currently delivered by an external provider.

Several BEP co-ordinators spoke about staff undertaking particular roles that assisted them with the organisation, delivery, evaluation and publicity of BEP activities. The approach of sharing the work was an obvious indicator of raising the profile (at least for the individual concerned) and demonstrating organisational commitment through how it used its staffing resource. Examples included:
• Support with organisation of trips and paperwork; this provided a point of contact for students and allowed more detailed ‘chasing up’ to ensure return of permission forms (Furness College)

• Use of a member of staff to help gather feedback and evaluate activities; this process served several purposes including the production of several short reports which they collated in an evidence folder which was available for reference by staff and anyone interested in monitoring and evaluation including governors and Ofsted (St Bernard’s)

• New Teaching Assistant appointments to undertake more intensive STEM support within the classroom and organisation of resources; although not exclusively BEP stimulated, the strategy of assigning specific duties to TAs was regarded as a good way of sharing the workload and cost effective (Walney)

Another major area in which schools and colleges raised the profile of the BEP was the curriculum and in particular cross curricula collaborations.

3.3 Curriculum

Curriculum was recognised as the major vehicle by which the BEP will embed STEM and make changes that will impact on students’ awareness and attitude towards Engineering as well as increase their attainment, capacity and interest to pursue progression routes leading to employment in STEM related careers. There is already evidence that BEP institutions recognise and are committed to embedding Engineering within the curriculum and activities associated with educational pathways and accreditation. As one senior teacher explained:

I think the fact there has been a discrete element within our 14-19 plan has raised the awareness of staff who wouldn’t normally be involved generally, it’s opened people’s eyes to what we are interested about in the area (Senior Teacher)

‘The universe of Engineering’ (Malpas, 2000) outlines two types of Engineering knowledge. The ‘know what’ covers the facts, experience and skills, together with an understanding of their application, and the ‘know how’ covers the ‘creative process which applies knowledge and experience to seek one or more technical solutions’ (Malpas, 2000 p5) to solve problems within a specific context. The Malpas review of Engineering highlights the potential crossover between subjects taught and the multiple areas for application that we believe may be useful for BEP organisations to map linkages between curriculum subjects (see Appendix D: Disciplines and Applications in the universe of Engineering p50).

The broad area of curriculum is broken down into three related issues:

• curriculum delivery and development;
• cross curricular connections;
• educational pathways and accreditation.

Although discussed separately it is recognised that the order and separation of these issues is artificial.
.1 Curriculum Delivery and Development

Schools and colleges described examples of how they have embedded BEP activities into the curriculum (see also sections on Learning Opportunities p8, Cross Curriculum Connections p23, Careers Education: Students p27 and primary activity p10 and p31).

- St Bernard’s School used BEP funding to purchase equipment and devise activities that can be re-used in subsequent years. BEP activities (and St Bernard’s School specialist Science status) have also been catalysts for cross curricular work.
- The Greenpower project was embedded into the scheme of work for GCSE Materials Science for year 10 pupils at Walney School and as a project for Furness Academy year 11 Diploma students at Furness College. The year 11 Engineering Diploma students built the car and then identified something in it that they would change and re-design.
- Ulverston Victoria used BEP funding to purchase resources for a pen project which was enhanced with ‘in kind’ support from a local employer.
- Barrow 6th Form College funded a visit to the Coca Cola manufacturing plant (with its own education centre) near Leeds, which provided a worked example for their exam (see also EES p8 and cross curricular links p23).
- Dowdales School focused on two topics in 2009-10, renewable energy and space. The BEP funded a school based visit of Starchaser, an off campus visit to Jodrell Bank, and rocket kits for classroom use.

A core role for BEP co-ordinators in respect of the activities that they made available to their students connects with that of curriculum development. The evidence collected in 2010 covers curriculum developments related to actual, planned and suggested changes.

When commenting upon the centrally organised and externally provided activities several BEP co-ordinators suggested that additional information provided ahead of activities would enable them to follow up work and embed activities within the curriculum. Another related suggestion was for BEP schools to co-operate on curriculum timing of BEP funded events. This would not be without its challenges but would allow all schools to maximise impact of activities by increasing the likelihood of organising preparation and follow up activities for each event rather than events fitting in by chance.

As discussed earlier there is already evidence

Preparatory information enhancing activities

Although pupils enjoyed year 8 STEM days, teachers felt that to maximise the longer term impact of the activities schools need the content of the days, in advance of the event, to enable them to have time to plan follow up work.

The Project Eggs-Factor STEM Challenge Day was another popular activity with pupils that teachers believed they could also enhance with more time and information. It involved the use of group work skills which the school could have extended during the following week had they been forewarned.

However, it was also noted that “Schools need to put in a fair degree of effort to ensure that one-off events are tied into the curriculum”
of BEP organising single and multi-school / college activities either as a stimulus or culmination of activities delivered during National Science and Engineering Week.

For most BEP institutions there was evidence of more strategic thinking with respect to the activities developed and the investments made (see Insert Box: Schools and Colleges: Managing their budgets p20). There was evidence of them linking activities and thinking about progression within the curriculum as well as connections with other curriculum subjects. Although one BEP co-ordinator mentioned this in 2009, this year senior teachers, BEP co-ordinators and teachers of different subjects described from their perspective the benefits to learning within different subjects and of writing ideas into schemes of work.

One teacher described a challenge which will help students to:

“think about using information about skyscraper design and how they would withstand an earthquake, ... [they had to] include costing, building, testing and evaluation – a mixture of Science, Maths and technology, we’ve got ideas from STEM activities and are developing our own.”

This approach involves students in solving what Murgatroyd (2010) described as ‘wicked problems’ which he argues helps prepare students to cope with real life issues. It is recommended (10) that BEP considers how it might facilitate schools and colleges to share or map its curriculum so that they can continue to collaborate over the focus of activities delivered in National Science and Engineering Week and inter-school / college competitions such as Greenpower.

Two specific foci for collaboration about embedding and longer term sustainability of curriculum interventions were:

- to lobby the examination boards to ensure that EES projects are eligible for AS level coursework thereby increasing the likelihood that EES becomes an integral part of the curriculum with core funding attached;
- for all BEP schools and colleges to use the same CAD (Computer Aided Design) software in order to facilitate progression into post-16 study in Design and Technology.

### 2 Cross Curricular Connections

There were several examples of schools and colleges making connections between different curriculum subjects. The mechanisms for identifying, developing and embedding cross curricular connections seem to operate along two continuums; the first associated with the institution, the second the individual.

![Mechanisms for understanding cross curricular connections](image)

**Figure 5: Mechanisms for understanding cross curricular connections**
Each development was influenced by varying levels of intention and degrees of embedding. There appeared to be four main strategies used:

- Existing team meetings which included discussion of BEP activities as part of their agenda (established and institutional);
- Establishment of working groups to undertake planning (evolving and institutional);
- Individual instances of teachers exchanging information about the curriculum content that resulted in more coherent planning for progression in the curriculum (ad hoc and individual);
- BEP stimulated activities that brought together teachers from different schools as well as teachers of different STEM subjects (planned and individual).

At one School, the BEP was the catalyst for a recently formed STEM working group which decided on the areas where their BEP school-based funding would be used, that is, space and renewable energy. For the renewable energy theme, the school intends to purchase a wind turbine, photovoltaic cells and data recording equipment. The generation of renewable energy at this school will then be available to evaluate using a range of STEM skills and knowledge.

_"we are already talking about opening it up to other people, how we can share the load ... e.g. space and the rockets and sustainable energy will help to widen the remit" (BEP co-ordinator)._ 

At another school joint Science and Mathematics meetings which the teacher thought were organised by BEP were used to:

_"discuss how we should be linking the two subjects together which is very important for Engineering, because in Maths we should be doing graphs work before the Science people need to do graph work as a result of an experiment. ... we teach graphs in Maths and then they teach Maths in Science because the children don’t make the connection" (Teacher)._ 

This type of discussion is clearly valuable in providing a more coherent programme of learning. As this teacher noted ‘children don’t make the connection’ and it is therefore helpful when teachers themselves are aware of what is being taught in other subjects so that they can enable students to make the connection.

One school described organising cross curricular activities ‘off timetable’ which was a practical solution that allowed students to engage in ‘projects’ or activities that required them to deploy knowledge acquired from individual subjects. It is possible that this type of approach allows for more obvious connections with Engineering to be made. However, a comment raised in a more general discussion is an important point for promoting cross curricular connections that include Engineering. They felt there was still a need to continue to give a “big push” to educate people about what Engineering is “No-one knows what an engineer is”.
As the BEP moves into its third year it is worth encouraging schools and colleges to ‘to emphasise the transference of skills otherwise we are in danger of a one off project’ (BEP co-ordinator)

.2 Educational Pathways and CREST Accreditation

Two other aspects we connect with progression into Engineering related careers are the development of a range of educational pathways with accreditation opportunities and effective careers education (see section 3.3 p27).

At a time when there is a plethora of qualifications and possible routes to pursue it is important to ensure students at whatever stage of the educational pathway receive accurate IAG. Where appropriate this should involve opportunities for their parents / carers to also have access to this information (see section 4.3 parents and carers).

One of the aims of the BEP is to support progression to Higher Education. Within Barrow there are progression routes and universities do contribute to activities e.g. Girls into Aerospace. However, as MacBride et al (2010) note there are additional benefits to schools, colleges and the universities in working together “to support and refine transition from the school environment to higher education Engineering courses” (p120). It is recommended (11) that BEP review the findings of the ‘Engineering the future project’ and consider approaching local universities with an explicit request to discuss longer term collaboration and curriculum development.

One existing mechanism that would allow students to demonstrate progression is through the acquisition of CREST awards. The CREST award scheme is a specific form of accreditation that may provide additional motivation and offer a framework for cross curricular Engineering related activities. The name ‘CREST’ stands for ‘CREativity in Science and Technology’. CREST projects are accredited and awards are made at three levels – Bronze, Silver and Gold. At each CREST level the student undertakes project work which encourages the use ‘know what’ and ‘know how’ Engineering knowledge (Malpas, 2000). The CREST resources include detailed profiles that guide students through work of an appropriate level and representing a particular number of hours (Bronze 10 hours, silver 40 and Gold 100).

At Bronze, the main message was ‘SET can be fun’ and students developed teamwork skills. • At Silver there was also an emphasis on fun, but students also felt they had built their skills in IT, presentations and problem-solving. • At Gold students developed their problem-solving and report-writing abilities and many said they had learned that they ‘want a career in SET’. (Grant, 2007 p7)

As discussed in 2009, the CREST awards offer incremental steps which would encompass pupils from the primary feeder schools as well as post 16 opportunities. The levels are progressive and can be awarded separately at any stage they help. From an Engineering
perspective there are four steps of progression moving from awareness to engagement see Appendix E for an adapted diagram\(^5\).

Another advantage (of Crest Awards) is that they involve students in reflecting on, and capturing their learning, which may help to reduce the atomisation of activities delivered in isolation. They also provide a focus for skill development that is likely to be useful for those who pursue a career in Engineering and those that do not. This provides flexibility for schools / colleges to embed the awards within their core lessons for all students or use the awards as a progression opportunity for particular students pursuing a specific project associated with an Engineering Club.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Bronze</th>
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<td>%</td>
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<td></td>
<td></td>
</tr>
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<td>59</td>
<td>39%</td>
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<tr>
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<td>24%</td>
<td>21</td>
<td>13%</td>
<td>27</td>
<td>18%</td>
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<tr>
<td>Working in a group</td>
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<td>34</td>
<td>21%</td>
<td>22</td>
<td>14%</td>
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</tr>
<tr>
<td>Freedom to choose the experiment</td>
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<td>13%</td>
<td>36</td>
<td>22%</td>
<td>17</td>
<td>11%</td>
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<td>Receiving the certificate</td>
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<td>28</td>
<td>17%</td>
<td>14</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Working alone</td>
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<td>3%</td>
<td>4</td>
<td>2%</td>
<td>6</td>
<td>4%</td>
<td></td>
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</tr>
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<td>5</td>
<td>3%</td>
<td>7</td>
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</tbody>
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\(^5\) Adapted from London Engineering Project: [www.thelep.org.uk/about/thelepapproach](http://www.thelep.org.uk/about/thelepapproach)

**Figure 6: Students favourite aspects of CREST (Grant, 2007 p27)**

Within Cumbria the STEM Cumbria Ltd co-ordinate submissions, they provided details of CREST awards for 2008 and 2010 for BEP schools and colleges. Four BEP organisations have participated in the scheme. In 2008 this involved two teachers with 5 gold and 277 bronze awards and in 2010 it involved five teachers and 3 gold and 177 bronze awards. With reference to the continuum associated with mechanisms for understanding cross curricular connections, current engagement is still operating at an ad hoc and individual level with some organisations choosing (for reasons we did not explore) not to use the CREST award scheme. There is the possibility for adopting a planned and institutional approach which might be used as a focus for encouraging collaboration between schools and colleges in a future beyond the BEP.

It is **recommended (12)** that the BEP give some thought about whether they will adopt a cross project approach to CREST awards or leave individual schools and activities to make unilateral decisions about the use of these awards.

If there is interest in collaboration it is **recommended (13)** that STEM Cumbria Ltd and participating organisations discuss the practicalities of rolling out a programme including consideration of how Engineering Club or curriculum projects might be linked to CREST
awards. This exploration might include discussion with local companies about sponsorship to cover the cost of accreditation and support from their STEM Ambassadors for a specific project award.

3.4 Careers Education and Development

Careers education and development is a cross cutting issue that impacts on both students and staff, it is an area which can help raise student aspirations and change stereotypical images about ‘what an engineer does’. As already noted awareness of Engineering is sometimes limited and one of the challenges associated with Engineering is that:

The public image of Engineering in the UK is poor, furthermore visibility of the profession is low and confused, and it is often difficult to gain access to information about the profession (Malpas, 2000 p8)

Despite this there is clear evidence of BEP institutions making use of STEM ambassadors as role models and including specific reference to a range of Engineering careers suitable for students who are either pursuing vocational or academic pathways. In addition, BEP coordinators and teachers outlined examples of professional development opportunities linked to BEP activities and described both personal and professional benefits.

1 Careers Education: Students

Careers education is perhaps the wider umbrella into which the IAG mentioned in our discussion of educational pathways fits. Although important, having the qualifications and even an interest in the array of activities provided by the BEP is no guarantee that students will move into Engineering related careers with local employers.

An interesting observation by Malpas relates to the hidden challenge for staff helping young people plan suitable qualification pathways or routes into specific careers. He reports that:

Renaming a course “Multi-media Technology and Design” from “Electronic Engineering —” resulted in

Tomorrow’s Engineers

Provides resources for tackling some of the challenges associated with promoting careers in Engineering.

From answering the basic question ‘what is Engineering?’ above, through to planning a career route below.

Resources also support activities showing how Engineering has relevance for everyday life and link closely with some of the projects offered by related Enterprise projects which might provide an ongoing opportunity for cross curricular projects.

For further information see: www.tomorrowsengineers.org.uk
many more applicants of higher standard. The content of the course remained unchanged. P25 (Malpas, 2000 p25)

Whilst this is a positive account of how students can be encouraged to study a specific subject it shows how important it is to try and raise awareness about the many branches of Engineering which might otherwise be missed. BEP activities clearly contribute to this awareness raising process. Remaining up to date and ensuring students receive the careers education to which they are entitled is an ongoing task (See insert box Identifying ways of enhancing STEM Careers Education). Due to their location in the school, job description, area of expertise it is therefore not surprising to find that this is not the priority of BEP co-ordinators. However, they clearly welcomed activity providers including information about different careers and pathways. From observation of STEM ambassadors, notice boards, newsletters and discussion with Connexions advisors in 2009, there was evidence of BEP giving opportunities for students “to see how STEM subjects relate to real world jobs” which they believed was very positive. BEP co-ordinators also felt that work with BAE graduates who have chosen to move to Barrow to pursue their careers may help stem the outflow of talented young people from the area.

In its 2008 ‘Taking Stock’ report the CBI (Confederation of British Industry) stated:

“The demand for highly numerate and analytical STEM-skilled individuals is expected to grow dramatically in the future... By 2014 demand for Science, Engineering and technology-related occupations is expected to have expanded by 730,000 and net requirement for these jobs, taking into account those leaving the labour market, is predicted to rise to 2.4 million.”

In 2009, one teacher described the contribution of the Connexions service explaining their role of establishing links with industry. Talking about the service in their school, this teacher explained that it:

is to promote curriculum links between the school and industry. I am very happy with the way this is

Identifying ways of enhancing STEM Careers Education

One of the challenges facing teachers is where to find the information and how to avoid misinformation based on inaccuracies. Future morph offers video case studies and materials for use within lessons to challenge perceptions and highlight the range of careers it is possible to pursue if studying STEM subjects.

Equality and Diversity Toolkit

To support staff development this provides a list of questions that support ‘self-review’, depending on the response further questions are asked with sources of IAG provided. For example:

I am aware of where I can find help if I need to support young people accessing STEM careers

Follow up questions ask

Who offers support to young people facing gender identity issues?
www.gendertrust.org.uk

Who would help a 15 year old girl to become an engineer? Gender links provided.

For further information see:
www.futuremorph.org/teachers/
www.stem-e-and-d-toolkit.co.uk/home/welcome-the-equality-and-diversity-toolkit
developing. A project such as this [BEP] can only contribute to this in a positive way. (Teacher)

A further recommendation (14) relates to IAG where we suggest it would be useful to explore ways of involving Connexions advisors and others responsible for IAG in the BEP. For example, the BEP might host an event with local companies to discuss the range of local career and work experience opportunities (including, but not exclusively Engineering companies). Many of the Connexions advisors or teachers responsible for work experience or careers already have networks and contacts it is therefore possible that closer collaboration with them might ease access to and support future approaches to local companies. This approach would also extend the staff engaged in BEP activity, enhance the embedding process and share the targets associated with raising awareness and increased progression into Engineering pathways.

A further recommendation (15) is to consider how careers education is delivered within schools to enable STEM IAG to become embedded into the careers education programme. The Timeline project (figure 7) includes examples for each year but does not emphasise Engineering links, this is something the BEP could usefully add.

STEM Careers Awareness Timeline Document - An example from Cramlington Learning Village, Northumberland NB. KS3 Science is undergoing major review – to be completed

<table>
<thead>
<tr>
<th>Subject</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Crest Award. SECURE lessons (ongoing).</td>
<td>Life without Technology project. Creative writing – the future of technology and engineering</td>
<td>The role of the architect and engineer in society.</td>
</tr>
<tr>
<td>Design &amp; Technology</td>
<td>Systems control – electronics, robotics project (ongoing).</td>
<td>Identifying the maths around you – including work-related situations.</td>
<td>Identifying the maths needed for today’s world, including a range of different career.</td>
</tr>
<tr>
<td>Maths</td>
<td>Identifying the maths around you – including work-related situations.</td>
<td>STEM attitude questionnaire.</td>
<td>The Afternoon Club – every Monday after school.</td>
</tr>
<tr>
<td>Careers, PSHE and Citizenship</td>
<td>The Afternoon Club – every Monday after school.</td>
<td>Puzzle Club – every Thursday after school.</td>
<td>Maths puzzle on the VI every other Monday.</td>
</tr>
<tr>
<td>Other? (for all KS3)</td>
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</tbody>
</table>

Figure 7: Example from the Timeline Project: (STEM Store cupboard, 2009 p3)

According to Houghton's (2003) typology of helpers, tutors may be regarded as 'peripatetic helpers' who offer what support they can but draw primarily from personal experience rather than from any expertise. It is therefore recommended (16) that to support the IAG and wider careers education the overall BEP Co-ordinator publicise relevant materials including the recent Centre for STEM Choices: A Resource Pack for Careers Education and Information, Advice and Guidance Practitioners (Science Education and VT Enterprise, 2009).
.2 Continuing Professional Development

Teacher development is a product of BEP both within and between participating institutions. Teachers described observing external providers’ STEM activities that they intended to incorporate into schemes of work. For example, a skyscraper design challenge for year 9 pupils at St Bernard’s School that combined Maths, Science and Design and Technology in designing, building, costing, testing and evaluating skyscrapers to withstand earthquakes. There are signs of knowledge gained from an out of school activity for a group of students being utilised to devise activities for entire year groups. At Furness College, the production of equipment to use in primary school outreach activities had been inspired by observation of a BEP funded rocket challenge activity for secondary school. A teacher observed that BEP activities have given some good examples of innovative teaching ideas.

BEP co-ordinators also perceived the networking opportunities provided by BEP meetings as beneficial for their continuing professional development particularly when staff came from small departments within a school or college.

There was also evidence of teachers utilising learning from a BEP funded training activity provided by Cumbria STEM Centre Ltd. where Science and Mathematics teachers worked together and exchanged ideas about the curriculum that could be covered using a table tennis ball firing activity. Another example where teachers and Teaching Assistants had opportunities to increase their knowledge of STEM subjects was when they accompanied students on off-site activities. This enabled staff to update their professional knowledge, whilst on a Geology field trip for Barrow 6th Form College students to nuclear decommissioning sites and to a local quarry.

Professional development supports the aims of the BEP by informing, inspiring and increasing the networking between colleagues within the same school or college as well as across the partnership. To date this has happened naturally, as noted elsewhere in thinking about the future sustainability it may be timely and cost effective to look at how BEP can plan to support CPD.

3.5 Partnership

Partnership is a core issue for embedding changes arising from the BEP. Partnership work is influencing development in a number of ways including: communication about activities; the exchange of information to maximise learning and effective use of resources, the extension of provision to the primary sector as an aid to developing a more coherent
progression pathways and interaction with local, regional and national stakeholders who provide funding and offer complementary activities.

.1 Closer working between BEP schools and colleges

Throughout the academic year 2009-10, co-ordinators in BEP schools and colleges have met on a regular basis, with meetings being chaired by Brian Wood the overall BEP Co-ordinator. One senior teacher stressed the importance of this networking, when they said:

\[ I \text{ think the collaboration is part of the long term sustainability [for BEP] and I'm seeing evidence of things ... a sense of excitement, purpose and widening brief about this type of work ... [there is] greater whole school knowledge, awareness of what's going on is wider than last year which must be a good thing (Senior Teacher) \]

A consequence of these meetings is that teachers are meeting regularly allowing for an exchange of ideas that may not have taken place otherwise. For example, after hearing about the success of Ulverston Victoria High School’s pen making project, Dowdales School are now planning a torch project for year 9 pupils.

The growth in the number of institutions participating in the Greenpower project has been partly due to BEP which has in turn strengthened the links between the participating schools and colleges.

\[ \text{we are in the process of establishing a more formal link with [name of school] we've already got an informal link but [this would be] greater collaboration because of BEP (Senior Teacher).} \]

.2 Primary

The collaborative work between Walney School, Furness College and primary schools was reported in section 2.2.4. One BEP co-ordinator recalled a previous Science project undertaken with a number of primary schools that involved secondary staff delivering / modelling an activity as an aid to developing primary colleagues’ confidence to assume responsibility for delivery in the future. To build on this intervention BEP funding was used in year 1 to purchase equipment for Primary Engineer Clubs. Unfortunately the level of engagement was disappointing. However, one of the benefits of a collaborative project such as the BEP is the opportunity to ‘test out ideas’ and to share learning between members. The experience generated some valuable insights relating to collaboration with primary schools which we believe would benefit from wider consideration.

Whilst acknowledging the project was not formally evaluated, from informal feedback and based on their earlier experiences they speculated that the Primary Engineer project “is just too complicated”. If true, this may have implications for BEP and some of its stakeholder partners notably Cumbria STEM Centre Ltd to think about future CPD, and future primary to secondary transition activity. Despite disappointing engagement from primary schools, they reported year 7 pupils describing their primary project and
remembering the staff involved. This incident is interesting for two reasons, firstly because it adds to evidence reported last year and elsewhere (Marsden and Houghton, 2008) regarding the benefits of secondary–primary collaboration for the purpose of staff development and secondly the impact on pupils’ awareness, aspiration and transition.

3 Industrial links and STEM ambassadors

Through the role played by STEM ambassadors (who are recruited and trained by Cumbria STEM Centre Ltd.), BEP students and staff are increasing their links with local industries. As stated earlier, STEM ambassadors are perceived as a valuable asset and good role models for students.

Teachers not only spoke positively about STEM ambassadors, there was evidence of them beginning to plan for their future use to support delivery of the curriculum. This is a positive sign of schools thinking about the use of STEM ambassadors as a longer term resource rather than an ad hoc bonus.

next year in technology we are going to see if we can get a STEM ambassador with the material Science to help us with the green car - not only will they have the teacher but also someone from industry (Teacher)

One BEP co-ordinator indicated that there may be a difference in the contribution of ambassadors depending on their age, background and experience. They explained:

Apprentice ambassadors can be quite “hard work” in school because they are quite young. This year we have had graduate apprentices who have been better, came in for GCSE Engineering, it’s a more suitable level for the situation (BEP –co-ordinator)

Teachers reported the beneficial role played by STEM ambassadors, for example:

- accompanying out-of-school trips where teacher cover is sometimes difficult to arrange;
- interacting with students at STEM events which gave pupils the opportunity to talk to current employees in STEM industries and to learn about their job and educational pathway.

Working in partnership: Champion-ships

The Champion-Ships project developed by BAE Systems STEM Ambassadors was a competitive activity that requires students to combine Engineering and business skills by designing and testing model ships, and purchasing virtual commodities to trade internationally. The idea for the project arose from booster training for BAE STEM ambassadors.

BEP allocated funding following a presentation to BEP co-ordinators and the original plan was to run five heats in February 2010 and hold the project final during National Science and Engineering Week in March 2010.

Two successful heats were held at Furness College in May 2010. Misunderstandings about insurance and logistical staffing and space issues resulted in some schools withdrawing and the postponement of the July 2010 final.

Despite these setbacks the project highlighted some important messages for future industry – school / college projects, these include:

- Greater clarity about logistics with industry and schools / colleges making clear any non negotiable procedure at the start
- Pooling solutions to possible hurdles
- Appreciating not all schools / colleges operate in same way Some of these issues relate to understanding respective organisational culture which may be enhanced by shadowing placements.
Teachers noted that STEM ambassadors educated to HE level can embody the long term benefits of academic study. One teacher described STEM ambassadors as “perfect role models”. Some participating institutions plan to have greater involvement from STEM ambassadors, for example, Walney School intends to involve a STEM ambassador with year 10 Materials Science group working on the Greenpower project.

Whilst the presence of STEM ambassadors is generally welcomed, at present most of them are employees of BAE Systems. Whilst the active co-operation of staff from BAE was welcomed it would be beneficial if more STEM ambassadors were recruited from other industrial partners. This is to minimise reliance on one company and diversify the range of Engineering role models with whom the students interact. One teacher expressed the view that there needs to be more discussion with industrial partners to see how knowledge about industrial practices can best be brought into schools.

It is **recommended (17)** that BEP continue to explore ways of involving STEM ambassadors in school based activities such as their Engineering Clubs. Where schools currently have parents / carers with an Engineering background they should publicise the scheme and explore ways in which role models with school or college connections might be able to access STEM ambassador training. Practically this might be undertaken as a central activity.

**4 Wider Stakeholders**

There was evidence of benefits gained from these wider stakeholder meetings. As one BEP co-ordinator reported:

> I was at another meeting yesterday EBP meeting and so basically [the BEP Co-ordinator] was spreading the word [about BEP] about town. It’s about contacts and raising the profile, ... [the BEP Co-ordinator] was reporting back about BEP’s involvement in National Science and Engineering Week, so this guy from Fishers said I’ve got two graduates who would hopefully be able to get involved, so that just happened.

As discussed in 2009, BEP benefits from a number of external organisations who fall into three broad categories – providers, partners and funders. In the current funding climate, the context is changing for partners and funders and this is impacting on their strategic and operational plans. For instance, Aimhigher Cumbria funding is due to finish in July 2011, currently there is no certainty this will continue. These changes are likely to influence how STEM activity is embedded within BEP organisations as well as the longer term sustainability of BEP objectives. It is therefore **recommended (18)** that the wider stakeholder meetings are retained and used by stakeholders to share longer term plans.
3.6 Key Points Relating to Embedding

.1 Raising awareness of Engineering in the local area

From the perspective of embedding, awareness of Engineering is now recognised by more than the BEP co-ordinator. School ethos and management structure influence the range of mechanisms used to raise awareness. Usually there is greater awareness and involvement of wider staff in schools where the BEP Co-ordinator is a Senior Leader or works closely with a Senior Leader.

It is difficult to extract the influence of the BEP from other activities, however, teachers report improved transition for pupils who meet and interact with secondary pupils / teachers and visit secondary schools. The BEP primary activities are integrated into schools transition programmes and thus beginning the process of raising awareness.

.2 Raising awareness of the valuable contribution of Engineering in our society

Awareness of cross curricular links with Engineering has increased and is closely linked to informal CPD and planning developments relating to the BEP. Explicit reference to Engineering is more obvious to staff and pupils when Engineering is in the activity title ‘Girls into Engineering’ and less obvious in Greenpower. However, the benefit to individual users (e.g. those in submarine) and the relevance and application of Mathematical skills is heightened by providing an Engineering focus for activities.

Industrial links and STEM ambassadors, graduates in particular, provide information about the range of alternative career opportunities and pathways, and indirectly raise awareness of the wider presence of Engineering in society.

.3 Enriching the attainment and skill level of local learners within the project

STEM ambassadors, graduates in particular, and activity bring pupils into contact with other adults who will ask and answer questions, demonstrate and challenge pupils with respect to technical skill development. This increased adult interaction enhances curriculum delivery.

As noted relating to achievement, BEP is making a definite contribution in supporting teachers CPD and curriculum development. There is evidence of CPD and curriculum planning moving from ad hoc discussions to becoming embed within most schools.
4. Sustainability of STEM and BEP impact

4.1 Summary

The foundations for sustainability are dependent on the extent to which activities are embedded in BEP schools and the way in which the enabling and process dimensions associated with ways of working are adopted. According to one commentator the challenge to sustainability faced by BEP is to ensure that the:

right ethos set, then [the] project will succeed. Engineering in all its forms will provide a good career base for young people [that] will allow them to apply their academic and personal skills. If schools just use BEP as a source of short term funding, then no [it won’t succeed]. (Commentator, 2009)

Evidence of sustainability is reported under three headings, funding, collaboration and parents / carers.

4.2 Funding and Longer Term Investment

There is evidence of schools and colleges beginning to use BEP funding creatively as well as their own financial resources, with longer term goals in mind. For instance:

- BEP co-ordinators purchase of resources for reuse and the development of resource boxes for use by others;\(^6\);
- the reorganisation of existing as well as development of new curriculum activities supported by BEP funding providing opportunities to experiment and test things out;
- involving and devolving responsibility to a wider group of staff which is perhaps the most obvious sign of schools and colleges willingness to invest their own funding;
- inter school collaboration and networking stimulated by BEP that is beginning to result in focused discussion about ‘how to’ adopt another schools / colleges effective practice, this bodes well for ongoing collaboration;
- an increase in the progression opportunities available within Barrow including the new level 3 Engineering Diploma.

Although schools and colleges talked about the impetus BEP provided as activities become embedded it is more difficult to disentangle what they might have done in the absence of funding.

4.3 Sustaining Collaboration

The two activities which are currently dependent on BEP funding and are therefore at greatest risk with respect to continuation in the future are co-ordination and external visits or high impact activities.

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\(^6\) Although this seems an excellent idea, the mechanism for publicising the availability and organising the ‘lending library’ of resource boxes still needs further thought if this is to be sustainable, in another context this type of scheme has proved valuable.
• **external visits and high impact activities (e.g. Starchaser):** although many felt these would not be possible without BEP funding, it was suggested by one BEP co-ordinator that the awareness raising and inspiration of high impact activities may be enough to lobby for school funds or seek external sponsorship. One idea was for BEP partners to negotiate favourable rates with providers by approaching as a partnership and being flexible over time. However, this requires co-ordination as well as collaboration between and within schools.

• **ongoing network meetings and co-ordinated action:** despite the benefits there was real uncertainty about how long these would continue without someone to co-ordinate. The biggest constraint was time and the absence of a co-ordinator to pull things together which is dependent on funding.

Several interview respondents spoke of the key role of the overall BEP co-ordinator (Brian Wood) who facilitates collaboration between participating institutions. This was apparent in the overall approach he adopted to the project which was a “combination of direction and reaction”. As one senior teacher explained:

> if he wasn’t chairing and organising the meetings then the project wouldn’t run because it needs somebody to pull people together, it needs a driver, it needs an organiser (Senior Teacher)

The view was expressed that an individual needs to fulfil this role; however this may not be straightforward. There are two issues to address:

• **BEP co-ordinators involvement in network meetings:** Individual enthusiasm and commitment of BEP co-ordinators is evident but with competing demands this needs institutional commitment in the form of time and senior leadership backing. As one senior teacher noted: “You’ll hear from lots of teachers funding helps but time is the barrier that comes up for people, it’s not because the will is not there, that is the barrier, finding time that’s allocated really helps.”

• **Co-ordination of specific activities:** within the BEP schools and colleges there are individuals and expertise which could be drawn upon. It was suggested that in view of its specialist Engineering status, a key worker at Walney School could undertake this role on behalf of BEP. Another option that may be possible would be to develop a devolved co-ordination model. This would require identification of clear areas of responsibility for the collaborative activities that would continue and then formal commitment from the relevant group (14-19 Partnership, or Furness Education Consortium - FEC).

Alternatively, to seek alternative funding to continue the role or explore the possibility of one of the stakeholders assuming responsibility for this role.

It is **recommended (19)** that the issue of co-ordination is a priority and needs to be explored with 14-19 Partnership / FEC and stakeholders so that there is clarity for the future.
4.4 Parents and Carers

Although not a focus of BEP as identified in 2009, parents and carers represent a key influencer on young people’s career decisions and educational pathways. In some respects they are crucial for the sustainability of ideas for their son or daughter and for wider changes in views about Engineering within the town.

Increasing their involvement and raising their awareness about career opportunities and educational pathways for girls as well as boys is important as a longer term goal.

During the year a few activities attempted to involve parents. Parent / Carer response and involvement varied. As one teacher pointed out many of the parents have an Engineering background, there was limited evidence of schools and colleges utilising parents and carers as a resource, and this may be something they consider in the year ahead. A Science teacher reported one of girls invited to Girls in Aerospace event turned this down as she was going to work with her father at BAE that day.

One BEP co-ordinator suggested there needs to be a:

removal of Science and Engineering stereotypes and gender perceptions. Work [is also] needed with parents to change perceptions. A possible future event for BEP - a celebration event with parents invited.

Another BEP co-ordinator spoke about challenging the traditional routes and associations made with Engineering when they said:

We need to encourage students to think beyond the shipyards and only following the craft route into Engineering.

With respect to feedback from parents, one teacher reported positive feedback and thanks received from a parent whose child went to a year 8 STEM event, the pupil said that this is what she wanted to do for the rest of her life – she wanted to be an engineer, “how do I become an engineer mum?” Parents and carers remain an important source of information, advice and guidance for their children and where possible schools in particular should consider how to include activities involving parents / carers. This will not only help to breakdown stereotypical myths about the types of careers associated with Engineering but also provide them with sources of IAG they can review with their child.

The involvement of parents is an effective strategy in the Aiming4uni in Furness which is a widening participation project to which all Barrow Schools are connected. The involvement of parents in their sons or daughters future education and careers is recognised as crucial. It is therefore recommended (20) that the BEP considers ways of informing and involving parents / carers about the activities in which their sons or
daughters are involved. One motivational strategy within the Aiming4uni in Furness project is the development of a DVD; this might be something BEP consider to capture activities during the third year of the project. See also career related recommendations p 27.

4.5 **Key Points Relating to Sustainability**

### 1 Raising awareness of Engineering in the local area

Visits, competitions and high profile BEP activities especially focused on National Science and Engineering Week have successfully and regularly been mentioned in newsletters, on notice boards and in assemblies. These embedded publicity approaches have helped to raise awareness of the wider school community including parents and governors. Cross-curricula activities, inter-school competitions and industrial links are likely to help to keep Engineering on the agenda. However, there is a real danger that without the high profile activities, other activities will gain greater coverage.

### 2 Raising awareness of the valuable contribution of Engineering in our society

The contribution of Engineering to society is clearest in activities with industry links, and when ambassadors talk about the relevance of their work. Explicitly raising the profile of societal benefits is something that needs to become embedded in activities if it is to be part of the sustainability plan of individual schools and the wider network of stakeholders.

### 3 Enriching the attainment and skill levels of local learners within the project

Parental engagement in their children’s learning is generally identified as a factor that influences attainment and skill levels (Jeynes, 2005). Activities involving parents or requiring pupils to discuss BEP activities including newsletters could be given greater prominence. Where schools have used the parents who have an Engineering background this has worked well, as noted in 2009 report, girls engagement in Engineering clubs was often linked to presence of an Engineering role model in the family.

Having a clear goal for the future helps to motivate pupils and is likely to enhance attainment, greater involvement of IAG / Connexions staff to support pupils in identifying career opportunities relating to Engineering is required.
5. Conclusion and Recommendations

The focus of the 2010 evaluation on institutions provides evidence of continued progress by the BEP with examples of how individual institutions are changing how they develop and deliver the STEM curriculum. Motivation and commitment to the goals of the BEP remain and ideas generated from BEP co-ordinators and teachers suggests there is not only awareness of how ideas may be embedded but practical suggestions and support for revising the curriculum and developing cross curricular links. The involvement and ongoing support of external stakeholders in providing STEM ambassadors and resources is valued and important for the longer term sustainability of the BEP.

To complement the evaluation project activity with respect to the three key points relating to awareness raising and enriching attainment (see sections 2.5, 3.6, and 4.5) we now offer assessment of the BEP approach to co-ordination, the value of partnership working with stakeholders and the emerging impact of the project as a basis for sustainability. Each of these issues relates to a number of activities inside and outwith the BEP project activity, it is therefore difficult and artificial to isolate them. However, at the end of year two it is appropriate to offer the following observations based on the first two years of the BEP.

5.1 Value of dedicated co-ordination

Feedback from all participants and partners suggests that there is universal support for the role of a dedicated impartial co-ordinator. Examples of the benefits are also verified by evaluators observation of meetings and communication between BEP participants and stakeholders. The value of this role was enhanced by the actual post holder Brian Wood who was already held in high regard and was well connected with schools and colleges. This enabled him to know how best to support, encourage, motivate and negotiate. A dedicated co-ordinator ensured time was spent on communicating, alerting colleagues to opportunities, reminding them of deadlines and working with them to think creatively when developing their individual bids. The regular, focused and purposeful co-ordinator meetings helped to ensure attendance, which some noted is not always evident in projects. The BEP co-ordinator’s awareness of the school context allowed him to represent school / college views at the stakeholder meetings. Stakeholders also valued the networking and connections arising from the BEP as this provided them with access to schools and colleges and resulted in synergy with their respective projects.

In 2010, as part of the discussion about sustainability the REAP team explored alternative approaches for co-ordination with schools and colleges. There remained concern and doubt that without co-ordination the network meetings would continue. The primary factor was a lack of dedicated time to fulfil the role played by Brian Wood, and for some a sense that they lacked the connections or may face a conflict of interest with school priorities.
The role of a dedicated co-ordinator in a project like this is a crucial enabling indicator that ensures continuity and coherent development, success is however also dependent on the skill base of the individual (in this case a high and relevant skill base). With respect to sustainability it is likely that an exit strategy involving a devolved or revolving model of responsibility needs to be planned from the outset and needs support from school / college leaders as well as staff involved in the development and delivery of activities.

5.2 Value of partnership working

The value of partnership working is multi-faceted. Within the BEP there is evidence of short and long term value added benefits resulting from this important process indicator. Financially, the BEP has benefited in securing additional funding and support to match its own investment, this has not only increased the range of activities offered but also the number of beneficiaries. Other projects such as Aimhigher Cumbria and Cumbria STEM Centre Ltd. have gained support from the dedicated BEP co-ordinator who facilitated access to the BEP schools and colleges and helped to maximise the resources available from all partners by identifying connections.

Partnership working has aided communication between BEP organisations and stakeholders. For instance, the BEP has supported an additional network of collaboration between these schools at the level of curriculum staff involved in the development and delivery of STEM related subjects. This complements other Barrow networks including strategic groups like FEC – Furness Educational Consortium, 14-19 partnership. There is evidence of curriculum developments and individual professional development resulting from this communication.

Partnership working has helped to raise the overall profile of Engineering in the local area through increased publicity of joint events. The wider network of organisations and individuals involved has increased the frequency of STEM activities reported in newsletters, the local paper, radio. The wider partnership has also helped to widen the audience hearing about Engineering and the BEP, for example, reference in partner organisations annual reports - Aimhigher Cumbria’s report to HEFCE.

The link with the number of local employers has not necessarily developed at the rate originally envisaged; however, this type of work is notoriously difficult because it involves interaction of individuals working in different contexts – the world of education and industry. Strong links with BAE exist and in 2010 other links have been established. It is worth noting that the change in personnel within BAE and some schools is an example of what challenges partnership work.

The number of STEM ambassadors are has increased and where used they have made a valuable contribution. The potential for greater use of STEM ambassadors in the future has been recognised. STEM ambassadors are an obvious value derived from the partnership work associated with the BEP providing support for and heighten the relevance of
activities, acting as role models and complementing other forms of Information Advice and Guidance by sharing their personal progression routes.

5.3 Emerging impact and potential for sustainability

Impact reported at the level of the institutions and changes in working practices if continued will enhance the potential for sustainability (see sections 3.2 ‘institutional context and change’ and 3.3 ‘curriculum’). BEP has helped to raise the profile of Engineering with respect to curriculum linkages with other STEM subjects. Based on a school or college’s experience or knowledge of other schools’ success in specific BEP funded activity, teachers are now reviewing their curriculum to identify cross curricula links and use Engineering projects to provide pupils with opportunities to apply skills and knowledge from other curriculum areas. Individual school and college bids in 2010 showed longer term thinking when purchasing resources and equipment or considering how activity ideas offered by providers might be developed and delivered in house. There is clear potential for this approach to continue and as noted in recommendation 4 to increase this approach schools and colleges need to be explicit about how they will use their funding to embed activity.

A related but discrete impact which will support sustainability is the continuing professional development (CPD) acquired from involvement in the BEP. CPD has been gained by observation of external providers and specific training associated with activities, formal and informal exchange of ideas between colleagues working in the same and other schools / colleges. The BEP has resulted in the increased use of STEM ambassadors and enhanced links with Cumbria STEM Centre Ltd. both of which have the potential for sustainability.

The BAE Champion-ships was a challenging and rewarding project, however, the raised awareness of school / college and industry working practices relating to health and safety procedure, the timescale and personnel involved in organising activities is a valuable foundation on which to develop activities in the future. Further opportunities are needed to extend the range of industry links and for all concerned to identify how best they can work together in a sustainable way.

5.4 List of Recommendations

The following list of recommendations have been identified, these build on those raised in the 2009 report and the developments made by the project during 2009-10. They focus on four core areas:

- collaboration between schools to aid communication, curriculum development and exchange of ideas and resources as part of the project and longer term embedding process;
• collaboration with external stakeholders to embed activities and to maximise use of investment in the form of accreditation (CREST), time (ambassadors), opportunities (employers) and CPD (Cumbria STEM Centre Ltd.);

• embedding strategies within schools and colleges to support the leadership of STEM initiatives, the involvement of more staff, inclusion of STEM related IAG, addressing gender issues, involvement of parents / carers;

• Project issues such as use of scorecards to capture participation, agreement about communication via moodle and linking bids to embedding strategies

List of recommendations

1 Disseminate the new Equality and Diversity careers toolkit (DfE, 2010) and continued use of female role models (see online ‘Inspirational women’ from the WISE 2007) (p10).

2 and 3 Retain and modify the ‘scorecards’ to try and enhance the accuracy of the information collected and reduce the way they are interpreted (p13).

4 Ask schools and colleges to indicate how they will embed the outcomes of their 2010-11 bids with their existing provision (p14).

5 Move bidding and planning for 2011-12 to the summer term to enable events to be recorded on school / college calendars (p14).

6 BEP co-ordinators to discuss and agree what and how to use the moodle as a source of information and begin to explore its potential for sharing resources and providing a forum for discussion (p14).

7 BEP co-ordinators and other stakeholders consider how best to exchange information in the future (p15)

8 BEP consider ways of using CPD development as an incentive for individuals and stimulus for cascading new ideas into schools and colleges (p16). 

9 Each participating school/college should reflect on the management model used to allocate BEP funding, in order to achieve the optimum use of this funding stream for long term benefit (p19).

10 BEP considers how it might facilitate schools and colleges sharing or mapping its curriculum so that they can continue to collaborate over the focus of activities delivered in National Science and Engineering Week and inter-school / college competitions such as Greenpower (p23).

11 BEP review the findings of the ‘Engineering the future project’ and consider approaching local universities with an explicit request to discuss longer term collaboration and curriculum development (p25).
12 BEP co-ordinators and local strategic groups give some thought about whether they will adopt a cross project approach to CREST awards or leave individual schools and activities to make unilateral decisions about the use of these awards (p26).

13 STEM Cumbria Ltd be invited to discuss the practicalities of rolling out a programme including consideration of how Engineering Club or curriculum projects might be linked to CREST awards (p26).

14 To explore ways of involving Connexions advisors and others responsible for IAG in the BEP (p29).

15 To consider how careers education is delivered within schools to enable STEM IAG to become embedded into the careers education programme (p29).

16 To support the IAG and wider careers education, the overall BEP Co-ordinator publicise relevant materials including examples from this report (p29).

17 BEP continue to explore ways of involving STEM ambassadors in school based activities such as their Engineering Clubs (p33).

18 To retain the wider stakeholder meetings use this forum to invite stakeholders to share longer term plans (p33).

19 To explore with the 14-19 Partnership / FEC and stakeholders the issues associated with co-ordination of joint activities and collaboration so that there is clarity for the future (p36).

20 For individual schools and colleges to consider ways of informing and involving parents / carers about the activities in which their sons or daughters are involved (p38).
References


www.cbi.org.uk/pdf/eduskills0408.pdf (last accessed 21.9.10)


URS (2008) *talentedMinds: In Furness and West Cumbria Nurturing & Attracting the highly skilled to live work & enjoy Furness & West Cumbria* prepared for West Lakes Renaissance, Manchester: URS corporation Ltd

Appendix A: Core Participants

BEP Organisation
Royal Academy of Engineering: Lynda Mann
Barrow Engineering Project: Brian Wood

Schools and colleges
Barrow 6th Form College
Dowdales High School
Furness Academy
Furness College
St Bernard’s Catholic High School
Walney School

External Organisations
Aimhigher Cumbria
BAE Systems
Barrow & District Association of Engineering
BMW
Cumbria STEM Centre Ltd
Furness Enterprise Consortium (FEC)
14-19 Partnership
Lancaster University
Smallpeice Trust
Starchaser plc.
West Lakes Renaissance
## Appendix B: Summary of participation 2009-10 based on scorecards

<table>
<thead>
<tr>
<th>Details of Activity</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-School and College Activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Centrally Organised STEM Challenge Days (YE)</td>
<td>378</td>
<td>197</td>
<td>181</td>
</tr>
<tr>
<td>Rotary Technology Challenge</td>
<td>24</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Science at the Dock Museum</td>
<td>120</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Young Engineers Clubs</td>
<td>130</td>
<td>81</td>
<td>49</td>
</tr>
<tr>
<td>Girls into Aerospace</td>
<td>49</td>
<td>0</td>
<td>49</td>
</tr>
<tr>
<td><strong>Activities - data only represents some</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>organisations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenpower Electric Car – (2 organisations)</td>
<td>30</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>BAE Champion-Ships Project – (2 organisations)</td>
<td>33</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td><strong>Activities organized by a single organisation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hovercraft Build &amp; Test</td>
<td>5</td>
<td>5</td>
<td>0</td>
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<td>Crest in a Day - Flying High</td>
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<tr>
<td>Starchaser</td>
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<tr>
<td><strong>Total - secondary school activities</strong></td>
<td>2850</td>
<td>1509</td>
<td>1341</td>
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</table>

| Activities with feeder primary schools           |       |      |        |
| **Total - primary school activities**            | 327   | 161  | 166    |

**APPROXIMATE NUMBER OF STUDENTS**

<p>| | | | |</p>
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<tr>
<td>Approximate number</td>
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<td>1670</td>
<td>1507</td>
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</table>
Appendix C: 2009 BEP evaluation report recommendations

1. It is recommended that the next area of communication the BEP needs to consider is how it extends its communication to support dissemination of its achievements and good practice as well as communicating the possible ways in which other organisations might connect with the project (section 2.2).

2. It is recommended that the bidding process is undertaken earlier in the year and that the half day planning event is used to explore initial ideas to aid collaborative bids that will complement central and school/college based activities thus providing progression for the students in their institution (section 2.2.1).

3. It is recommended that as many of the centrally organised events are agreed as soon as possible and that the Project Co-ordinator explore the possibility of a centralised calendar or communication mechanism to which schools and other partners can add their activities (section 2.3).

4. As the BEP moves into its third year it is recommended that they consider a framework for capturing the data that is seen as important for future evaluations of overall impact (section 2.4).

5. It is recommended that all participating schools are invited to share, at least with future evaluators, relevant references from their School Development and Improvement Plans. These should provide a sign of engagement and embedding for future sustainability of the BEP goals (section 3.1).

6. It is recommended that some central publicity material or identification of resources already available from the LEP might be modified for distribution to staff who support BEP activities (section 3.2).

7. It is recommended that the BEP consider ways of using CPD development as an incentive to individuals, not only for personal benefit but as a stimulus for cascading new ideas into the school (section 3.2).

8. It is recommended that the BEP give some thought about whether they will adopt a cross project approach to CREST awards or leave individual schools and activities to make unilateral decisions about the use of these awards (section 4.1.1).

9. It is recommended that BEP co-ordinators discuss with providers ways of sustaining engagement of students when they are evaluating or testing products (section 4.2.2).

10. Given the different approaches and projects undertaken by the different Engineering clubs it is recommended that BEP co-ordinators and teachers assuming responsibility for the clubs have an opportunity to exchange approaches (section 4.2.3).

11. Observations noted by the LEP and practical advice for the inclusion of girls are recommended as a source of useful advice for the third year of the project (section 5.1.1).
12. It is therefore recommended that the BEP considers ways of informing and involving parents / carers about the activities in which their sons or daughters are involved (section 5.1.2).

13. To support the IAG and wider careers education it is recommended that the Project Co-ordinator publicise relevant materials (section 5.2.2).

14. A further recommendation relating to IAG would be to explore ways of involving Connexions advisors and others responsible for IAG in the BEP (section 5.2.2).

15. To support the development of this strand of the BEP it is recommended that an initial draft of a menu is produced for informal discussion with different groups during the first term (Section 6).

16. It is recommended that BEP explore ways of involving STEM ambassadors in school based activities such as their Engineering Clubs, where schools currently have parents / carers with an Engineering background they should publicise the scheme and explore ways in which their own role models might be able to access STEM ambassador training (section 6.1).

17. It is recommended that future evaluations include identification and analysis of the enabling and process outcomes associated with organisational change (section 7).
Appendix D: Disciplines and Applications in the universe of Engineering

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</table>

(Malpas, 2000 p15)

For further details see
Appendix E: A four step model for STEM awareness, engagement, attainment and experience

**Step 4** - An improved student experience in Engineering HE Departments, developed from a fresh approach and aimed at widening participation of students.

**Step 3** - STEM attainment at Key Stage 4 and post 16, through good information and guidance about progression from appropriate role models.

**Step 2** - STEM engagement and clearer definition of the role of the engineer in society at Key Stage 3.

**Step 1** – STEM awareness and raising aspiration in nursery and primary schools, preparing the foundation.

*Figure 8: Crest Awards – incremental steps of accreditation*
Appendix F: BEP Wider Stakeholders


BEP

Providers: including RAEng approved agencies such as Smallpeice, Go4SET, and Starchaser;
Partners: including Aimhigher Cumbria who collaborate in planning as well as funding, Cumbria STEM Centre Ltd. who operate as a provider as well as a contact to other agencies and source of STEM ambassadors; FEC and 14-19 Partnership who provide strategic direction and include members who can influence school and college responses to the BEP;
Funders: including Aimhigher Cumbria, Barrow Borough Council, West Lakes Renaissance (please advise and clarify)

There are numerous ways in which these agencies currently interact and complement their respective contributions. Figure 7 provides an overview of the relationship between one partner / funder and the BEP.

<table>
<thead>
<tr>
<th>BEP funded</th>
<th>BEP and Aimhigher Cumbria</th>
<th>Aimhigher Cumbria funded</th>
<th>Opportunities – People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities only happening due to BEP</td>
<td>Joint funding and therefore enhancement of the other project</td>
<td>BEP role in publicising and promoting the activities and opportunities to BEP schools – evidence this was more effective than cold calls</td>
<td>BEP providing the linkage and making use of existing local resources e.g. Graduate Ambassadors, Drawing in other funding and sponsorship which would not have gone to individual schools</td>
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</table>

Figure 9: An overview of the BEP and Aimhigher Cumbria interactions