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Barrow Engineering Project

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REAP
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1. Background

1.1 Barrow Engineering Project (BEP) Context

*We are familiar only with things which specifically enter into our lives and with which we steadily reckon and deal. All concepts, theories, general ideas are thin, meager, and ineffectual in the degree in which they are not reflective expressions of acts and events already embodied, achieved, in experience.* (Dewey, 1922[2009 p3])

These words from John Dewey’s article ‘Education as Engineering’ exemplify ideas that relate to both the aspirations for, and the achievements of, the Barrow Engineering Project (BEP) in its first year. This evaluation report attempts to capture the many and varied experiences of multiple individuals connected with the BEP from its inception and offer observations and recommendations to inform the second year of the project.

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 (RAE) successful ‘London Engineering Project (LEP). The BEP is managed by Lynda Mann from the RAE, with Brian Wood the local BEP Co-ordinator providing an effective link with the Furness 14-19 Partnership (Steering Group) and individual school and college BEP co-ordinators, local industry and members of the Researching Equity, Access and Participation (REAP) evaluation team. Like the LEP, the funding is matched with additional funding and ‘in kind’ support from organisations including Aimhigher Cumbria, Barrow Borough Council, Cumbria Local Authority, Cumbria STEM Centre, West Lakes Renaissance, North West Development Agency.

Six secondary schools and the two post-16 colleges from the Barrow area are participating in the project (namely Alfred Barrow School, Dowdales School, Parkview Community College of Technology, St Bernard’s High School, Thorncliffe School, Walney School, Barrow Sixth Form College and Furness College).

Throughout its first year, schools and colleges have either continued, extended, or connected for the first time with a number of the RAE national projects, notably the Young Engineering, the Smallpeice Trust, the Engineering Education Scheme, and Go4SET. In addition, the BEP has 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 have offered activities for feeder primary schools in the area, undertaken activities with local universities, begun to strengthen links with local industry and benefited from the contribution of STEM Ambassadors.

The overall aims for the BEP mirror the strategic priorities of the RAE (see section 1.2 context). The intention is that the BEP will provide tangible pathways to apprentice, technician and undergraduate learning and employment and enhance current activities. Across the age range:

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1 REAP: Researching Equity, Access and Participation is a research and development group based in Lancaster University’s Department of Educational Research.
• attainment levels should improve;
• more young people will be aware of the valuable contribution engineering makes to our society;
• more young people will be motivated to take STEM related studies;
• more will gain employment in the engineering sector. (Taken from Barrow Engineering Project Overview)

These aims are consistent with the aims of other partners who are committed to improving attainment, extending educational pathways, widening participation, regeneration, and as one commentator noted “retaining talent from the Barrow area”.

1.2 Context

Moving to the wider context, it is evident that the BEP is positioned to contribute to the overall strategic objectives of the RAE, the Department for Children, Schools and Families (DCSF) and Higher Education Funding Council for England (HEFCE) funded national programmes of Science, Technology, Engineering and Mathematics (STEM).

The RAE provides the national focus for the engineering strand of the STEM and states its strategic priorities are

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. (RAE, 2009)

The BEP was established at a time when the DCSF were developing their national STEM programme that recognises the importance of raising awareness and achievement in the different subjects of Science, Technology, Engineering and Mathematics. Key features of the DCSF programme include: media and publicity to raise the profile of jobs that students can progress to after studying STEM subjects; initial and continuing professional development of staff to enhance the teaching of these subjects (DCSF, 2009). Similarly the Higher Education Funding Council for England confirmed their ongoing support for STEM subjects with their announcement of a three year funding initiative that builds on earlier projects such as the London Engineering Project (LEP) on which the Barrow Engineering Project (BEP) is based. The targets of the National Higher Education STEM programme complement the features integral to the BEP. They include:

• outreach, enhancement and enrichment delivered to schools and further education colleges (see sections 4.1 Curriculum Development and 4.2 Activities)
• equality, diversity and widening participation, actively targeting groups that are currently under-represented within the STEM disciplines (see section 5.1 Participation)
• ensuring students are supported to succeed (see section 3 Schools and Colleges and 5.1 Students Participation)
• working with others to ensure the provision of appropriate, up-to-date careers information (see section 5.2 Progression)
• reviewing and enhancing the content, delivery and assessment of the undergraduate STEM curriculum (see sections 4.1 Curriculum Development)
• workforce development and lifelong learning: identifying the current skills needs of employers, developing flexible provision and encouraging individuals in the workforce to engage in their own skills development. (see sections 3.2 Continuing Professional Development and 6 Industry)

The local context for the BEP is also important. Barrow has a long history of schools and colleges collaborating on a range of initiatives, for instance demonstrating a concern for improving attainment through its Furness Progression Project (Davies, 2005). The Furness Education Consortium (FEC) and the Barrow 14-19 Partnership both provide effective networks for local planning. Barrow was one of the few successful authorities authorised to deliver all five Diploma strands which includes engineering. Individually and as a consortium, schools have close links with Aimhigher Cumbria whose aim is to widen participation. In the past, they have been recipients of activities provided by Cumbria STEM Centre Ltd.

A final, but important local contextual factor is that this first year has coincided with the development of a new Furness Academy which will merge three of the participating schools (Alfred Barrow, Parkview and Thorncliffe).

1.3 Evaluation

This evaluation report covers the first year of the BEP which was officially launched in July 2008. REAP were asked to undertake an evaluation of year 1 of the Barrow Engineering Project (BEP) that will investigate and report on progress towards the following success criteria identified by RAE in order to aid their decisions about future funding.

1. Engineering (and limited science and maths) curriculum enrichment activities becoming the norm in the schools and colleges in Barrow.
2. An attitude shift towards a more positive view of engineering as a career choice amongst participants in the BEP (teachers and students alike).
3. Increasing support from local industry (as steps towards a sustainable future for the BEP).
4. Emerging evidence that the BEP is having a positive effect on the number of students opting for STEM subjects beyond Key Stage 3 (or attaining better in national tests) or even engineering FE or HE.

Within any evaluation there are a number of factors that influence the process and final outcomes. We have had regular contact with, and sought guidance regarding the direction of the evaluation from Lynda Mann and Brian Wood. Decisions in this evaluation were influenced by practical considerations of gaining access to and not making too great a demand on participants' time; ethical considerations of how to refer to participants and maintain their anonymity; and dissemination considerations.

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; staff involved in providing activities or working in industry are known as providers or industry, with all others known as commentators.
Gaining access to teachers is notoriously difficult due to the multitude of demands made on their time during the working day; it has not been helped this year by the distraction of work relating to the new Furness Academy. As Day et al (2006) notes staff availability also varies according to their position, timetable commitments, workloads and phase of professional life.

The report draws on feedback obtained from:

- staff via face to face and telephone interviews, informal conversations during visits to schools, email updates, questionnaires and attendance at meetings;
- students in each school or college obtained via informal discussion during observations, questionnaires distributed to cohorts participating in specific activities organised by schools and review of some samples of work;
- representatives from industry, providers of activities and partners via face to face and telephone interviews.

When practical, recordings of interviews have been made and notes and quotes captured for subsequent analysis and inclusion within this report. At other times we have written researcher notes either during or soon after the observed events.

In addition, to help understand the context we have reviewed documentary evidence relating to schools and colleges including Ofsted reports, DCSF GCSE results, websites, newsletters and school brochures. Although not presented in this report we anticipate some of this may be useful as a baseline archive for subsequent tracking purposes.
1.4 Structure of this report

The formative and utilisation approach to evaluation has resulted in the collection of a diverse and rich source of data which offered numerous possibilities with respect to this final report. Many of the participants in the BEP are interconnected and relate to each other in different directions at different times. The project is not hierarchically organised but rather operates as a series of cogs that connect and influence other cogs in the system.

*Figure 1: An overview of the interconnection cogs within BEP*

This report is based on one configuration with Figure 1 providing an overview that begins with the background, moves to the central cog of the BEP organisation and then onto schools and colleges, the BEP co-ordinators, via curriculum to the activities that provide the connection with students’ participation and progression into industry and external agencies and onto the future recommendations. Each cog (section) connects with a series of smaller cogs (sub-sections). To illustrate the range of activities and provide individual feedback for schools and colleges to use as evidence of impact we have included a series of activity based appendices.
2. **BEP Organisation**

2.1 **Co-ordination**

All those consulted thought the overall project co-ordinator had made an extremely useful contribution to its development in the early stages and would continue to play a very important role as the project unfolded. A list of very complimentary adjectives was gathered from numerous sources describing his role such as “sensitive to needs”, “good communicator” and “key to success of the project”. This sensitivity was seen as vital given the different roles within schools or the colleges in which BEP co-ordinators operated:

> [we’re] very pleased with Brian’s input, he’s helpful [and] sensitive to needs of school, communication is good. (BEP co-ordinator)

> Brian helps with some of admin work, he helps co-ordinators by removing that burden from them and does admin work on their behalf to make the best use of their time e.g. in running Engineering Clubs.

Brian was described by one commentator as:

> acting as a conduit between [organisations] and schools, [he] is good at getting to [the] most useful contact in schools.

It was thought that the BEP co-ordinator’s “insider knowledge” of how schools work and how teachers think in Barrow had made him an ideal appointment. This was apparent in the overall approach he adopted to the project which was a “combination of direction and reaction”. An additional but significant observation concerns the effective working relationship with the Project Manager, Lynda Mann (see section 2.2 communication)

Several interviewees, especially those with the experience of managing new initiatives, cautioned against expecting the project to get everything right from its start. Instead they anticipated a “settling down” phase and a period of two years was suggested before firm conclusions about the performance of BEP were drawn. For example, it was recommended that BEP first needs to “get roots in the ground, not do everything in the first year”.

A member of the local Connexions staff had noted from an external perspective how initiatives were received differently by schools and colleges in Barrow with some embracing new ideas more quickly than others.

> “Need for the more pioneering schools to do work early on and then ideas get picked up by others”

Several commentators noted and welcomed the fact that the BEP has provided an additional source of activities that complement existing provision. Individual schools have stronger or weaker links with different initiatives which are based on historical as well as personal connections and interests. There was a concern raised by a provider and echoed by a BEP co-ordinator about the potential for “duplication of schemes [and the suggestion that] these could be condensed”.

The BEP is well positioned in the year ahead to support the mapping of activities and information exchange. External organisations already attend BEP co-ordinator
meetings to discuss what they are doing and promote new activities. At present this is undertaken in an ad hoc manner, it is possible with given resources and pressures on time that this approach is practically the only viable one. However, with the recognition and commitment to getting activities on a centralised calendar so that schools and colleges can get dates fixed into the school diary, it is possible that there will be an opportunity to explore ways of developing a more holistic view of what opportunities are available within the area. This may also support the development of provision targeted at progression pathways and the identification of gaps or new areas for curriculum development.

2.2 Communication

There was very positive feedback from BEP co-ordinators regarding the regular communication from the Project Co-ordinator. Regular emails and telephone meetings, sent to the group as well as individuals, provided a good balance of ‘general’ and ‘individual’ information that served the purpose of keeping BEP co-ordinators informed, engaged and supported. Throughout the year there were six co-ordinator meetings to which partners including providers and representatives of other local projects attended. This allowed BEP co-ordinators to hear first-hand about new opportunities, exchange information about events or activities and contributed to the overall collaborative approach.

The benefit of encouraging BEP co-ordinators to share their experiences was evident at the final closed meeting, and the decision to organise a half day planning meeting during the Autumn term will address the requests for more forward planning. Something that is inevitably difficult to achieve in the first year of a project.

The Project Co-ordinator has also established and maintained contact with providers (e.g. Smallpeice), partners (e.g. Aimhigher Cumbria, Cumbria STEM Centre Ltd.) and local industry, (e.g. BAE, Forge Europe, Oxley and Marl International). Working closely with the Project Director, he has played a key role behind the scenes in responding to areas of concern. This attention to detail and responsiveness by both the Co-ordinator and Director is seen as a definite strength of this project.

The flexible and responsive internal communication seems to be well established. 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. Use of virtual learning environment e.g. moodle for internal communication and a project website (with links to existing LEP website) for external audiences should be considered, this might include links to existing LEP website, with responsibility for the good practice achievements section funded as a project for students studying at Furness or Barrow 6th Form. Final decisions will depend on the eventual purpose, however, the merits of a centralised communication / dissemination tool should not be underestimated.

1 Bidding Process

Within the project, schools and colleges had the opportunity to bid for funding school based activities. Several felt the process was unclear, rather cumbersome and time consuming; one reported uncertainty about what was required, despite being shown
an exemplar from another school. There were several who commented on the apparent change in the system, originally they thought the Project Co-ordinator was going to approve their bid and were surprised that it was presented to the sub-group of the 14-19 Partnership. Interviewed at the time of the bidding process another BEP co-ordinator said:

“Look at the whole machine from the people who are conceiving this at the top, .. reviewing it and everything – how many people are involved in that process, how many teachers delivering it, how many kids benefit?”

The pressures of time and local context clearly influenced the attitude towards the process and the extent to which the bids connected with current school / college plans. The approach of individual schools and colleges was diverse, with some using the funding for larger scale activities e.g. St Bernard’s SPACE WEEK involving other BEP schools and primary feeders, others on software thereby building school capacity to deliver aspects of the engineering curriculum e.g. Dowdales, and Thorncliffe originally bidding for funding to take pupils to the Big Bang event in London (see section 2.3 Time and a Central Calendar).

Awareness of RAE programme of activities was very limited at the outset of the BEP. This is one of the reasons why there was not much evidence of schools having bid to use their funding for these tried and tested activities. Although there was some use of the RAE Handbook of approved activities this was not as extensive as might have been expected. Reasons for this are unclear, however, distribution of this material and the timing of the bidding process suggest that staff tended to stick with bidding for items that were familiar or that appeared to be straightforward. 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.

2.3 Time and a Central Calendar

Several BEP co-ordinators referred to and demonstrated the time involved in an additional project, there was a general recognition that the BEP was a project that they “could spend a lot of time on but have to draw a line”. Another acknowledged that it “does take time but it’s worth devoting the time to it”. He had been allocated a one-hour lesson off timetable to do work on BEP, but like other co-ordinators clearly spent more time on the project.

There were several other aspects of time associated with the project. Getting the time and support from colleagues, organising activities within an existing school calendar. As one BEP co-ordinator explained it was a challenge:

Trying not to clash engineering activities with other activities especially when they are out of school. [It’s] hard to timetable activities during school hours. (BEP co-ordinator)

The pressure on time and the potential for clashing with school and other providers’ activities means that the earlier activities can be included on school and college calendars the better. The BEP consisted of centrally organised activities and school based activities.
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. This would not only aid planning but act as a record of the range of activities organised throughout the 2nd year that could be analysed for progression as well as breadth and depth of provision (see section 2.2 recommendation re a Virtual Learning Environment).

2.4 Collecting Data

The data collected for this evaluation relates to individual activities. Individual schools have records of who has participated in activities but none have reported collating or analysing this for the purposes of tracking or measuring the impact of the BEP. Given the current approach to who participates in activities (see section 5.1) it is not likely or appropriate to try and measure the specific impact of BEP activities. However, as the BEP moves into its second year it is recommended that they consider a framework for capturing the data that is seen as important for future evaluations of overall impact. In deciding what is required the following ideas may be useful to address RAE interests as well as other partners:

- **Total number of beneficiaries:** A simple recording sheet for the name of the activity, the school, the total number of participants, a breakdown of gender, ethnicity and disability (depending on the level of interest in these final 2 groups the total of students from a minority ethnic group and SEN could be used);
- **Tracking participation 1:** A register for all participants at every event that is recorded into a standardised Excel spreadsheet by schools and collated centrally for analysis, permitting identification of the number of activities in which different students have participated
- **Tracking participation 2:** exploration of tagging students and linking to Cumbria County Council’s student record system to allow connection with other school records, would require negotiation with the sector and dedicated time to identify reports to be generated
- **Cohort tracking:** identifying some sub-groups e.g. participants in the engineer clubs or students attending the Smallpeice residential to collect profile and achievement data throughout the duration of the project
- **Baseline performance data:** asking schools to report on their GCSE results for STEM subjects, some GCSE results are publicly available, other more nuanced results would need to be negotiated with the schools. Issues of data protection will influence any data collected about individual pupils, although schools may be able to provide anonymised data providing it is not attributable to individuals.

A key factor in any decisions about collecting data is the pressure on BEP co-ordinators’ time and the fact that this task will detract from their preparation and engagement in activities. The scope and scale of data collection needs careful thought and clear commitment from those who will be responsible for providing the data. Schools may be encouraged to see this as contributing to the evidence base needed for their Self Evaluation Forms. The extent to which funding is dependent on the provision of this data is something the BEP will need to consider. Collecting
smaller amounts of data in a reliable way is likely to be practically more realistic for a project of this scope and scale.
3. Schools and Colleges

On numerous occasions all interviewees stressed the importance of viewing BEP as the start of a new relationship between schools/colleges and the world of engineering and not just as a time limited programme. 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”.

However one BEP co-ordinator explained how:

*in [the] infancy of BEP there seemed to be a lot of money available so that I could run more projects. But I only have so much time. Lot of initiatives and cash about to do stuff, but most teachers are running three or four activities a week after [classes finish]. We don’t [need] money but we do need someone instead of collecting money and walking around to actually do it.* (BEP co-ordinator)

Central to the purpose of BEP was that schools would view it as a source of initial ideas which they would then adapt and add to as time progressed. For several BEP co-ordinators it was about: “Getting to work with other schools, [on] an outreach project and see what’s going on and bring those ideas in school – sharing of ideas” that motivated and interested them to get involved. However, this transference of ideas and collaboration was not automatic, straightforward or without hard work. One of the school co-ordinators who was actively promoting BEP and receiving a reasonably good response from the rest of the school thought BEP was nevertheless taking some time to have “a school wide impact or awareness”. This was not thought to be an insurmountable problem as it was still “early days”.

3.1 Ethos and Context

Whilst recognising that BEP has a specific purpose and set of intended outcomes, it was nevertheless noted that it was being introduced into a range of schools and colleges each possessing a particular context and experiencing individual sets of challenges. Of these challenges, the move to the new Furness Academy structure in Barrow was mentioned as amongst the most significant. For example, one BEP co-ordinator stated that the school:

*“would participate and take advantage of opportunities (within BEP) but was also focussed on the transition to the academy at the end of the academic year”*

However, whereas the Furness Academy might be viewed as a constraint on the development of BEP occurring at a particular
point of time, many of the usual features of school and college life were also acting as further constraints such as:

“Schools being torn between league driven A* to C grades and vocational training”

“Problems getting staff out of lessons and cover issues”

“Departmental friction within school”

“A history of (schools and industry) letting each other down in the past”

There was also some indication, at least in the initial months of the project that there was more of an emphasis on schools rather than colleges. Over time the colleges have become more involved, however, with respect to developing progression routes it remains an important goal for the BEP to ensure the college BEP co-ordinators are actively engaged. It is worth noting that the Project Co-ordinator is aware of the colleges’ context and how their organisational structure provides a different set of challenges and opportunities.

The consequence of school and college factors such as these is that BEP has taken shape in different forms and progressed at different rates within individual institutions. It has been delivered flexibly in order to survive. As one commentator noted:

“One of the features of schools in Barrow is that they move with new initiatives at different paces”

Whilst recognising the individual differences between each school, one BEP co-ordinator stressed that it was:

“essential for the schools and colleges to work together for the project to succeed. Need something to grip pupils’ imagination and to create a momentum of its own. Otherwise project will just run for a few years and then ‘die-a-death’. I would be very disappointed if this happens... Collaboration between all the schools in the area is a must. There is a [risk of] too many with their own agenda that might benefit a fraction of the people in this area which to me is wrong and selfish”

With so many contributing schools and colleges there is inevitably a range of competing agenda and opinions about how best to achieve the aims of the project. The overall structure of the project provides a structural balance for different agenda combining centrally organised with school / college based activities. There are however differences in approach to who participates with the size of school, the position, pressures and philosophy of the BEP co-ordinator

Using BEP to support wider School Development Plans

The project provided one school with the opportunity to promote STEM subjects within the school, ... and in common with other schools and colleges provide opportunities for pupils which we could not otherwise afford.

For Walney, the BEP has also complimented their aspiration to promote STEMs as part of our Engineering bid. News of this successful bid was reported in July 2009, this offers an opportunity for tracking achievements at a school as well as student level.
influencing decisions (see section 5.1 Participation).

With respect to existing school foci some BEP co-ordinators recognised their existing position / role or School Development Plans may influence their approach to the BEP. One BEP co-ordinator felt that it was important to see the connections with different STEM subjects:

_You don't get a good engineer without having maths and science, I may be coming from a particular angle._

A teacher who helped supervise one of the activities suggested that there may be a tension in promoting “promoting engineering when the school has a [different specialist] status”. The extent to which this view was held throughout schools was not explored, it does however, raise an interesting point that relates to: the purpose of the BEP; the perception of the benefits of engaging in engineering focused activities; and the career possibilities for working for an engineering company (see section 3.2.2 Other Staff).

With respect to the impact of the BEP on individual school and college development 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. The possibility of devising some common statements to which all can subscribe may also help strengthen collaborative links.

### 3.2 Continuing Professional Development

The training of new teachers and professional development existing staff is identified by RAE, DCSF, HEFCE, the BEP and a requirement of Ofsted inspections. Within the BEP there is evidence of a range of incidental and more obvious professional development opportunities having taken place throughout the year. These pertain to the BEP co-ordinators, other school or college based staff, the providing organisations and STEM ambassadors working in local industry (see section 6.1). In addition there is potential for extending and formalising some of the opportunities.

The BEP co-ordinator meetings and attendance at activities delivered by external providers are perhaps the most obvious examples of incidental learning. The informal learning resulted in schools adopting ideas from other schools, saving time, and included a professional exchange of approaches and mutual problem solving. Several BEP co-ordinators undertook what might be described as informal professional development to extend their knowledge base and enable them to develop and deliver and activity more effectively (see informal CPD insert).

Actual involvement in the BEP was seen to:

**Informal CPD: sign of commitment**

Following submission of a bid for Greenpower racing, the Parkview BEP co-ordinator visited the Technology Teaching Exhibition in Birmingham. He looked at the Greenpower racing stand and had a useful talk with a teacher from the winning team. He also attended a seminar about primary and secondary school linking.
Improve staff confidence and establish positive relationships, as well as introduce ideas and resources which can then be incorporated into teaching. (BEP co-ordinator)

Learning from providers was not restricted to BEP co-ordinators, and often allowed staff within a school to share an experience that was subsequently the basis of cross departmental discussion. Establishing links with colleagues was also useful for future curriculum development planning and one of those unplanned but beneficial outcomes from a project such as the BEP. One commentator felt that external organisations played an important role by:

Offering opportunities to students and TUTORS, we are using latest technology, we have been offering staff development for tutors, it’s all about maintaining the teachers’ enthusiasm

The awareness of BEP, RAE opportunities and more local activities offered by Cumbria STEM Centre Ltd. varied amongst other teachers in BEP schools. For example, one teacher new to the area and teaching was not aware, until their involvement supervising a BEP activity, of the outreach activities available from RAE or Cumbria STEM Centre Ltd. Involvement of other staff could be used as an opportunity to raise awareness of the BEP. 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.

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. As well as the more obvious engineering focused CPD opportunities in which staff might extend their own knowledge and understanding, it was suggested by one commentator that there would be benefits in raising staff awareness of what local employers actually do. This might be achieved by holding a BEP co-ordinators meeting at a local employer’s premises and combining the meeting with a tour of the facilities and an opportunity to meet staff working in different engineering capacities having followed different educational and career pathways. This type of activity may also be relevant for those responsible for Information Advice and Guidance, e.g. Connexions, or work experience.

Finally, a longer term proposals relating to CPD made by a BEP co-ordinator who suggested that:

As the project becomes established support with writing external bids, funding!! Which would give time to plan and explore resources.
4. Co-ordinators

A common view expressed was that the support of teachers was a critical factor determining the success or otherwise of the project. It was stressed how important the role of the school/college BEP co-ordinators were and how they were reliant on the support of their management teams, and the enthusiasm, or at least limited resistance, of their colleagues.

The first task was “keeping school and college co-ordinators sweet”. This was thought to be “absolutely vital” as they were the most important link in the chain and were the people who could either actively promote BEP within their institutions or hinder its prospects by providing only lukewarm support. There appeared to be a link between the enthusiasm of co-ordinators for BEP and its rate of progress within schools, although the amount of support or resistance they faced from internal sources was another critical factor and this varied over time.

“Key to success is support for teachers from within their schools”

Several of the school based BEP co-ordinators commented on difficulties they faced organising BEP activities if they faced opposition from:

“other departments less than enthusiastic about pupils missing lessons”.

A further practical challenge that is often reported by school and college based projects was time (Houghton and Moser, 2006). As one BEP co-ordinator explained he was:

“trying to get as much done as possible .... but hitting wall in terms of staff time ... Staff need less timetabled lessons, more time to organise activities”

At a specific level it was noted during the evaluation how the enthusiasm of teachers was having a direct influence on how the BEP menu of activities was being presented to pupils. The development of a lunch time and after school engineering club seemed largely due to the direction and energy provided by the teacher in charge of this (see section 4.2.2 for an example of an observed activity: Rubber Band Powered Cars: Working in Partnership). The success of this rubber band powered car competition was mainly the result of the positive way it was promoted by a group of secondary and primary teachers working in partnership.

4.1 Curriculum Development

A core role for BEP co-ordinators in respect of activities they made available to their students connects with that of curriculum development. Although they received copies of the RAE’s Directory of Engineering activities this was not as widely used as might have been expected. This resource shows how different activities connect with and contribute to other curriculum subjects. It is anticipated that it would be useful for this resource to be given greater consideration in future planning. It is anticipated that the BEP Co-ordinator’s role with respect to developing new curriculum activities and planning links between BEP activities and those offered by their school / college will become increasingly important. In discussion BEP co-ordinators and commentators highlighted issues such as the depth, breadth, quality and equal opportunities that schools and colleges needed to consider when making decisions.
about which activities they focused on in their own institution and how they might develop the curriculum in the future. With respect to the BEP, one commentator, noted, schools and colleges would:

*eventually develop a series of engineering activities to form a progressive pathway of opportunities for their students.*

One of the BEP co-ordinators thought this would also enable schools:

*to link subjects together within the BEP framework which could also lead to schools and colleges working on collaborative projects.*

There was evidence of this beginning to happen, as one BEP co-ordinator admitted; the BEP had helped them to become more aware of what was available and through discussion with other BEP co-ordinators to find out how others were incorporating BEP activities to enhance the curriculum.

*before BEP, [I] was just delivering my science content. Now I see opportunities for incorporating STEM into existing lessons and by expanding the curriculum.*

With respect to activities delivered by external providers several BEP co-ordinators and some commentators noted the importance of making connections with existing curriculum subjects in order to avoid activities being delivered in isolation. For instance:

*a schools’ knowledge of a Science [or] Maths project that underpins [what is] taught internally and would be highlighted. For example, they will be collecting evidence in science to underpin number analysis – the BEP activities [need] to make more concrete, to emphasise the transference of skills otherwise we are in danger of a one off project (BEP co-ordinator)*

When discussing the possibility of future embedding of the BEP within schools and colleges, several commentators stressed the importance of linking the BEP activities to other educational developments such as the new diplomas. Several noted 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. Therefore, in order to extend a new development beyond its life as a new, separately funded project, considerable thought had to be given to how it might be attached to other activities. New vocational diplomas were viewed as one possible enterprise to which BEP might become attached, but according to one commentator this was only likely to be successful “if more able students are encouraged to apply (for diploma courses), otherwise their credibility will be lost”.

Providers’ awareness regarding school curriculum varied. There was a sense in which the package was developed and the time to adapt or modify to local circumstance was not possible. For example activities offered that did not connect with the current curriculum or where the task drew on knowledge that had been dropped from a syllabus. These are not insurmountable challenges. They are highlighted as points for consideration and exploration during the planning stage. For instance, activities not matching the current curriculum might be presented as consolidation or
an introduction; whereas feedback to the provider and to other BEP co-ordinators regarding an assumption made about prior knowledge can be used to improve future quality. A related point is that there is also potential duplication between the content of providers’ activities, for instance several dealing with cars, or paper planes/rockets. As the increase in activities and providers increase there will become a task for someone within a school to have a clear idea of what is being covered by specific activities (see section 2.4 collecting data).

.1 Accreditation and CREST
The potential for additional accreditation for participation in the BEP activities has only been discussed with respect to individual activities. There are a range of views about accreditation between the BEP co-ordinators and it is likely that a mixed approach is the most practical solution in the immediate future. For some it was refreshing not to have the “pressure of targets” within this project and that this allowed “greater freedom to be creative and try new activities”, or “a chance to take a risk”.

One existing mechanism that would allow students to demonstrate progression is through the acquisition of CREST awards. There are four steps in the engineering progression (see figure 2).

![Figure 2: Crest Awards – incremental steps of accreditation](image)

Adapted from London Engineering Project: [www.thelep.org.uk/about/thelepproject](http://www.thelep.org.uk/about/thelepproject)

The CREST awards offer incremental steps which would encompass pupils from the primary feeder schools as well as post 16 opportunities. One of their advantages is that they involve students in reflecting on and capturing their learning which may help to reduce the atomisation of activities delivered in isolation.

The achievement of CREST awards might also be used as an impact indicator and be included in the data collected (see section 2.4). 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. The Cumbria STEM Centre Ltd. has expertise in this area and it could be used as a basis for project wide professional development and moderation discussions for STEM staff within schools.
4.2 Activities
There were several factors influencing the activities organised by the BEP and schools. Many of these are covered elsewhere, they include:

- funding (see sections 2.2.1 Bidding Process and 7.1 Providers);
- time (see sections 2.3 Calendar, 3.1 Ethos);
- information (see section 2.2 Communication);
- expertise (see sections 3.2 Continuing Professional Development and 6.1 Role Models and STEM Ambassadors);
- staffing arrangements including briefing and selection of staff (see section 3. Schools and Colleges).

There were two broad categories of activity that were organised by: the Project Co-ordinator, the school / college BEP co-ordinator. In addition there were activities not directly funded by the BEP but which connect with the overall aims and objectives of the project, these were organised by partner organisations and offered to BEP schools and colleges. The other activities whilst not the explicit focus of this evaluation of the BEP warrant a mention with respect to their contribution to achievement and demand on staff time and the school calendar. When joining the BEP, schools were also asked to establish, and where they already existed to develop an Engineering Club.

1. Centrally Organised
These included a central event in (September 2008), Smallpeice Trust STEM days (November, 2009 see Smallpeice STEM day observation) Smallpeice Trust residential (Lancaster University July 2009), a series of ‘National Science and Engineering Week’ activities, events organised by Cumbria STEM Centre Ltd.

There were also projects to which several schools got involved to varying degrees for instance: Go4SET, BAE System Engagement Project, activities with feeder primary schools, and visits e.g. to ‘Energise your future’ in Newcastle upon Tyne.

Smallpeice STEM Days: Observation
Generally there was positive feedback and constructive observations for enhancement from all staff participating. As one BEP co-ordinator said:

“Pupils get so much out of a day like this, they are keen and enthusiastic”.

For the pupils there was awareness raising in three broad areas. The wide range of engineering situations – pupils learned from Kevin’s introductory remarks and were interested to be told about different engineering opportunities in the mechanical, electronic, aeronautical and other fields. Several were interested in the close association between engineering and green issues.

“About engineering and green things”
“Lots of different types of engineering”

They appreciated that Engineering needed to work in teams and that engineering projects could only be designed up to a point. A lot of the time Engineering have to tackle ongoing difficulties – looking for the solutions to the “solvable problems” mentioned above. Attitude as well as aptitude is important.

“The importance of team work”
“You original idea will change”
“To succeed in engineering you need team work”

Several now had a greater appreciation of the value of what they learned in school – particularly the importance of maths and the fact that the principles they learned in D/T did apply to the real world.

“I didn’t know you needed to use so much maths in engineering”

“What we learn in class is true – triangles do provide the strongest form of support”

Team work
The most successful group had a clear leader – a girl who worked closely with the single boy in the group. At the start she suggested that the project depended on the strength of the tower and designed a pyramidal shape based on a series on inter-connected triangles. This design, however, was very material and labour intensive and for most of the morning two other members of the group were happy to produce a steady flow of paper tubing for the tower. This group not only benefited from team work but also from a hierarchical division of labour, where design and manufacture were separate from each other. The pupils in this group kept in role for most of the day, enthused and engaged because they could see that their design was most likely to work and was eventually being copied by other groups. Their work came to the attention of other pupils who came over to look at and discuss the design. Interestingly, the leader did not have an immediate answer to a final problem of stabilising the generator and the rod connecting this to the sails. However, a boy from another group suggested a solution based on a carved lollipop stick.
From the perspective of one BEP co-ordinator it was clear that his:

“School supports anything to encourage pupils and ‘give them a buzz’, a day that gives a lift, leaves pupils eager to learn more”.

Many of these centrally organised activities involved time out of school. As one BEP co-ordinator commented:

“Pupils like being out of the classroom, learning can still take place outside classroom, pupils sometimes respond better to the challenge”.  
(BEP Co-ordinator)

This view was echoed by a number of students whose comments are taken from individual evaluations.

It gets us out of lessons for something more interesting (Alfred Barrow pupil)
To see the rocket before I had never seen a rocket before (Alfred Barrow pupil)

Eleven of the 20 comments from Parkview pupils emphasised their interest in the hands on and making aspects of their Grand Engineering activity.

Was fun and it taught me more about engineering. We also met new people and made new friends (Parkview pupil)
The tools never worked with them (Parkview pupil)
Designing the concorde hanger because I never used the software before (St Bernard’s pupil)
I liked building it all because it was challenging (Dowdales pupil)
They are fun and I get to work with materials that I would not normally work with (Dowdales pupil)
Using all the pieces of equipment they would use in real life-ROV simulator (Furness College student)

.2 Deployment of Staff

The deployment of staff within schools has already been discussed. Teachers other than the BEP co-ordinators were often used to support BEP activities and consequently provided valuable insights into their perception of the purpose and impact of activities on pupils in their school. For instance, one teacher thought the activities were valuable in:

“Highlighting to pupils what skills they are using and what they have learned. ... Students don’t necessarily realise how activities are STEM related but are told over the course of the day, applied learning which makes pupils more interested and motivated. ... I see [my] role in these STEM activities as checking that pupils are happy and joining in. Teaching assistants are also usually on hand to help where needed”.  
(Teacher)
Staff arrangements for these off timetable activities are notoriously problematic, and often there was little flexibility about who would provide support. During observations of one activity delivered by an external provider we noted that:

*considerable help was at hand from the facilitator, the ambassadors and there were also two members of staff. However, support for the students was not provided uniformly from all those who were present which meant that certain key individuals spent a lot of time offering support and rapidly moving from group to group. Consequently, the work of some groups was put on hold until suitable help was provided.* (Researcher observation)

In another activity we noted that staff tended to fulfil the role of disciplinarian and did not actively engage in the activity.

Observation of, and interviews with providers suggested that not all had teaching experience. This showed itself in two ways, the behaviour management techniques employed and the duration of ‘presentations’. This tended to happen at larger events with bigger numbers, a more diverse group attending and where timing (either too much or too little) influenced the overall organisation of the activity. BEP co-ordinators’ comments mirrored our own observations that all students were “not always on task”, and in one event the students themselves identified that the event could be improved if the facilitator had been more in control and stopped their peers talking. The role of staff in supporting behaviour management and perhaps taking a more active role with those students who might for a number of reasons be less engaged is important. It should be noted that with the exception of one activity held during the National Science and Engineering Week, which was deemed by BEP co-ordinators to be inappropriately pitched, the engagement of students was felt to be good. In some of the smaller activities we observed it was excellent. We would recommend that staff supporting external providers discuss when and how they

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**Smallpeice Residential**

This was a centrally funded a four day residential attended by 52 students (although originally planned for 60 students, ten from each school). The residential was organised by Smallpeice and included three engineering projects developed and delivered by BAE Systems ambassadors from their graduate scheme; BMW ambassadors from their Apprenticeship scheme and Lancaster University Engineering Dept with support from technicians.

Feedback to Smallpeice on the residential was very positive and comments recorded on their evaluation summary were consistent with our observations and informal interviews with deliverers, teaching staff, students and other commentators attending the residential.

This was a highly focused set of projects which groups of 4 to 5 pupils worked on over the duration of residential. The BAE groups worked on an incremental project that was designed by Lucy Healey and 2nd year apprentices. Their challenge was to build a car with Meccano parts and balsa wood, taking account of criteria including speed, weight, ability to climb an incline, maximum load and cost. Throughout the project each group worked with an ambassador, all of whom reported that the experience had “challenged their thinking”, by “really making me think ..., I often take things for granted, but these kids wanted to know why things worked”.

The BAE project consisted of two exercises each day, one led by a different BAE member who had prepared the project in their own time. The activities were all loosely based on principles linked to submarine design.

The Lancaster University project was based on an idea from NASA, a Bottle Rocket Challenge. Groups designed and tested their rockets, with modifications concerning the inclusion of a parachute required on day two. Like the other two groups they presented their findings on the final day in the form of a PowerPoint Presentation.

In addition to the individual projects the whole group participated in a series of other activities including: an initial team building challenge and familiarisation with the university (day 1), presentations from each of the project teams about educational and career pathways, and a formal conference dinner at which they displayed posters about their projects and mixed with adults including representatives from the Cumbria Professional Engineering Society (PESC).

Observations of final presentations and answers to questions provided clear evidence of learning and allowed students to learn from each other. The range of projects and combination of industry and academic inputs provided a high quality experience. See section 2.4 regarding the potential for tracking this cohort over time.
should intervene to ensure that providers are able to focus on delivery and that as familiar adults they can demonstrate their own interest and enthusiasm for the subject. Demonstrating interest may be a particularly useful course of action for female teachers to provide an additional role model and source of encouragement (see 5.1.1 gender).

As noted we received comments from teachers and students regarding the length of some presentations. Generally students seemed to have shorter concentration spans than providers and external speakers anticipated. When asked what they would not like or would change, the most common response from students involved in activities that included an initial presentation, was the talk. Ten of the students in the Alfred Barrow evaluation asked for less talking and more activity. As one suggested they did not like:

the talk at the beginning because I didn’t get it (Alfred Barrow pupil)

Whereas another asked for:

Less talking and get us involved (Alfred Barrow pupil)

This request for more active involvement was not only made by younger students.

More involvement in sessions (Barrow 6th Form)

The need for shorter presentations was also echoed by teachers who recognised from their own experience the challenge of getting the balance right, there was some concern expressed about “level of briefing and explanation from the front, which needed to be clearer” or “shorter”.

The Smallpeice residential included several presentations which met with mixed response. Perhaps the most informal was that delivered by the BMW Apprentices, however, this was the one students and staff felt was most appropriate in terms of tone and style. In contrast the formality and level of detail included in the university presentation was deemed to be too high. One

Rubber Band Powered Cars: Working in Partnership

This was quite a modest event involving three schools. A group of year 7 pupils from Alfred Barrow and groups of Year 5 pupils from Ormsgill and Cambridge Primary Schools. The event was organised by Mr Price from Alfred Barrow School, with support from a technician and Dave Smith the Head of Technology. Each of the primary schools brought with them large groups of teachers, learning assistants and others.

Prior to the event pupils had made basic rubber band powered model cars from a band attached to the back axle, four plastic wheels and various boxes and containers that formed the body of the car. There were a variety of designs from the very basic (plastic salad container with wheels) to quite ornate and sophisticated designs which mirrored the dramatic names the pupils had given their cars.

The first part of the afternoon was a line up of all the vehicles where pupils and staff voted for the best looking vehicle. After this they went back into small groups (about 4 pupils) where they made last minute adjustments and generally tinkered with their cars prior to the main competition – the measured run.

Speaking to the pupils two main things were emerging. First, they had learned quite a lot about how powerful a wound up rubber band could be when powering a car and how the design of the car could maximise the potential power source in this wound up band. Second, what might have appeared to be a relatively routine technology lesson in school had been given added spice by the prospect of competing with other cars from the other schools.

Following qualifying rounds the final consisted of a ‘run off’ between the fastest cars from each of the schools. There was a clear winner and the general mood amongst the pupils was that the power each car possessed had something to do with where the wheels were placed and the rigidity of the body. A car powered by a rubber band but with long playing vinyl gramophone records as wheels was demonstrated, this travelled the length of the hall.

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I thought this was a very successful afternoon which required relatively low level resources. The teachers noted that it had been very useful not only for the technical lessons which had been learned but also because it had contributed to team building. The competition between teams within and between schools was a factor in its success but pupils were not over competitive.

One of the important factors in its success was the positive contribution made by staff both in the previous week during the construction stage and on the afternoon itself.
teacher suggested it might be useful to brief speakers in the future.

The issue of active engagement also presented itself in activities that involved students ‘testing’ or ‘demonstrating’ what they had made. For instance in one observation we noted that:

*When each team’s device was actually being tested the other pupils were quiet and attentive but generally they were quite restless at this time. Pupils displayed their marketing posters whilst testing of their turbine was taking place but it didn’t appear that these or the costing information was assessed.*

It is recommended that BEP co-ordinators discuss with providers ways of sustaining engagement of students when they are evaluating or testing products. It is possible that staff might need to take a more active role in the ‘management’ of this phase of an event to enable. The following ideas are offered for consideration:

- Each group to evaluate their own work e.g. how could they have worked differently if they were doing the work again, what were the best/worst features of their design?
- Engineering word search or group quiz if they are not to play an active role in watching / measuring the outputs of other groups?
- Using this time to complete CREST Award accreditation documentation if the day is part of an accreditation process (likely to need supervision at the end of a day to remain on task).

### Engineering Clubs

One of the activities all schools were required to undertake was the creation of an Engineering Club. There were mixed starting positions for this activity, some already had established clubs other had to start from scratch. One reported feeling "*Generally negative about nature of this type of after school club activity*" but having received information about the Young Engineering club was willing to try. Another BEP

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**An Established Engineering Club**

After entering the engineering room, the pupils moved quickly onto the tasks which seemed to be appropriate for their age and engineering experience. The older pupils were doing jobs which were heavier, required more skills and which needed them to use the more sophisticated engineering tools. The pupils who were doing the more basic jobs e.g. filing, knew how their particular tasks fitted into the whole process. The teacher kept quite a low profile but I think this was because he had put a lot work into it and the pupils who were well motivated, had a sense of direction and knew what was expected of them.

One of the most distinctive features of conversations with the pupils was that a lot of the decisions about the design and construction of the cars had not yet been made. Pupils spoke of options – “we might do this or we might do that”. They were being guided by the teacher rather than instructed into what they had to do. They were gaining a sense that engineering was about making choices between different routes and working out which route best served their purpose and context.

Almost all the pupils in the club (including the girls) came from backgrounds where family members, particularly fathers, had encouraged them to get experience of working with tools and making and repairing things. Some of the older pupils had a ‘can do’ attitude to engineering. That is, if there was an engineering problem, there was also an engineering solution which could be found to overcome it. As well as showing good engineering and all round technical skills, the pupils also demonstrated good communication skills.

Pupils were very committed to the success of the project. There was a lot of interest in cars and how they performed. Several mentioned how they liked cars and programmes about them. Top Gear and Richard Hammond were mentioned in this respect.

A main point emerging from the visit was the amount of thinking and problem solving in which pupils engaged. They were given a considerable degree of autonomy and were deliberately put in a position where they had to attempt solutions to the problems they faced. This called on a wide range of skills including maths. For example, one pupil explained to another that a component would fit better if the sides were smoother. She then explained that a file works most effectively if used at an angle of 40%. Another pupil who was designing the shell of the Formula gravity car was selecting designs from a catalogue of potential shapes and was trying to work out the relative wind resistance of the different shapes. Owen explained that there were now computer software that would do this calculation, although many car designers still preferred to use wind tunnels.

In summary. On the basis of this visit the engineering club appeared to be a success. Good progress was being made on the construction of the cars and the mood in the club was very positive.
co-ordinator described their previous experience when setting up an engineering club:

*Our original trial to start the club hit two problems. The Engineering club attracted boys, [whereas] the Science club attracted girls. We then launched our “Sci-tech” club and [this] was more successful with the mix. Club is now established working with kit provided. [Future] plans to look at trips but struggle to find close locations.*

The gender difference is interesting and highlights the importance of thinking about how ideas are presented to students. Finding the right hook is important, for one girl it was about timing “it’s good to have a club to come to at lunchtime, it’s something to do”. As noted earlier all the pupils in one engineering club came from families where family members had encouraged them to work with tools. This combination of role models and practical experience is something BEP activities can provide especially for young people without these family connections.

All schools have successfully introduced or continued to offer students within their school the chance to join an Engineering Club. The students connected with these clubs may provide the basis for some more intensive pupil feedback in future years, or become the basis of a cohort who is tracked over time (see section 2.4 Collecting Data). 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. This might become an annual event to which students also give presentations, demonstrate their products, and undertake inter-club competitions. The potential for inviting parents / carers to such an event may also be a useful addition (see 5.2.2 Parents and Carers).
5. Students

The BEP is concerned with both the participation of students as well as the progression and changing attitudes of those who participate. This section of the report revisits issues from the perspective of these two important strands. With respect to participation questions about who and when are addressed together with the impact of participating in BEP activities. The question of progression is considered from the perspective of educational pathways and future careers, both of which are influenced by access to Information Advice and Guidance (IAG).

5.1 Participation

With respect to the impact of participation several teachers during our observations commented on the behaviour of their pupils and noted that there was less behavioural disruption, this they attributed to the more practical ‘hands on’ feature of the activities. As one BEP co-ordinator remarked you can:

“**see in their faces how much they are enjoying it … behaviour disruption is minimal. [Pupils who] cause problems in school tend to get on well in these kind of activities**”.

Looking at one of the common questions included in the school based evaluation questionnaires it would seem that activities designed for older students or delivered to a smaller cohort were more likely to influence the students general interest in engineering.

*Figure 3: Bar chart comparing responses from school based evaluations relating to likelihood of taking a greater interest in engineering*
The selection of pupils for both ‘in school’ and ‘out of school’ activities is a central issue to the overall goal of participation. The practical considerations that influenced decisions about who should participate are not unique to the BEP and have been noted elsewhere both anecdotally as well as more formally (Ford, 2005; Houghton and Moser, 2006). Teachers are often very clear as to who should or should not be offered an opportunity, for example, one teacher explained:

*that sort of day wouldn’t be suitable for every kid in the school. [You] always get some who will play up. ... [there] will always need to be an element of selection.* (teacher)

Another teacher invited to supervise pupils participating in one of the BEP events commented that it was:

*nice to see kids outside the classroom, see them doing things that they weren’t directed to do by me. ... taking a bit more initiative than they would usually be asked to do. concentrating on something for longer [for a whole day], classroom tasks can usually only last an hour at most. At first, I wondered if they could concentrate on one thing for the whole day, was a good task. [The} kids were selected, and that helped. ... Interesting to see their reactions.* (Teacher)

The importance of individual choice was another consideration. As one BEP co-ordinator noted, together the BEP and other providers are offering a range of “different [activities] attracting different people” he went on to question the “extent to which you let all [students] choose their own [activities] or try to engage new people” who might not put themselves forward.

In the first year of the project schools and colleges have organised events involving large and small numbers of students. At the final review meeting of BEP co-ordinators it was evident that there was a range of approaches with respect to who participates and how many opportunities any given individual should be able to access. There was general agreement that it depended on the purpose of the activity as the following two examples illustrate. At one end of the continuum there was Alfred Barrow’s use of *Starchaser* that provided an opportunity for all students within the school, and was designed to raise aspiration and awareness. At the other end of the continuum was Dowdales *Formula Gravity* activity that was a targeted opportunity for eight male students that was designed to challenge and help raise attainment. It is important to recognise that each has their place within an overall framework of activity. As the BEP moves into its second year it is *recommended* that collectively and individually the BEP co-ordinators consider the overall balance between aspiration and attainment activities they are trying to achieve.

1 Gender

Girls and minority ethnic students are identified as groups the RAE wish to monitor and increase the numbers participating. Girls’ participation in science is a longstanding (Whyte 1986), national (DCSF, 2009) and worldwide concern (UNESCO, 2007). A recent study by Smart and Rehman (2009) looking at the participation and progression of Bangladeshi girls in the London Borough of Tower Hamlets found that selection of subjects was based on a number of factors including:
career ambitions; interest in and enjoyment of the subject; self-perceived ability; perceived difficulty of the subject; the options on offer in the school/college; previous experience of studying the subject (p 10)

The participation of girls in BEP activities has not been a core focus of consideration, however, it has been discussed by BEP co-ordinators and is recognised as an issue. One teacher who had begun his career as an apprentice in the shipyards prior to training as a teacher said:

*I think that reluctance amongst girls to consider engineering as a career is partly a feature of the Furness area. When working in another area [name] there were a greater proportion of female apprentices.* (Teacher)

Although in the academic year 2008-09 no girls applied for the engineering diploma at the college there were about 15-20% female apprentices. As one BEP co-ordinator suggested:

*I think there is a need to attract girls earlier, suspects that they don’t always realise the higher wages available in engineering jobs. Has a role this year to increase numbers of girls applying for diploma course.* (BEP Co-ordinator)

Within the BEP schools and colleges there are positive role models and as the project continues it is possible that role models from college might support activities in secondary schools and primary feeders. During the year there have been some single gender activities offered for instance Girls Into Aerospace. We have also observed a wide range of participation behaviours from girls including the stereotypical passivity allowing boys to dominate and take over through to girls taking charge and organising a winning team. Observations noted by the LEP and practical advice for the inclusion of girls are recommended as a source of useful advice for the second year of the project.

.2 Parents and Carers

During the year there have been a few activities that have attempted to involve parents. Parent / Carer response and involvement varies. For instance, in one school they are seen as a source of speakers and are keen to get involved, in another school there was very poor turn out to view displays prepared and presented by their own children. The engineering connection for pupils attending one engineering school was noticeable, it would be interesting to explore this matter in the future and consider ways in which parents / carers might be involved (see recommendations in section 2.2. communication).

As 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 also to change perceptions. A possible future event for BEP - a celebration event with parents invited.*
This has been 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 that the BEP considers ways of informing and involving parents / carers about the activities in which their sons or daughters are involved. It is possible that the Local Authority and those with a remit for family learning might be interested in supporting family learning activities based on engineering challenges.

5.2 Progression

The positive experiences offered by the vast majority of BEP activities offered during the past year are likely to have contributed to raised awareness, increased aspiration and attainment.

Whilst these have not formally been measured, feedback from students given in individual school and college evaluations, together with observations made by teachers about the achievements of their pupils would suggest this is a reasonable claim to make. One BEP co-ordinator was clear that the activities available within the BEP:

- will improve levels [of achievement], and maintain enthusiasm. If pupils are engaged and enjoying [a] subject then attainment will follow.
- Provided it is supported by good teaching.

This is an important caveat and is connected with earlier comments relating to the involvement of teachers within activities and the possible inclusion of pre and post event activities (see section 4.2 Activities).

Figure 4: Bar chart comparing responses from school / college based evaluations relating to the study of a STEM subject at a more advanced level
Given the difference in activity and sample size it is difficult to draw any definite conclusions. However, for all activities there are signs that the activity has had a positive effect on changing the attitudes of some students. Also it appears that activities for older students (i.e. Barrow 6th Form and Furness Colleges) who have already made some decisions about subject choice are still encouraging these students to continue their study in this area. It should also be noted that the St Bernard’s activity involved a greater proportion of girls (8 out of 12). Appendix 3 provides a table of the results for closer analysis.

Two other aspects we connect with progression into engineering related careers are the development of a range of educational pathways into which students can progress and effective careers education.

1 Educational Pathways

The development of progression pathways has been enhanced in the past few years with the introduction of engineering qualifications, notably the Engineering GCSE and Diploma.

Looking first at the GCSE, one BEP co-ordinator talked about the re-introduction of the Engineering GCSE. However, he felt that this needed to be "sold differently". Although GCSE Engineering was taught in the past it was dropped because it did not attract the brightest students, it is a difficult GCSE. Consultation with 25 of the 50 participating students at a STEM workshop, revealed considerable interest in pursuing an engineering GCSE, the BEP co-ordinator reported that the school would need to review their plans in the future. Another BEP co-ordinator remained sceptical about the engineering GCSE in the "real world" believing that some schools still "look down their noses" which they attributed to the fact that local companies still want Mathematics, English and science qualifications rather than engineering GCSE. This highlights the importance of changing attitudes across the board and is one reason why the BEP should give thought to how it communicates messages about STEM subjects, engineering in particular (see section 2.2 Communication).

The Diploma is a vital stepping stone on the progression pathway and, in the academic year 2008-09, the Engineering Diploma has been introduced at Furness College. In connection with teaching the Diploma Furness College has purchased resources including a wind tunnel where students will be able to test their balsa wood designs. This is a resource teachers at the college hope other schools can use. With respect to the Diploma’s long term future, one commentator, who described themselves as a supporter of specialist diplomas, felt that they would only be successful:

if more able students are also encouraged to apply [for them] otherwise their credibility will be lost. If not there won’t be any qualifications at the advanced levels and parity with A-levels will be lost.
The advantages and disadvantages associated with the vocational and academic routes as well as the possible options available to students pursuing these are hotly debated and often there was resistance to change. There have been examples throughout the year when ‘misinformation has been provided’. During our observations we have noted that others present have been able to supply the ‘correct’ information. Changing attitudes means ensuring accurate and current Information Advice and Guidance is available and that someone is present to ensure ‘mis-information’ is corrected (see section 5.2.2 Future Careers).

Finally, one of the aims of the BEP is to support progression to Higher Education. The Barrow 6th Form College activities included a visit to Lancaster University which was valuable in providing answers to some of the more detailed questions asked by older students who would soon be making a decision about what to study at a higher level.

- Gives you a better understanding of the courses you are interested in (Barrow 6th Form)
- It gave me insight into what the departments do (Barrow 6th Form)
- It provides an overview of what to expect on a course (Barrow 6th Form)

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

2 Future Careers

Careers education is perhaps the wider umbrella into which the IAG mentioned in our discussion of educational pathways fits. 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.

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 developing. A project such as this [BEP] can only contribute to this in a positive way. (Teacher)

One BEP co-ordinator commenting on the career aspirations of students said:

Changing Recruitment Patterns

(13.5.09) Dave Green (Furness Diploma Project Manager) reported that “although the recruitment process was not yet complete, there were already 39 applications this year for the Foundation and Higher Engineering Diploma, a significant increase on the previous year.” This included 5 applications from girls.

Engineering as an option

Feedback collected from one school for pupils participating in the Smallpeice event indicates that over a third of pupils were now considering engineering as an option, only one pupil was put off by the day, and a further 7 retained an ongoing interest.
Many youngsters only aspire to apprenticeships for which there is fierce competition. Not enough pupils are yet aspiring to become graduate Engineering. (BEP co-ordinator)

This raises a question about the purpose of raising awareness within the BEP activities and the extent to which the project is about more about raised aspirations which will only be achieved through raised attainment. Feedback from the Furness College students attending ‘Energise your Future’ demonstrates how activities can begin to address the challenge of raising aspiration and attainment.

It was really interesting and was a good way of seeing different types of engineering jobs (Furness College student)

It improves my knowledge and will help me get a good job or career in engineering Furness College student

It gives me an idea of the working world and then it gives me an idea what company I want to aim for (Furness College student)

When you get told all the different jobs it shows you what is out there and all the experiences and opportunities you can have (Furness College student)

More businesses near to Barrow (Furness College student)

Figure 5: Bar chart comparing responses from school / college based evaluations relating to a career in engineering and technology

As a result of taking part, are you more or less likely to find out more about a career in engineering and technology

It is important to note that not all activities included an explicit reference to engineering careers or how to pursue them. Starchaser for example was motivational but appropriately for the age group and activity did not go into detail
about specific careers. This is something schools might want to pursue after an activity like this drawing on the expertise of their Connexions colleagues. For those activities offered to older students the link between educational pathway and career was more explicit. To support the IAG and wider careers education it is recommended that the Project 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). A further recommendation relating to IAG would be 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 associated with engineering). Many of these teachers already have networks and contacts it is therefore possible that a meeting with them might ease access to and future approaches to local companies.

Looking at both Figures 5 and 6 the quantitative responses to the vocationally orientated activity ‘Energise your Future’ suggest that the earlier qualitative comments about the range of career possibilities may well be transformed into students pursuing an engineering career (see Appendix 3 for a tabulated breakdown of results). Not surprisingly there are high proportions of students from the schools who are undecided with respect to future careers. It is interesting to compare their willingness to find out more about careers in this area with their current views about what they might do when they finish their education. This potential openness is a hopeful sign that attitudes may not be fixed and that BEP activities can make a helpful contribution to students making informed decisions about their future.

Figure 6: Bar chart comparing responses from school / college based evaluations relating to a career in engineering and technology
6. Industry

There are numerous ways in which schools and colleges already link with local industry, most obvious are the contacts through Connexions advisors and those with responsibility for organising work experience. The contribution of work experience to the wider careers education referred to in section 5.2.2 should not be underestimated. This section builds on points raised earlier by outlining examples of current links and confirming based on feedback gathered the approach adopted with respect to building industry links.

There are a range of approaches and existing contacts with local industry. One school outline engineering opportunities in a school newsletter to parents/carers:

> those interested in **engineering** can choose from BAE, BNFL, Kimberly Clark, Acrastyle, Tronic and many other engineering companies. (school newsletter)

Whereas another school reported that their links with industry were enhanced by the employment of:

> An Enterprise Coordinator who actively seeks support from industry. She manages visits, speakers and we have an excellent system of promoting career opportunities through a scheme “Above and Beyond” which she manages. (BEP co-ordinator)

Other BEP co-ordinators and Connexions staff we interviewed also outlined ways in which schools already had links with industry that they were keen to develop further, a process they hoped would be enhanced by their involvement in the BEP.

In the economic climate one commentator felt that “companies may not support with cash but will do so with good will”. As ways of contributing to the BEP are explored with schools, colleges, existing industry links and new industry links it is recommended that a list of examples of how companies can support the BEP and what schools would find useful is compiled.

From the perspective of local industry, one interviewee felt that:

> “**BEP is enhancing our relationship with schools and enhancing opportunities ... [giving] real life experience to the young people, [so that] we become an employer of choice so that they know what we offer and what we can support them with, it stretches on so it could support them with bursaries – sponsorships**.

These sentiments resonate with the views expressed by other representatives from industry who have indicated their interest in getting involved in year 2 of the project. The need to break down increase the awareness of staff as well as students is an important stepping stone in enabling staff to consider how the opportunities available from local employers can be used to enhance the curriculum. Discussion between Brian Wood, Dave Green (Furness Diploma Project Manager) and BAE regarding the development of MODULES of work which will represent:

> a plan for the different work experience areas, [a] programme of activities that are structured and opportunities to put in front of any pupil which they can achieve (Industry)
This first year of the project has allowed schools and colleges to continue to develop their links with industry. One school planned a project involving regular curriculum inputs from a range of companies, due to timing this was rescheduled for the next academic year. It will be interesting to review the impact of regular contact with companies and if successful consider ways of extending this model to other schools.

With respect to planning closer links, an industry interviewee explained how their: 

*drive is to look at how we can best support the different educational institutions, … what we want is that any opportunities [need] to have real and structured approach and not making cups of tea, this is welcomed by [Project Co-ordinator] and the projects … none of us will be working in silos and they will understand what we need and we can understand what they need – [so we are working together] Anticipate a bonus to us*

When discussing ways of progressing school and college links with industry one commentator said it was important: 

*to GROW the project before approaching industry … there is a history of some schools working with industry, or industry approaching in the past and not necessarily getting a positive response, they have let each other down in the past*

The approach adopted by the Project co-ordinator is based on extensive experience of schools and the local area. In essence it is based on “encouraging schools to think what they would like and in a way that it would suit them (i.e. input from industry)” and using this as a basis for developing a menu of ideas that could be presented to industry to consider. Clarifying what is needed and what local companies can offer seems a sensible way to progress and minimises the risk of unrealistic expectations and disappointment on both sides. A more measured approach also allows time to develop long term relationships and increase understanding of the working worlds of educators and employers. 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, this might include ideas already suggested throughout the report, capture existing links where schools are willing to reveal these as well as suggestions made during preliminary approaches to local companies.
6.1 Role Models and STEM Ambassadors

The importance of role models, mentors and student ambassadors is widely recognised within widening participation initiatives (Houghton and Moser, 2006). As one BEP co-ordinator said:

*Engineering is fun and everyone should try it but it’s not for everyone.*

Many of the BEP activities made use of role models whose personal enthusiasm and interest was an effective means of showing how “engineering can be fun”, whilst at the same time sharing knowledge and expertise to aid learning. As one student noted after their ‘Energise your Future’ visit:

*The fact that we were able to interact and obtain information with fully qualified Engineering (Furness College student)*

Role models included teachers, parents and Governors. One employer referred to their Governors’ Forum which brings together employees who are on governing bodies to discuss ways of linking. One school described how they found parents a useful source of help and a potential source of speakers for events.

*School has wide catchment area, many parents who work in local industries are willing to get involved also. (BEP co-ordinator)*

Providers often included brief information about how they personally had got involved in engineering for example Smallpeice and Starchaser, whereas others included more detailed accounts such as the BMW Apprentices and BAE Graduates. In addition to these, many activities relied upon the valuable contribution of STEM Ambassadors who belong to a network co-ordinated by Cumbria STEM Centre Ltd.

When discussing contributions to Robolab, an event delivered by Cumbria STEM Centre Ltd., one BEP co-ordinator commented that the:

*key to the success of the event was the support provided by the ambassadors. Several of these were absolutely excellent, but a few seemed to have difficulty relating to the pupils. Whilst most were able to help the pupils with the design and construction of the robots’ frames, a few of them were unable to offer much support with the programming and it was here that pupils tended to struggle most. This led one or two [pupils] to withdraw from their pupil groups.*

This highlights the need for training of ambassadors which has been identified and is the focus of another RAE project in which STEM Ambassadors and BEP schools and colleges have been chosen to participate. 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.

Interestingly, one employer recognised their own need to become more familiar about the role and responsibilities associated with being a STEM ambassador:

*we know they go into schools and give talks – to be brutally honest not sure what they are doing going on a course which will give us a better*
understanding [so we’ll know] what the Ambassadors needs are and how they can be supported (Industry)

Finally, one BEP co-ordinator felt that a huge untapped source of role models would be “newly retired Engineering”. In agreeing that they were enthusiastic one commentator was more cautious and stressed it was important to present students with an image of engineering to-day. The booster training project offers potential here for retaining enthusiasts whilst ensuring they present an accurate account of the engineering world.
7. External

The BEP has benefited from a number of external organisations who fall into three broad categories:

- **Providers**: including RAE 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 Rennaissance (please advise and clarify)

These external agencies together with the schools, colleges and local industry provide a rich resource for the development of future BEP activities. 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.

**Figure 7: An overview of the BEP and AimhigherCumbria interactions**

<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 wouldn’t have gone to individual schools</td>
</tr>
</tbody>
</table>

Exploring and understanding the relationships between agencies is one way in which future evaluations might support future embedding and the organisational changes necessary for BEP to achieve its goals. It is **recommended** that future evaluations include identification and analysis of the enabling and process outcomes associated with organisational change.
8. Future

The challenge facing BEP according to one commentator is to ensure that the:

right ethos set, then 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].

8.1 BEP Achievements

Although it is too early to provide a list of definite outcomes, a number of interviews suggested a range of potential outcomes for which there was some initial, if tentative, evidence. These included:

- An increased interest in STEM subjects in school and engineering as a possible career choice;
- Students developing a more sophisticated engineering approach when viewing particular technical problems;
- BEP serving to remind people of the importance of engineering to the local economy in Barrow;
- BEP organised special days and events viewed as a success and contributing in some measure to the outcomes listed above.

Taken together it was thought that these outcomes represented a very satisfactory set of indicators of good performance during the first year of BEP. This was especially the case since the education system in the town was passing through a period of major change and there was an inevitable temptation or indeed necessity to postpone decisions until there was further clarity about how the new Furness Academy would function.

In addition to providing students in Barrow with a very useful window in the world of engineering, the BEP was performing another function in making schools and colleges examine the status of engineering as a subject. There were numerous comments contained in the data which suggested that engineering was not necessarily perceived as one of four equal components within the STEM group. Furthermore, some, in schools in particular, were still equating it with lower ability students and with craft/technical occupations rather than professional careers.

Raising the profile of engineering as an academic discipline, and in doing so promoting professional engineering as a worthwhile career for those girls and boys in Barrow who are high performers in science and maths, may be the most important challenge faced by the BEP project as a whole. For success in relation to this challenge might free the notion of ‘engineering’ from automatic and simplistic associations with Barrow’s heavy industrial past. This was an intention, or at least a hope, expressed by many of those consulted and who were endeavouring to make BEP a success.

8.2 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 second 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 second 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).
References


Appendix 1: Core Participants

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

Schools
The Alfred Barrow School
Barrow 6th Form College:
Dowdales High School
Furness College
Parkview School
St Bernards Catholic High School
Thorncliffe A Specialist Sports College
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 2: Overview of Pupil responses

The following graphs show the combined results for 208 replies received from students participating in the Concorde Project, Engergise your Future, Formula Gravity, Grand Engineering Challenge, Lancaster University Taster and Starchaser Rocket activities. It is important to note that the number, age and gender of participants within each activity varied. For a summary of the findings for each activity see Appendices 2A to 2G. See also Appendix 3 which contains a breakdown for activity and each question.

Combined Results for BEP

Participants: As a result of taking part in this activity are you more or less likely to study a science, technology, engineering or maths subject to a more advanced level

Interest in studying at a higher level is an important indicator and for individuals who will be tracked over the coming years it will be important to establish the extent to which this interest is maintained and try to identify factors which help to maintain this interest, or conversely cause students to change their mind.

Combined results for BEP participants: As a result of taking part, are you more or less likely to find out more about a career in engineering or technology

Overall 93 (44%) reported an increased likelihood of finding out about a career in engineering or technology. There remain 64 (31%) who are unsure and who may therefore benefit from further activities and information advice and guidance to support them in making a decision.
Combined results for BEP participants: As a result of taking part, are you more or less likely to seriously think about entering a job in engineering or technology

Overall the numbers of students reporting they unlikely or more unlikely to think seriously about a job in engineering is 63 (31%) this was more than those willing to find out more information 51 (25%). As with any snapshot and given the different ages of the recipients it is difficult to draw any conclusions, however, in future monitoring and tracking, it would be useful to explore the answers of individuals who may be open to finding out more but who at the same time are reporting this is not likely to be an area of employment they might consider.

Combined Results for BEP Participants: As a result of taking part in this activity are you more or less likely to talk about engineering and technology opportunities with my friends and family

The influence of families in young people’s decision making process is widely recognised (Houghton, 2005). It is interesting to note that within this group that the likelihood of talking to friends and family is more evenly distributed.

Observation at one engineering club suggests that there is a link between family connections with engineering and the likelihood of getting involved. It would be interesting to explore this issue further as it may help to inform the extent to which activities are designed to involve family members.

The final generic question asked students if they were more or less likely to take an interest in engineering and technology on the television or to read about relevant topics. Eighty seven (42%) reported they were likely or more likely to, with 71 (34%) remaining unsure and only 14 (7%) felt this was unlikely.
Appendix 2a: Alfred Barrow Starchaser

Background
The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which pupils from Alfred Barrow attended. In addition, Dave Smith as Alfred Barrow BEP Co-ordinator applied for and was funded to deliver several school based activities, of which Starchaser was one targeted for external evaluation. This mini report summarises feedback from pupils and staff, a further breakdown of the data for this activity and other schools is included in appendix 3.

Starchaser Rocket
Overall the response from this group of students was positive, this matches the positive atmosphere observed during the day and reported by the BEP co-ordinator following the event. The results suggest that there is some room within this activity for helping and supporting students to see the connection with future learning.

In common with some other activities, we observed that the testing phase of the project was less organised and there were perhaps missed opportunities for building on the learning. However, given the broad age range and the focus on making learning experiences fun, on this particular occasion it is possible this would have
'dampened the enthusiasm of the students’ and made it ‘too like school’. It is not possible to offer any definite conclusions about the high proportion of students unsure about how well they did, however, it is possible that general levels of self esteem and confidence with this group were not high, which may have impacted on their self assessment. In situations like this, ways of building in peer assessment or developing ‘assessment for learning’ skills for group tasks might be more useful.

When asked students said they would like to take part in more activities like this because “It was fun and educational at the same time” and another said “It was good coz we don’t get a lot of time to work in a group as year 10”. The event was regarded as something different from what is normally done at school by sixty four pupils (86%).

Commenting on which part of the Starchaser Rocket Project they liked most, 12 pupils offered comments on the practical rocket making activity one student said they particularly liked “The part where we fired them up in the air”. Other comments related to the presentations given to KS 4 students with one student saying they liked the “Micro waved northern lights [because it] inspired me”. This activity was an interactive lecture / presentation which engaged the KS 3 and KS 4 audiences. Feedback from other presentations suggests that pupils’ willingness to simply listen is generally not great and that they welcome hands on opportunities. This presentation showed that with the right balance of visuals and ‘audience participation’ pupils will remain engaged. It would be interesting to know to what extent presentations like this are followed up and connected with the existing curriculum. As noted earlier this will depend on the purpose of the activity.

Starchaser activity was seen by the school as a great success in motivating and engaging pupils about STEM, which is clearly an important phase in their longer term interest in this area of the curriculum.
Appendix 2b: Barrow 6th Form College, Lancaster University Taster Day

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The 6th Form College used BEP funding to transport a group to attend a STEM taster day held at Lancaster University. This included opportunities to learn about a range of subjects and gain an experience of university study. In essence it combined both subject knowledge and opportunities for receiving information advice and guidance (IAG) about studying a STEM subject at university. This mini report summarises feedback from students and staff, a further breakdown of the data for this activity and other institutions within the BEP is included in appendix 3.

Lancaster University Taster Day

The response to the overall event was very positive with students confirming that they were glad to have taken part. The event provided the opportunity for students to work with materials and equipment that would not normally be available to them and participate in activities that they would not normally do at college. As one student said “It makes me experience something different whilst learning” and another “It was informative and interesting”.

Despite the newness of activities forty-three (85%) of the students were still able to see how the taster event would help them with future learning. At this stage on the educational pathway it is important that this connection is made. The event covered
a range of STEM activities not all of which were engineering, it is therefore not possible to comment on whether the connection was made with plans to pursue engineering. For students not studying engineering a taster event like this might introduce them to the subject and possibilities available. For those with some familiarity or even extensive experience an event can provide the opportunity to explore the subject and possibilities in more detail. As one student explained it “*gives you a better understanding of the courses you are interested in*” and another “*It gave me insight into what the departments do*”.

The results in the table above need to be seen in the context. The students who attended were a mixed group and the content of the day was not exclusively focused on engineering. Despite this, twenty-four (47%) reported they were more likely to find out about a career in engineering or technology and thirty-seven (74%) indicated their intention to study a STEM subject at a more advanced level.

The event attended was a general taster event, it would be worth exploring for the purpose of using BEP funding more targeted taster events in which the engineering careers associated with all subjects is made explicit. This might be part of the day itself, or part of a preparatory activity. For instance, the Biology session could have referred to Biomechanical engineering\(^2\) and the mathematics session highlighted the close connection with engineering.

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\(^2\) See for example Types of Engineering: www.futuresinengineering.com/what.php?id=2#mineral
Appendix 2c: Dowdales School – Formula Gravity

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which pupils from Dowdales attended. In addition, Owen Belsey as BEP Co-ordinator applied for and was funded to deliver several school based activities, of which the Formula Gravity project was one targeted for external evaluation. This mini report summarises feedback from pupils and staff, a further breakdown of the data for this activity and other schools is included in appendix 3.

Although the school had participated in similar activities in the past, this had involved “using left over materials, sidelining department funding or by teachers dipping into their own pockets”. This year through BEP funding the school was able “to design and develop a car that has real potential to be very competitive and as a result has really fired up the students’ enthusiasm”.

The objectives of this activity complement those of the BEP see website for further details [http://www.formulagravity.co.uk/objectives.htm](http://www.formulagravity.co.uk/objectives.htm). As the BEP co-ordinator explained the activity was one that inspired pupils. When discussed with other BEP Co-ordinators it was a topic that also generated interest.
Although only eight participated in the activity the feedback from pupils suggests it was a very positive one. When asked to comment on the activity, pupils said they would like to take part in more activities like this because:

- They are fun and I get to work with materials that I would not normally work with.

- It is a challenge and is something new.

The novelty factor is something that pupils reported when asked about the part of the Formula Gravity Project they liked most, and why?

- Putting on the brake because it was very interesting.

- Building it and meeting new people and taking part.

- Making it offers new challenges everyday.

When delivered in Dowdales it was an all male team, it is recommended that in the future the possibility of having an all girl team might be considered. However, it is noted that the involvement of girls in engineering is a wider concern and challenge (LEP, 2009). For practical suggestions for how to encourage girls into engineering please see the handbook produced by the London Engineering Project\(^3\).

Appendix 2d: Furness College – Energise your future

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which students from Furness College participated. In addition, Scott Wilson BEP Co-ordinator applied for and was funded to deliver several activities, of which ‘Energise your Future’ was one targeted for external evaluation. This mini report summarises feedback from pupils and staff a further breakdown of the data for this activity and other schools is included in appendix 3.

For further comments and a discussion of factors influencing progression and future careers please see section 5.2.

Energise your Future

There was overwhelming interest and support for this activity with all students agreeing that they were pleased to have taken part in the event and that it was interesting. With the exception of one student all reported they had been able to work with new materials and equipment. There was some uncertainty about how well some students felt about their achievements at this event.

![Image of survey results]

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am glad I took part in the &quot;Energise your future&quot;</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>I thought what we did was interesting</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>I was able to work with materials and equipment I do not normally work with</td>
<td></td>
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</tr>
<tr>
<td>I can see how the &quot;Energise your future&quot; will help me with my future learning</td>
<td></td>
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</tr>
<tr>
<td>The &quot;Energise your future&quot; was different from what we normally do at college</td>
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<td></td>
</tr>
<tr>
<td>I did better in the &quot;Energise your future&quot; than I expected</td>
<td></td>
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</tbody>
</table>
The intentions of this group were not collected prior to the event and so it is difficult to judge to what extent these students’ views changed as a result of the activity. Nevertheless the results show that this group took part in an event that encouraged them to want to find out more about a career in engineering, think seriously about applying for a job in engineering and consider studying a STEM subject to a more advanced level. Although seven (64%) of the group were uncertain about higher study, all 20 (100%) reported that they were thinking seriously about entering a job in engineering or technology.

The students identified a number of very positive reasons for why they would like to take part in more activities like ‘Energise your Future’:

*It gives me an idea of the working world and then it gives me an idea what company I want to aim for*

*It was really interesting and was a good way of seeing different types of engineering jobs*

*It helps me with my future learning*

In common with feedback on other activities, the ‘practical stuff’ was a popular part of the ‘Energise your future’ event. Other comments included:

*Using the simulation ROV [remotely operated vehicle]*

*When we were told about all the different jobs you can do it makes you realise all the choices you have*

*When you get told all the different jobs it shows you what is out there and all the experiences and opportunities you can have*
Appendix 2e: Parkview School – Grand Engineering Challenge

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which pupils from Parkview attended. In addition, Steve Howes as BEP Co-ordinator applied for and was funded to deliver several school based activities, of which the Grand Engineering Challenge was one targeted for external evaluation. This mini report summarises feedback from pupils and staff, a further breakdown of the data for this activity and other schools is included in appendix 3.

Grand Engineering Challenge

This involved a challenge in which groups of pupils had to build a wheeled "Buggy" to carry a weight down a ramp. Eighteen (90%) of pupils felt the activity was different from what they normally do at school, as one pupil said “It gives you a chance to try different things” and another said “It is different to what we normally do and beneficial”.

Whilst the new opportunities provided by BEP funded activities is clearly a bonus it is important for the learning to be consolidated that pupils are supported in making connections between the experiences they have and the existing learning. It is worth noting that nine (45%) of the pupils either were uncertain or felt they could not see how the Grand Engineering Challenge would help them with future learning. Yet, when asked about the activity the pupils were particularly positive and identified a number of very positive reasons for why they would like to take part in more activities like the ‘Grand Engineering Challenge’:
It helps your understanding of certain materials

I thoroughly enjoyed winning it was great way to get me thinking

[It] was fun and it taught me more about engineering. We also met new people and made new friends

The most popular features of the ‘Grand Engineering Challenge’ provide insights into how pupils’ enthusiasm for the topic might be used as a point of connection with other learning. Pupils reported that they liked:

- The planning was the best part of the challenge
- Making the weight car because it was very interesting
- Making things because it was challenging
- The making because everyone had a job and you worked together as a team

These skills of planning and team work are clearly integral to engineering tasks as well as other areas of the curriculum. In some respects identification of a skill is a prerequisite to enabling pupils to see the relevance of that skill and recognising how they might use it in the future. The challenge of encouraging pupils to understand what and how their own learning and achievements may be useful is ongoing. It is possible that the use of ‘assessment for learning’ strategies that are an existing feature of other teaching and learning might be used as part of the preparation and debriefing for this type of activity.
Appendix 2f: St Bernard’s High School – Concorde Project

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which pupils from St Bernard’s attended. In addition, Margaret Campbell BEP Co-ordinator applied for and was funded to deliver several school based activities, of which the Concorde Project that included a visit to Manchester was one targeted for external evaluation. This mini report summarises feedback from pupils and staff, a further breakdown of the data for this activity and other schools is included in appendix 3.

Concorde Project

The Concorde project was different from the rest of the school and college based activities in that it involved more girls than boys. It is interesting to note that seven (58%) felt they did better in the activity than they expected. There was also a positive response from the students with nine (75%) saying they were pleased to take part and thought the activity was interesting.

There were seven (58%) who were either uncertain or disagreed that the activity would help with future learning. This is rather disappointing given that other evidence gathered during the year suggests that St Bernard’s works hard at enabling pupils to see the connection between different STEM subjects and how learning in one area of the curriculum can be applied and used within another area.
When asked if they would like to participate in similar activities the aspects pupils said that:

*I liked working as a team and most of our concorde work was team based*

*It's interesting to do things I wouldn't normally do*

The chance to engage in new activities is an obvious attraction of many of the BEP activities. When asked which part of the Concorde project they liked most pupils gave a range of different answers. For some it was:

*Building the hanger because it was creative and different from what we usually do*

*The trip at the end because it was rewarding after all the hard work we had put in*

*Designing the concorde hanger because I never used the software before*

The incentive of a trip is one example of an element of an activity that operates as a motivation for pupils. It would be useful to investigate this when evaluating activities in the future.

The response from this group to pursuing more advanced study or a job in engineering is lower than for other activities, it should, however, be noted that there are more girls within this group, who traditionally are difficult to engage in STEM activities.
Appendix 2g: Thorncliffe School – Starchaser

Background

The Barrow Engineering Project (BEP) is a 2 year project that was launched in summer 2008 and is funded by local sources which the Royal Academy of Engineering (RAE) is matching. The local 14-19 Partnership operate as the strategic group who are responsible for approving additional priorities. The BEP has funded a series of centrally organised activities to which pupils from Thorncliffe attended. In addition, Andrew Poole as BEP Co-ordinator applied for and was funded to deliver several school based activities. The original focus for a mini report was the trip to the RAE Big Bang event. Unfortunately, due to timetable clashes it was not possible for this activity to be delivered. In the academic year 2009-10 this activity is to be hosted in Manchester which may make it more manageable for pupils to attend.

The views of pupils attending the Starchaser event co-ordinated by St Bernard’s Catholic High School were targeted for external evaluation. This mini report summarises feedback from pupils and staff, a further breakdown of the data for this activity and other schools is included in appendix 3.

Starchaser at St Bernard’s

This is an example of an activity that illustrates the benefits of working collaboratively. With the exception of Alfred Barrow who organised a separate whole school event, all other secondary schools within the BEP participated in this week long series of activities. They were also joined by primary pupils for some activities.

![Starchaser Graph](image)

When asked why they would like to take part in more activities like this in the future six explained that it was fun, three interesting, and a further three because “It is

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4 For additional information and feedback on this event please see materials collated by Margaret Campbell at St Bernard’s.
different from what we usually do in school”. Several pupils combined fun with interest, learning and education. For example,

I found it interesting and I learnt a lot.

It was fun and educational

The subject matter and the rocket itself clearly impressed a number of pupils, when asked which part of the Rocket Roadshow they liked most eight said “The part where we looked at the rocket because it was interesting” and another said “seeing the rocket because I had not seen one close up”.

With respect to ways of improving the activity several said they would like to have “gone in the rocket” or “seen the rocket taking off”.

The results are more evenly spread and there is more uncertainty than for other activities, it is possible that the gender balance may account for this or the age group of the pupils. It is also probable that the isolated context in which the activity was undertaken did not focus attention on some of the linkages with careers and educational progression pathways. Although we did not observe this event, the Starchaser event we attended at Alfred Barrow suggests that the activity and input would benefit from either a supplementary activity to enhance the information advice and guidance or more explicit references within the presentations.
Appendix 3: Overview of pupil response to individual school based activities

As a result of taking part in the event/activity are you more or less likely to do the following?

<table>
<thead>
<tr>
<th>Find out more about a career in engineering or technology</th>
<th>More likely</th>
<th>Likely</th>
<th>Not sure</th>
<th>Unlikely</th>
<th>More unlikely</th>
<th>Total replies</th>
<th>Total forms</th>
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<tr>
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<td>9</td>
<td>12%</td>
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<td>21%</td>
<td>26</td>
<td>36%</td>
<td>16</td>
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<tr>
<td>Barrow 6th Form College, Lancs. Uni. Taster Day</td>
<td>5</td>
<td>10%</td>
<td>19</td>
<td>37%</td>
<td>12</td>
<td>24%</td>
<td>12</td>
</tr>
<tr>
<td>Dowdales School, Formula Gravity</td>
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<td>25%</td>
<td>3</td>
<td>38%</td>
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<td>38%</td>
<td>0</td>
</tr>
<tr>
<td>Furness College, Energise your Future</td>
<td>4</td>
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<td>11</td>
<td>58%</td>
<td>4</td>
<td>21%</td>
<td>0</td>
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<tr>
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<td>6</td>
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<td>25%</td>
<td>3</td>
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<tr>
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<td>2</td>
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<td>5</td>
<td>42%</td>
<td>4</td>
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<tr>
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<td>7</td>
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<td>9</td>
<td>36%</td>
<td>4</td>
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<table>
<thead>
<tr>
<th>Study a science, technology, engineering or maths subject to a more advanced level</th>
<th>More likely</th>
<th>Likely</th>
<th>Not sure</th>
<th>Unlikely</th>
<th>More unlikely</th>
<th>Total replies</th>
<th>Total forms</th>
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<td>11%</td>
<td>15</td>
<td>21%</td>
<td>26</td>
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<td>Barrow 6th Form College, Lancs. Uni. Taster Day</td>
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<tr>
<td>Seriously think about entering a job in engineering or technology</td>
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<td>Not sure</td>
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<td>More unlikely</td>
<td>Total replies</td>
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<th>Talk about engineering and technology opportunities with my friends and family</th>
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<th>Likely</th>
<th>Not sure</th>
<th>Unlikely</th>
<th>More unlikely</th>
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<th>Generally take more interest in engineering and tech. e.g. watching TV programmes, or reading articles about them</th>
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