

## **The Big Bang 2010 – Final Evaluation**

Please see the attached independent evaluation of The Big Bang 2010. Carried out by the Centre for Science Education at Sheffield Hallam University, the evaluation focuses on the experiences of young people, teachers and parents. It also details the participants' attitude to STEM subjects and careers - as well as the kind of impact that The Fair had on teaching and learning after event.

The report is really encouraging: the event as a whole received an overwhelmingly positive response from attendees, in terms of their experience of the day, enjoyment, and learnings providing an invaluable guide for improving in 2011.

Other research has also been conducted with:

- Sponsors
- Activity providers
- Competition entrants
- Judges
- Volunteers

The data collected in these additional research surveys have been analysed and reported on separately from this main evaluation report.

**The Big Bang Team**

# **The Big Bang 2010 Final Report**

**August 2010**

## Executive Summary

- EngineeringUK led the organisation of The Big Bang: UK Young Scientists and Engineers Fair 2010, which was held between March 11th and 13th 2010 at Manchester Central Convention Complex
- The event was attended by 23,500 people, including over 15,000 young people and 4,000 parents and other adults
- Schools represented were from the full range of socio-economic neighbourhoods, with more than 30% from areas from the lowest quartile based on deprivation index analysis
- Information sent out to schools prior to the event was largely seen to be helpful, although there were some comments about the need for more information about the content of workshops
- The venue worked well, with the facility to house most of the event in a single space, creating a 'buzz'. It was easy to get to, and the logistics 'on the day' worked well, including getting in, and getting out
- Most Primary attendees were part of whole class or whole year groups, and represented the full spectrum of attitudes to Science and Engineering
- Most Secondary and post-16 attendees were to some degree self selecting (e.g. were members of STEM Clubs), and were in the main more positive about STEM subjects than the comparator groups
- The event as a whole received an overwhelmingly positive response from attendees, in terms of their experience of the day, enjoyment, and 'things learned'
- Around 80% of teachers said that the event had exceeded their expectations
- The Shows were most popular element of The Big Bang, followed by the Exhibition Stands
- A majority of teachers suggested they would use materials or ideas from the event back in school, although few had done so six to eight weeks after the event, but with most saying they would eventually. However, just 9% of Secondary teachers had downloaded careers material after The Big Bang
- There is an ongoing gender difference between in terms of perceptions of Engineering, but less so for Science. For example, in the post event data set for pupils who attended the event, just 21% of girls said that they would consider a career in Engineering, compared with 53% of boys. This gap is smaller for Science careers, with 41% of girls prepared to consider a career in Science, compared to 49% of boys.
- The lack of Mathematics activities at the event was a concern for some
- The event raised teachers awareness of what else was on offer in terms of STEM activities

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## 1.0 Introduction

EngineeringUK led the organisation of the The Big Bang: UK Young Scientists and Engineers Fair 2010, which was held between March 11<sup>th</sup> and 13<sup>th</sup> 2010 at Manchester Central, a large convention complex in Manchester. The event was attended by 23,500 people, including over 15,000 young people and 4,000 parents and other adults - figures can be seen in Table 1 below. The key aims of the events were to celebrate and raise the profile of young people's achievement in Science and Engineering, and to encourage more young people to take part in STEM initiatives, with support from their parents and teachers. Over 100 other organisations contributed to the event, including businesses, STEM community organisations and government departments.

**Table 1 - event attendees**

Under 5	130
Age 5-7	236
Age 7-11	3395
Age 11-14	7064
Age 14-16	2046
Age 16-19	1151
Student	67
Teacher	1107
Accompanying adult	1024
Parent	1817

The evaluation of the event, carried out by the Centre for Science Education at Sheffield Hallam University, focussed on the experiences of young people, teachers and parents on the day, participants' attitude to STEM subjects and careers, and the impact of the event on teaching and learning after the event in participants' schools.

The methodology used was based on an adaptation of the Programme Logic Model approach, which identifies the *inputs*, *outputs* and *outcomes* of the intervention and seeks to identify relationships and causal links in these (for example, does family connection with STEM employment – an input, correspond to higher than average positive response to the event - an outcome).

A longitudinal study of the attitudes young people have towards STEM, in the curriculum and in their lives was carried out as part of this process, comparisons being made between the data collected before, at and after the event.

## 2.0 Data gathering process

Data collection for the evaluation of The Big Bang has taken place in three phases.

### 2.1 Registration

The first part of the data collection took place at the online registration, where teachers and parents were required to answer a series of questions concerning their awareness of resources to support STEM in schools, and how they felt about encouraging and informing pupils/their children in STEM career choices.

### 2.2 Questionnaire surveys

There were three separate paper-based questionnaire survey phases. The aim was to assess pupils' attitudes towards STEM, with the evaluation of The Big Bang aiming to take a longitudinal and comparative approach, as well as assessing how much the pupils and teachers who attended gained from the day, whether they found it useful in terms of learning and how they would like to see the event improved in the future. In order to obtain a longitudinal data set, pupils who were registered to attend the event were given three separate questionnaires, before the event, at the event and after the event.

In order to achieve a comparative sample, schools that were registered to attend the event were also asked to give questionnaires to pupils who were not intending to attend. In this way the responses of pupils who attended could be compared with those who did not.

Post-event questionnaires were sent out in early May, with follow-up letters, email and telephone calls a few weeks later, with the aim of boosting the response rate.

### 2.3 At-event activity and show observation

Throughout the event, the various shows, activities and displays were observed by the team of teacher training students from Sheffield Hallam University. The students had received training as to how this was to be carried out before the event. The students completed sheets to assess the level of audience engagement, audience size and makeup. These observations aim to give a "flavour" of how the shows<sup>1</sup> and other activities were received by pupils and of their popularity throughout the days.

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<sup>1</sup> A Show: Includes headline shows, Presentations and show floor demonstrations presented in a theatre style viewing format.

## 3.0 Data Analysis

Most of the data tables relevant to these results are included in the appendices. This also includes data on school regions and school neighbourhood deprivation index scores.

### 3.1 Pupils

#### 3.1.1 Primary pupil data – general attitudes to STEM subjects

Questionnaires were used at pre-event, at-event, and post event stages. For pre- and post-event questionnaires, schools were asked to provide a comparator sample from non-attendee pupils. Insufficient post-event non-attendee questionnaires were received to allow a post event comparison of the attendees and non-attendees. The first 14 questions looked at pupil attitudes to STEM subjects, including Art and Design, including attitudes to STEM in school and outside school. Some questions related to careers awareness. The same 14 questions were used in each of the three primary pupil questionnaires, to gain some insight into the immediate and medium term impact (6-8 weeks after the event) of attendance.

For the pre-event questionnaires, where there were both attendee and non-attendee respondents, a chi square test (indicating whether there is a significant difference in responses between two separate respondent groups) showed no significant differences between the test and comparator groups (see table 1 in Appendix 4a and Appendix 4b for comparisons of questions 18 and 19). This indicates that there was little evident preferential selection of pupils who had a predisposition towards STEM. Registration data indicates that whole class and year groups attended.

#### *Comparison of Q1-14, pre-, at- and post-event questionnaires*

The table shows the positive responses ('strongly agree', and 'agree') for Q1-14. For questions marked \* the 'strongly disagree' and disagree' figures are used, as these questions had a negative sense.

Question	Pre	At	Post	Shift Pre-At	Shift Pre-Post
1. Science lessons are among my favourite lessons	45.72	56.19	46.17	10.47	0.45
2. I like watching Science programmes on TV	51.39	54.78	54.47	3.39	3.08
3. I'm not sure what a scientist does*.	62.63	62.26	71.02	-0.37	8.39
4. I enjoy solving problems	65.87	65.63	59.95	-0.25	-5.92
5. I enjoy visiting Science and Technology museums	73.13	81.38	72.45	8.25	-0.68
6. Maths lessons are among my favourite lessons	53.85	49.52	44.90	-4.33	-8.95
7. I think Maths is difficult to do*.	57.18	56.25	64.34	-0.93	7.16
8. It is very useful to know about Maths	83.62	81.19	85.61	-2.43	1.99
9. Design and Technology lessons are among my favourite lessons	76.01	70.85	76.47	-5.16	0.46
10. I enjoy making things	90.92	90.24	91.52	-0.68	0.60
11. I enjoy doing Art and Design.	88.46	85.23	88.34	-3.23	-0.12
12. I'm not sure what an engineer does*.	51.62	51.34	65.21	-0.28	13.59
13. Engineering is important for our society	55.76	55.02	60.05	-0.74	4.29
14. It would be good to have a job as an engineer.	27.70	30.48	31.63	2.78	3.93

Some responses show a distinct rise 'at-event', (eg Q1 Science lessons are among my favourite lessons), which might indicate an effect of spending a whole day at The Big Bang, immersed in Science and Technology. However, there was no comparable rise for Mathematics (Q5), which might indicate the lack of Maths-based activities at the event for pupils in this age-phase. There is also a drop 'at event' for positive attitudes to Q9 (Design and Technology lessons are among my favourite lessons). One suggestion is that the exhibits and activities relating to Engineering actually linked more closely in pupils minds to school science rather than school D&T. Q5 (I enjoy visiting Science and Technology museums) showed a rise between pre- and at-event data which could indicate that the event itself was recognised as a 'visit' and pupils responded more positively whilst actually at the event than they did when they were sat in school 'imagining' or 'remembering' visits to Science and Technology venues. There was a small rise for Q14 (it would be good to have a job as an engineer).

Changes from pre- to post-event show some return to pre-event levels for items such as Q1, which might indicate that follow up work back in school was not carried out, so pupils did not think of their school science in terms of the types of experiences and contexts they had met at the event. This might indicate a fruitful area for case-studies to be carried out were funding to be available in future years, so that pupils could be interviewed to establish the causes of their attitudes to school subjects. Q5 also showed the same pattern, perhaps indicating the 'wearing off' of the enthusiasm generated on the day of the pupils' visit. Results for Q6 (Maths lessons are among my favourite lessons – negative pre- to post-event shift of -8.95), Q7 (I think Maths is difficult to do – positive shift pre- to post-event shift of +7.19) are somewhat paradoxical, as they show large moves in opposite directions. This might be a further indication of the lack of visibility of primary school level maths at the event. The most positive shifts were for Q3 (I'm not sure what a scientist does – positive shift pre- to post-event of +8.39) and Q12 (I'm not sure what an engineer does – positive shift pre- to post-event of +13.59)<sup>2</sup>. Given the aims of The Big Bang, these must be seen as highly positive outcomes.

### 3.1.2 Secondary pupil data - general attitudes to STEM subjects

The same pattern of pre-, at- and post-event questionnaires was used for secondary pupils. The first 19 questions looked at pupil attitudes to STEM subjects, including Art and Design, and also covering attitudes to STEM in school and outside school. Some questions related to future subject choices, and careers awareness. The same 19 questions were used in each of the three secondary pupil questionnaires, to gain some insight into the immediate and medium term impact (6-8 weeks after the event) of attendance.

In terms of the comparison between attendee and non-attendees (pre-event), the data indicates that significant differences between the two groups were found for nearly all questions (see table 2 in Appendix 4a). In general, the attitudes of attendees were more positive than non-attendees, and indicates that some selection of pupils to attend the event had taken place, for instance members of STEM Clubs. (Also, see section 3.2 below).

The table on the next page shows the positive responses ('strongly agree', and 'agree') for Q1-19. For questions marked \* the 'strongly disagree' and disagree' figures are used, as these questions had a negative sense.

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<sup>2</sup> These were 'negative sense' questions and data shown is for negative responses, which indicate a positive response in terms of intended outcomes for the event.

Question	Pre	At	Post	Shift Pre-At	Shift Pre-Post
1. Science lessons are among my favourite lessons	60.04	64.86	56.66	4.81	-3.38
2. When I have a choice after GCSE, I will choose at least one Science subject	60.93	63.98	61.17	3.05	0.24
3. I enjoy solving problems	65.94	68.52	59.55	2.58	-6.39
4. I like watching Science programmes on the TV	49.02	59.09	50.46	10.08	1.44
5. I enjoy visiting Science and Technology museums	63.25	69.71	61.81	6.46	-1.44
6. - It would be good to have a job as a scientist	42.87	48.65	44.61	5.78	1.74
7. Science has a positive influence on society	63.17	69.14	66.74	5.97	3.57
8. People who do not know much about science are at a disadvantage in today's society	48.63	51.29	52.36	2.66	3.73
9. Maths lessons are among my favourite lessons	40.40	46.06	38.24	5.66	-2.16
10. I think Maths is difficult to do*	56.56	51.58	51.39	-4.98	-5.17
11. When I have a choice after GCSE, I will choose Maths.	44.29	49.45	43.81	5.16	-0.48
12. It would be good to have a job where I need to use Maths.	46.44	50.12	41.92	3.68	-4.52
13. People who do not know much about Maths are at a disadvantage in today's society	56.97	55.23	55.19	-1.74	-1.78
14. I enjoy doing Art and Design	74.40	69.88	72.80	-4.52	-1.60
15. Design and Technology lessons are among my favourite lessons	68.89	64.88	64.47	-4.01	-4.42
16. I enjoy making things	84.28	79.75	79.18	-4.52	-5.10
17. When I have a choice after GCSE, I will choose a Design and Technology subject	40.83	44.31	39.94	3.49	-0.89
18. It would be good to have a job where I need to use my Design and Technology skills	53.80	52.81	53.31	-0.99	-0.49
19. People who do not know much about Design and Technology are at a disadvantage in today's society	22.95	28.89	23.08	5.94	0.13

Responses about science generally showed a rise in positive attitudes between pre- and at-event data, although this largely fell away by the time of the post-event questionnaire. This is a pattern that has been identified in other evaluations of event-based STEM interventions (eg Lab in a Lorry evaluation carried out by University of Durham in 2007-8). An at-event rise of 3.05, from a high baseline of 60.93, was shown for Q2 (When I have a choice after GCSE, I will choose at least one science subject), which is encouraging. Also, Q6 (It would be good to have a job as a scientist) showed a rise of 5.78 (from 42.87). By the time of the post-event questionnaire, some of this rise had been maintained (1.74, pre- to post- shift), which is also encouraging. There also seems to have been a positive effect on pupils' views about Science's influence on society (Q7), which showed an at-event rise of 5.97, which fell back a little in the post-event questionnaire to 3.57, but still a positive shift from the pre-event baseline. The

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Fig 3 - Secondary attendees



Fig. 4 - Secondary non-attendees



What is clear from all these word clouds, apart from the prevalence of the word "like", is that "fun", and "making" things are important to all four groups. The secondary pupils also used "interesting" a great deal. However, overall there seems to be a very little difference in the aspects of a subject which will make a pupil choose it as their favourite.

### 3.1.4 Pupil views about The Big Bang from the at-event questionnaire.

All Secondary pupils (Y7-Y11) expressed a high degree of satisfaction with the event; almost 90% of all Secondary pupils attending agreed with the statement that they **enjoyed The Big Bang**. This global figure however, shows a general fall off for each year group with a slight observed rise for older pupils in Y11. It is interesting to note that Y7 pupils show the highest levels of satisfaction with the event. No discernable difference was observed between boys' and girls' levels of satisfaction.

Again, when asked if the Secondary pupils would like to visit a similar event in the future over 80% indicated that they would with, once again, the Y7 pupils showing greatest enthusiasm. The experience of Secondary pupils visiting exhibit stands was generally rated highly although this was not as strongly expressed at the overall satisfaction rate for the day. Nevertheless, an 80% satisfaction rate with the exhibitor stands was recorded for Secondary pupils.

When asked if the experience had increased the pupils STEM understanding a high figure was recorded over all ~ 70% but this did show rather more ambivalence particularly among older pupils. Similarly, pupil understanding of careers was generally felt to have increased for most pupils (60-70%) but again this was an area in which an increased number of *don't knows* indicated a slightly more ambivalent message. Nevertheless, the event did have the salutary effect of encouraging over 60% of the Secondary pupils to see STEM careers in a more positive light with a similar level of importance accorded to qualifications in Mathematics. In all, 71.44% of secondary students indicated that the event had increased their understanding of careers in Engineering, with 73.80% indicating the same for science. Also, 58.92% of secondary pupils indicated that The Big Bang had made them more likely to choose a career that will need a STEM qualification.

The Secondary pupils were asked if The Big Bang related to their school work. This produced a more mixed picture. Although most pupils could relate the activity to their school work (~55%) this was an overall lower figure than for satisfaction in other areas tested with reasonable numbers showing ambivalence or a negative response.

In terms of influencing attitudes towards engineering **The Show** stood out as the most popular for respondents in all categories (overall - Primary pupils 18%, Secondary pupils 27%) as did the **Exhibition stands** (overall - Primary pupils 25%, Secondary pupils 22%). Similar levels of awareness were recorded with the Saturday visitors being representative of the whole sample suggesting that some 49% of visitors felt that these two activities influenced them most with regard to engineering. **Careers Quest** was consistently the least favoured part of The Fair with regard to the way it influenced the attitude of visitors. Nevertheless, those who took part in **Careers Quest** rated it highly with generally around 50% of respondents in each category rating it Good or better. Very few rated it as poor or worse.

Primary pupils showed particularly high levels of enjoyment in visiting The Big Bang. Hardly any difference was noted neither between Primary girls and boys (girls 98%; boys 94%), nor between school parties (94% and 98%) and self selecting visitors (98%). The vast majority (over 80%) of Primary pupils indicated that they would like to go to an event like this again.

With regard to the impression made about Science, **The Show** was rated most highly (overall - Primary pupils 22%, Secondary pupils 33%) as were the **exhibition stands**<sup>3</sup> (overall - Primary pupils 24%, Secondary pupils 18%). The **Industry Stands**<sup>4</sup> did not attract a high level of support from visitors in this regard (Secondary pupils only 8%) whilst **meeting real engineers** was rated highly by 1 in 6 or 7 visitors with similar levels of satisfaction from boys and girls at both Primary and Secondary level. Over three quarters of Primary pupils felt that they had learned something new about engineering at The Big Bang and that the majority of Primary pupils (~60%) had understood what they had learned in Engineering. Similarly, the figures for Primary pupils having learned Science were consistently between 85% and 94%. With regard to understanding the Science learned, the Primary girls (85%) came out more strongly than the Primary boys (76%) giving figures that reflected the high levels of understanding indicated by all the visiting groups.

When asked to express what was the highlight of The Big Bang, respondents indicated that **shows** in general (Primary pupils 10% Secondary pupils 12%). **Brainiac Live!** was particularly popular with Secondary pupils, with 17% rating it as the highlight of The Fair for them. **Bang Goes the Theory** was visited by more people but was not rated quite so highly by Secondary pupils (rated 5 by 57% of Primary pupils and 42% of Secondary pupils). The exhibition stands were highly rated by both groups, with 19% of Primary pupils and 8% of Secondary pupils stating that these were a highlight. Eleven per cent of Primary pupils enjoyed the hands on/interactive elements of the event, compared to 5% of Secondary pupils, while 9% of both groups said that the freebies were a highlight. Post 16 pupils were also enthusiastic about the Competition stands with 10% of this group saying that it was a highlight for them.

It is more difficult to assess the relative success of the workshops<sup>5</sup> and how they were rated. This is because pupils were not able to identify easily the workshops, for example when asked which workshop they attended, over 70% of Primary pupils identified an activity stand instead, and another 8% identified a show. **So you think you can build a jet engine?** was identified by 7% of pupils and **The secret life of robots** by 5%. However, results from a later question showed that a large number of

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<sup>3</sup> Exhibition stand: An interactive stand awarded a position on the show floor after review of the activity by the Activities Working Group. The activity has been provided a free space as it fits the zone allocations, educational outcomes and interactive experiences required by the Fair.

<sup>4</sup> Industry stand: An interactive stand provided by a business or organisation that has paid for its position on the show floor as part of a sponsorship position and has not been subject to the review of the Activities Working Group.

<sup>5</sup> A workshop: An interactive experience delivered in class room style format that has been awarded a session slot based on its educational outcomes and interactive elements after review by the Activities Working Group.

pupils thought that **The secret life of robots**, or **robots** more generally were the most interesting thing they had seen. As a result of the confusion over what constituted a workshop, these were rated by a very low number of pupils, these scores can be found in the appendix.

The same pattern is seen for the Secondary pupils, with a combined 34% either not being sure or stating that they did not attend, 27% identifying an activity and an additional 6% selecting a show. Eleven per cent stated that they had been to all the workshops, possibly confusing them with the activity stands. **The secret life of robots** and **So you think you can design a jet engine?** were each identified by just over 4% of Secondary pupils, **Through the looking glass... again and again** identified by 3% of pupils. Just eight post-16 pupils responded to this question, six of whom identified **Through the looking glass... again and again**. As a result, the workshops were only rated by a few pupils, the scores can be found in the appropriate appendix.

In terms of improving the event - **What could have made The Big Bang better** - the majority of Primary respondents (~35%) stated that there was nothing that could have improved the event. However, pupils also referred to there being a better eating area and better value food, as well as finding the event too busy, needing more time and wanting to attend more shows/workshops.

A number of the Secondary pupils (11%) also stated that there was nothing about the event that needed improving and 7% were not sure what to improve; but, in common with the Primary respondents, these pupils also felt that cheaper food/better eating area was important (5% of Secondary pupils overall, 20% of post-16 pupils). However, the Secondary pupils also commented that they would have liked more hands on/interactive activities (around 9%), more interesting and fun activities (5%), experiments and also more freebies (9.5% overall, this climbs to 17% for post-16 pupils); these proved to be very popular. Secondary pupils also noted that the venue was very busy (4%) and that they would have benefited from better signage or a map (6%).

The overall view of The Big Bang was that it was an enjoyable experience and that no major changes should be made except, perhaps more interactive activities and better free gifts. None of the workshops sessions were recorded as being attended by more than 5% of visitors (this is likely to be due to pupils being unable to recall the specific name of workshops) but, of these the most highly rated by visitors were; **The Secret Life of Robots**, **So you think you can design a jet engine?** and **Lab in a Lorry**. Overall, it is clear that those stands and activities that involved interaction scored well. These include: **Making things**, **Flight Simulator**, **Bang Goes the Theory** and **Brainiac Live!**. This was a common feature for both the Primary and the Secondary pupils.

### 3.1.5 Post event pupil views about The Big Bang

The Fair was enjoyed by the vast majority of participants. For the Primary pupils, 95% said they enjoyed this in equal numbers of boys and girls - although girls expressed their preference more strongly. At Secondary level enjoyment was also high with 87% of pupils saying they enjoyed it. Nine out of 10 of all pupils said they would like to attend The Big Bang in 2011.

Over 70% Primary pupils said that they felt that what they had learned at The Big Bang had helped them with their Science at school. For Secondary pupils this figure was much lower (55%) a view shared equally by both boys and girls. It was felt that the contribution of The Fair to learning in Mathematics was not as strong with only 22% of Secondary pupils agreeing with this. Of the Secondary group the boys (26%) were more strongly in favour than the girls (18%). At Primary level slightly more positive views were expressed in that 32% felt that the Fair had helped them with Mathematics equally spread between boys and girls.

An ambivalent response was received from the Secondary attendees with regard to how The Fair would have helped them with Design and Technology whilst for the Primary pupils over 50% felt it would have helped.

### 3.1.6 Pupils views on careers in Science and Engineering

Secondary pupils were asked if they would ever consider a career in Science in both pre-event and post-event questionnaires. The figures show a slight rise for each subject in terms of those who answered 'yes', which is encouraging.

	Pre-event	Post-event
Do you think you would ever consider a career in science?	60.37%	61.55%
Do you think you would ever consider a career in engineering?	34.70%	36.74%

These figures are much higher than the actual proportion of students studying these subjects at undergraduate level. HESA<sup>6</sup> data for 2008-09 shows a total 268,000 undergraduates across all subjects, of whom 26,800 are studying Engineering and Technology (10% of cohort), and 80,395 are studying Science and Maths (the figure for Science includes Mathematics, Computing, Medicine and allied subjects: this figure also includes 6526 students studying built environment courses including architecture), or 29.98% of the cohort. Whilst undergraduate numbers are not a true comparison for pupil intentions, as they include mature students, and many pupils who eventually follow STEM career route may not go to university, they do indicate that the numbers of pupils expressing positive views about careers in Science and Engineering are well above the current HE figures. Obviously, with the skewing of attendees from secondary towards those already positively disposed towards STEM subjects, one set of figures cannot be interpreted too broadly. A comparison with non-attendees views (problematic due to the small number of post-event returns), shows that attendee figures for those who might consider a career in Engineering or Science are roughly 10% higher than non attendees for Engineering, and 20% for Science. This leads us to suggest that a better comparison data set might be a national survey, carried out annually, which creates a 'background count' for young people's attitudes to STEM subjects. Positive responses from girls about Engineering careers (see Appendix 6, Q25 and Appendix 19, Q25) are much lower than for boys. Figures for science show less of a gender difference, with boys responses marginally more positive than girls (see Appendix 6, Q26 and Appendix 19, Q26)

## 3.2 Pre/post-event data comparisons

Chi square tests were carried out for Primary attendees, Secondary attendees and Secondary non-attendees pre/post-event on the attitudinal questions (Q1-14, plus 18 and 19 for Primary pupils, Q1-19 plus 23-26 for Secondary pupils), in order to assess whether there were any statistically significant differences in the responses given by pupils. This was not possible for Primary attendees due to the low post-event response rate. The full results for these can be found in Appendix 19. Alongside these, Appendices 23-25 also give a breakdown of responses across the questionnaires phases for these three pupil groups.

The following sections highlight those questions where statistically significant results were found.

### 3.2.1 Primary attendees

Just two questions - **Maths lessons are among my favourite lessons** and **I'm not sure what an engineer does** returned statistically significant results between pre- and post- questionnaire returns.

<sup>6</sup> HESA – Higher Education Statistics Agency  
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For the first question **Maths lessons are among my favourite lessons**, there was a rise from 18% to 23% and from 13% to 17% for the *strongly disagree/disagree* categories, and drop from 24% to 19% and from 30% to 26% in the *strongly agree/agree* categories respectively.

However, the results from question 12, **I'm not sure what an engineer does**, gives a more encouraging picture. In this case there has been a rise in the *strongly disagree* category from 31% to 37% and in the *disagree* category of 21% to 29%, indicating that the pupils were more sure of what an engineer might do after attending The Big Bang than they were before.

### 3.2.2 Secondary attendees

Statistically significant differences were found when comparing pre- and post-event responses to 10 questions (3, 7, 8, 10, 12, 15, 16, 18, 19 and 24). None of the results display particularly dramatic changes of attitude between the pre and post-event questionnaires, more likely these significant results are due to the combination of the shifts that can be seen. The results are a mix of positive and negative shifts.

For example question 3, **I enjoy solving problems**, shows a 3% rise in the not sure category, alongside a 6% drop in the *agree* category, while question 7, **Science has a positive influence on society** again shows a drop in the *not sure* category, and a rise of 4% in the *strongly agree* category.

Similar results are seen for question 10, **I think Maths is difficult to do**, question 15, **Design and Technology lessons are among my favourite lessons**, question 18, **It would be good to have a job where I need to use my Design and Technology skills**, question 19, **People who do not know much about Design and Technology are at a disadvantage in today's society**. All of these questions show overall shifts but the differences, while statistically significant, are not overwhelming.

Questions 12, **It would be good to have a job where I need to use Maths** and 16, **I enjoy making things** show changes of 5% or more in one or more categories. For question 12 this is in the *agree* category, and in question 16 in the *strongly agree* category which shows a drop of 7%.

### 3.2.3 Secondary non-attendees

As might be expected, as they have not been subject to any kind of STEM intervention, the chi square tests for the non-attendee Secondary school pupils showed fewer significant results than those for the attendees of The Big Bang. Just two questions returned statistically significant results; question 4, **I like to watch Science programmes on the TV** and question 9 **Maths lessons are among my favourite lessons**. For question 4 this result is due to a drop of 9% across the *strongly disagree/disagree* options, and a rise of 10% in the *not sure* category.

For question 9, **Maths lessons are among my favourite lessons** this is again due to a swing in the *disagree* category, with it jumping from 24% to 34% of pupils in the post-event survey. The *strongly agree* category dropped from 10% to 5%.

### 3.2.4 Conclusions

With the possible exception of question 12 for the Primary attendees - **I'm not sure what an engineer does** - it is difficult to attribute any of these changes to attending or not attending The Big Bang. There are many influences on young people, it is not possible to isolate the effect of The Big Bang from all the other influences, and in fact, evaluations that attempt to identify a single intervention as the cause of

any attitudinal change fail in terms of internal validity as it is impossible to establish causal relationships between intervention and observed effect with any certainty.

Indeed, while some comparisons have produced a significant change, these have not always been leaning towards the positive, which would have been the hoped for outcome. Attitudes, particularly in children, are nebulous and may have been impacted upon as a result of a plethora of experiences. In addition, questionnaires are a somewhat blunt and simplistic tool when it comes to assessing an issue as complex as that of attitudes.

### 3.2.5 Pupil selection for event

Clearly the difference between the selection of primary and secondary groups is of note with regard to gauging the effectiveness of attendance at the event. For Primary pupils, Science, and Design and Technology is usually taught within the broader sweep of the curriculum by a single class teacher. In general, primary teachers do not have specialist STEM knowledge and skills - and can lack confidence in these areas - and so the pupils are not generally exposed to specialist STEM teaching. For secondary schools, the reverse is the case. Specialist teaching does take place through which it is possible for teachers to identify those pupils who may have an aptitude for or interest in STEM. The data would suggest that it is this group of pupils that has – in some cases – been selected by the secondary schools to attend the event whilst, for primaries, no similar differentiation takes place. This means that, although secondary pupil visitors to the event may be more highly motivated than one would expect if the sample were truly randomised, some element of preaching to the converted will take place.

The above findings would suggest that differentiation acts to suppress measures of overall effectiveness of the event [pre-test v post-test] by providing an overall lower change when compared with the higher change observed by undifferentiated groups.

## 3.3 Teachers

### 3.3.1 Registration Questions

While teachers thought that Science and Engineering were good career choices, they seemed unsure when asked if they were aware of the material and activities available concerning STEM, with 30% of teachers selecting the *not sure* option for the question **I am aware of the range of materials and activities available to support and inform young people about careers in Science and Engineering.**

Teachers in general seemed divided when asked whether they felt unsure about talking to children about STEM careers, with over 30% agreeing with the statement, 27% being unsure and just over 40% *disagreeing/strongly disagreeing*. However, for careers professionals this picture changes, with 65% of these focussing on STEM subject choice and careers. Fewer than 30% of teachers used a planned programme of STEM enhancement and enrichment activities. However, 84% of teachers either *agreed/strongly agreed* that events such as The Big Bang have a positive impact on young people's perception of STEM.

See Appendix 1 for graphical representations of these data.

### 3.3.2 At-event data - Primary teachers

Nineteen Primary school teachers from 12 schools filled out an at-event questionnaire, five of these schools attended on the Thursday, the rest on the Friday. The average time taken to get to The Big Bang for Primary schools was 1 hour and 10 minutes.

#### *Pupil selection*

Reasons for choosing a particular selection method included a desire to be fair to all pupils, and providing them with as many experiences as possible (whole class/year), provision of activities for G&T students or for those seen to be interested in Science, or meeting broader curriculum aims such as developing approaches to independent learning and thinking, or promoting a creative curriculum. Some more pragmatic responses were received, which indicated that bringing parts of classes (as opposed to a whole class) would cause problems back in school.

#### *Workshops and shows*

60% of respondents indicated that there were workshops, activities or presentations that they wanted their pupils to participate in, but which they were unable to get into, these included the under 11s activities, and the flight simulator. Several commented on the fact that all the activities seemed to be booked up very quickly. One teacher commented:

*If we had been given a clear list of the actual activities we probably would have been far more selective. The pupils enjoyed everything but didn't necessarily access the parts which were most relevant to them.*

However, almost all teachers knew that it was possible to book activities, workshops and/or presentations in advance of the event taking place.

#### *Information sent out before The Big Bang*

Reasons the information was useful included the clear nature of the information and the insight it gave into the venue and event overall. However, some respondents suggested that the information was late arriving, and that there could have been more specific details about the content of the workshops and activities, which would have been useful.

Opinion was split on the usefulness of the emails sent out, with over 27% suggesting they were unhelpful, against 32% suggesting they were helpful. One teacher reported that it was impossible to book some workshops just hours after receiving an email. Others indicated that only the recipient of the email saw its contents, a problem if several teachers were attending. One teacher noted some confusion about the timing of the **Brainiac Live!** show, indicated as 1.30 in an email but confirmed as 2.00 in a telephone message, resulting in 38 pupils missing that show. Over 70% of teachers stated that they did not know they could sign up for email updates.

#### *Enjoyment of event*

In terms of enjoyment of the event, there was a 100% positive response, with over 57% suggesting they strongly agreed with the statement: **I enjoyed the visit to The Big Bang**, with over 42% agreeing.

In addition, a large majority of teachers saying the event exceeded their expectations, with over 52% saying they strongly agreed with the statement. However, over 73% of teachers agreed that they couldn't take part in the activities they wanted. This reflects comments made earlier about not being able to book activities, or not receiving enough information about what was on offer.

Teachers were also asked what they liked about The Big Bang. This gave rise to a range of positive responses, including:

- Positive interactions with staff and exhibitors
- Hands on activities, particularly the range on offer
- How pupils were kept engaged throughout the day
- The variety of what was on offer
- Good presentations and shows.

#### *Age appropriateness*

Primary teachers generally felt that the activities worked well for Primary schools. This seems to be an improvement on the 2009 event, with 78% agreeing/strongly agreeing. This does however, contradict some of the comments given by teachers and also it should be noted that some Primary pupils suggested that there should have been more available for their age group.

#### *Using The Big Bang experience in Schools*

A majority of teachers (>63%) indicated that they would incorporate experiences from The Big Bang in future lessons (Q21), whilst just under 32% were unsure. This is encouraging, as good practice in making use of external resources such as The Big Bang (or visits in general) involves carrying out follow-up work back in school. The number of teachers choosing *not sure* might suggest that further, activity-specific guidance is produced (although we accept that many providers do give schools follow-up materials), for distribution at the event or via the web site post-event.

#### *Logistics at the event*

Logistical issues received generally positive feedback from these teachers, reflecting effective management of throughput (particularly at the start and end of days) and good signposting/layout. The venue itself was easy to find.

#### *Improving The Big Bang*

A range of suggestions were made regarding how The Big Bang could be improved in the future, including more activities for Primary pupils.

### **3.3.3 At-event data - Secondary/post-16 teachers**

Ninety teachers from 45 Secondary/post-16 schools filled out at-event questionnaires, along with one scout master. Secondary schools took slightly longer to get to the event than Primary schools, an average of 1 hour and 15 minutes.

#### *Pupil selection*

The proportion of teachers using some sort of selection method (compared to Primary), and pupils' existing positive attitudes to Science (e.g. membership of a STEM Club, participation in CREST Awards) means that the pupils responses should be considered carefully. In the main, Secondary and post-16 attendees were already positive about Science (or STEM subjects).

Reasons for using particular selection methods included using the visit as an incentive to greater efforts in class, to inspire pupils to 'aim higher', to promote particular subject options at age 14 (e.g. Triple Science), to expand careers awareness, and to focus the effort on those pupils perceived by teachers to potentially benefit the most. Motivation and inspiration were key factors. Teachers wanted to inspire pupils towards considering careers in Science and Engineering. There were several teachers who mentioned their aim to inspire girls in particular. The event was also used as a reward e.g. for being well behaved, for coming in the top ten in a year group, and for showing a keen interest in Science and Engineering.

For those schools that brought whole classes or year groups, 'fairness' was a recurring theme. Pragmatic reasons for choosing whole classes were also cited, including avoiding the problem of having to provide cover for those pupils in a class that did not attend the event.

Almost 80% of teachers downloaded careers activity materials from The Big Bang web site prior to the event. The main reason teachers cited for not accessing the resources was the lack of time, including time to fit the activities into class activities. Lack of awareness was also a factor, which might indicate that more promotion of The Big Bang web resources is needed.

When asked about how the materials could be improved, respondents generally seemed satisfied with what was on offer, although there was a suggestion that materials could be sent directly to schools.

#### *Workshops and shows*

Around half of teachers (49%) suggested that there were activities in which they wanted their pupils to participate, but were unable to get into. Some teachers stated that the information provided could give fuller explanations of what specific activities involved, and to the difficulty in booking some activities, even within a day of the information being sent out.

Difficulties created by a change of timing for the **Alphabeat** show was also cited, and the popularity of **Brainiac Live!** meant many pupils could not attend the show. There was again comment that workshops filled up very quickly. Around 50% of respondents indicated that they knew it was possible to book places for activities, workshops and presentations in advance, but that still leaves half claiming not to have known.

**Brainiac Live!** was given as the show that teachers most wished they had been able to attend, followed by workshops more generally, and **CSI Manchester**.

#### *Information sent out before The Big Bang*

Secondary teachers generally thought that the information posted out to schools ahead of the event was helpful. The material was seen to be well written and easy to understand and contained relevant information useful for planning the visit. It was described as useful and clear, and containing good tips and guidance. The majority of negative comments came from staff that had not seen the materials that had been sent out to schools. There were several comments criticising the quality of information about how to get to the venue, which appears to contradict comments made by Primary teachers.

In addition to printed materials, emails containing useful information were also sent out. This was seen as marginally more useful than the printed materials. The few negative comments referred to the teacher not receiving the emails, or to the website (*not very helpful*). Over half (55%) of teachers were aware that they could sign up for updates/news about The Big Bang.

### *Enjoyment of event*

All teachers questioned agreed with the statement **I enjoyed The Big Bang**, with over 44% agreeing strongly. Whilst the sample was self selecting (i.e. they chose to complete the questionnaire), this is still a remarkable outcome. Around 80% indicated that the event had exceeded their expectations.

In addition, almost 97% of teachers said they were glad they came to The Big Bang, and over 84% of teachers said they are likely to attend a future event. These positive scores could be used in future marketing strategies.

Comments on future attendance included:

*Teacher benefits:* acquisition of new teaching resources, updating of subject knowledge, making new contacts for use in the future

*Pupil enjoyment:* increased motivation, and excitement about Science and Engineering, increased engagement, increased awareness and understanding of Science and Engineering careers,

*Logistics:* the geography of alternating North and South (if that is the future plan) may result in biennial attendance by schools.

### *Age appropriateness*

Almost all teachers (>95%) indicated that the activities were appropriate for the age of the pupils they took along. This is an improvement on 2009 when the mismatch between activities and the ages of pupils was noted, and should also be considered in the light of some of the comments made by Primary teachers/pupils.

### *STEM careers and The Big Bang in the classroom*

Secondary teachers placed a high priority on raising pupils' awareness of STEM careers, citing it as an important factor in their decision to attend The Big Bang. Specific careers-focussed elements of The Fair were available, as well as industry stands, and the expert guides as role models. Pupils saw real people who were STEM professionals, and engaged in activities and shows that highlighted the careers dimension. However, Q5 indicated that less than 23% of teachers had downloaded the careers activity materials from The Big Bang web site, and so the degree to which the messages from the event translated into classroom activity might be low. If teachers have not 'pulled' the resources down, then it might increase awareness and use of the careers materials if some of them were 'pushed' at the teachers through direct emailing, with embedded links to the resources. However, over 80% of teachers said they would incorporate experiences from The Big Bang in their lessons

### *Logistics*

The logistics of the day received a largely positive response from Secondary teachers. However there were sizeable minorities who thought the event was too busy, or that the event was difficult to find your way around. This was also noted by some secondary pupils. Differences in views about logistics should perhaps been seen in the light of the different journeys made by schools in getting to the event, and of the different group sizes/pupils.

### *Competitors at The Big Bang*

The competition entrants in 2010 were integrated into the main exhibition space, and were therefore highly visible to visitors. As a result, teachers and pupils were able to see, and perhaps talk to, other

pupils who were exhibiting their competition entry. This might explain the high proportion of teachers who, when asked, agreed that they would like to see pupils from their school/college entering one of the competitions.

### *Improving The Big Bang*

Secondary teachers commented that it would be good to have more show availability, better and cheaper food, better directions and traffic management at the event and better layout and signage. Full comments can be found in the appropriate appendix

### **3.3.4 Post-event data - Primary teachers**

Twelve teachers responded to this questionnaire, from seven schools.

#### *The Big Bang in the classroom*

The majority of Primary school teachers (73%) agreed/strongly disagreed with the statement **I cannot see how The Big Bang related to my teaching**, with a third of teachers overall having included learning from The Fair into the classroom already; those who had not stated that either the topics would not have fitted into planned work, or that it was not relevant at Primary level. However, 75% of respondents stated that they intended to include learning from The Big Bang into their lessons in the future. Comments concerning how it might be easier to include such learning in lessons included providing resources, such as teacher packs and lesson plans and making content more relevant for Primary level pupils.

All the respondents thought that events like The Big Bang are useful and worthwhile, with over 90% of teachers saying that they would recommend the event to colleagues.

#### *STEM activities/providers*

None of the respondents had used the listed of Science, Technology, Engineering and Maths enrichment and enhancement activities/activity providers several times year. Just three had been used once a year - STEMNET/STEM Ambassadors, STEM Directories, Science Learning Centres, The British Science Association (one teacher for each) and the Museum of Science & Industry (two teachers).

Seventy three per cent of teachers stated that their school would be more likely to use Science, Technology, Engineering and Maths enrichment and enhancement events as a result of The Big Bang. A few teachers expanded on this with comments, stating that they were now more aware of what was available, and that they had been interested to see how much the pupils had enjoyed the event. However, again the issue of suitability of events and resources for Primary children was raised.

#### *Future attendance at The Big Bang*

The Primary teachers were positive about future attendance; with 82% disagreeing with the statement **I don't think my school/college should attend The Big Bang 2011**. Forty per cent of teachers thought that they would bring more pupils, with 60% stating that they would bring about the same number.

Over half of respondents (55%) thought that The Big Bang should run for more than the three days. Other suggestions of how to improve the event included more activities and events suited to the younger age groups and more maps and further information about The Fair prior to the visit.

There was not a good awareness of The Big Bang Regional Fairs, with 82% of teachers not knowing that there were any. Responses were mixed when teachers were asked whether they were likely to attend the regional event; 43% thought it was likely that their school would attend, with the remaining teachers split evenly between not being sure and thinking it was unlikely.

### 3.3.5 Post-event data - Secondary teachers

Twenty three teachers responded to this questionnaire, from 13 schools.

#### *The Big Bang in the classroom*

The majority of teachers (>60%) had not incorporated any learning from The Big Bang into their lessons as yet, but nearly 90% of respondents said that they would like to in the future. Reasons given for not yet having done this included a lack of time and relevance in the current scheme of work.

A number of teachers gave some ideas of how the organisers/exhibitors might have helped them with using The Big Bang learning in lessons; these included the production of free resources, lesson plans and project ideas, as well as highlighting links to the curriculum. Two thirds of teachers *strongly disagreed/disagreed* with the statement **I cannot see how The Big Bang related to my teaching.**

In addition, over 65% of teachers stated that they would be more likely to use STEM enrichment and enhancement events as a result of The Big Bang; teachers felt inspired and enthused by the range of ideas displayed at the event. This is further backed up by the response to questions Q35 and Q36, with 95% of teachers agreeing with the statements **I think events like The Big Bang are useful and worthwhile** and **I will recommend The Big Bang to other colleagues.**

#### *Careers*

Over 90% of teachers had not downloaded careers materials from The Big Bang website; reasons given included not knowing that this was available to them, a lack of time and a lack of relevance to their subject area/pupils (i.e. year 8 pupils).

#### *STEM activities/providers*

From the list of Science, Technology, Engineering and Maths enrichment and enhancement activities/activity providers given on the questionnaire, just seven (STEMNET/STEM Ambassadors, STEM Directories, STEM Clubs Network, Science Learning Centres, the British Science Association, the Museum of Science and Industry (MOSI), Catalyst) had been used by more than one teachers several times a year. The most used provider were the Science Learning Centres.

One or more respondents stated that they had *Never heard* of all of the listed activities/providers. However, the numbers of teachers giving this response was notably high for the Arkwright Scholarships, Industrial Trust, Engineering Development Trust and the Smallpiece Trust.

#### *Future attendance at The Big Bang*

The Secondary teachers were positive about future attendance; with 83% disagreeing with the statement **I don't think my school/college should attend The Big Bang 2011.** However, they seemed ambivalent about whether they wanted their pupils to be competitors. Thirty per cent of teachers thought that they would bring more pupils, with 65% stating that they would bring about the

same number; due to how manageable the number was, bringing a whole year group, or being a small school.

The majority of respondents (57%) thought that The Big Bang should run for more than the three days. Other suggestions of how to improve the event included over crowding, more hands on activities and the swift booking up of the shows and workshops.

There was not a good awareness of The Big Bang Regional Fairs, with 57% of teachers not knowing that these were taking place. Responses were mixed when teachers were asked whether they were likely to attend the regional event; 37% thought it was unlikely, 21% were unsure and 42% thought it was likely that their school would attend.

### 3.4 Parents

#### 3.4.1 Registration data

While parents thought that Science and Engineering were good career choices, they seemed unsure when asked if they were aware of the material and activities available concerning STEM, with 35% of parents answering *not sure* to the question **I am aware of the range of materials and activities available to support and inform young people about careers in Science and Engineering**. Just 30% of parents *agreed/strongly agreed* with this statement. While parents did feel reasonably confident about talking to their children about general career choices, this drops when it comes to careers in Science and Engineering.

See Appendix 1 for graphical representations of these data.

#### 3.4.2 At-event data - Parents

Although the majority of visitors to the event were children who attended in school groups a number of parents brought their children on Saturday. Of these, 76 parents completed at-event questionnaire forms. This group formed a useful counterpoint to the school groups in that they were generally highly motivated individuals whose ratings of the event and of other aspects of STEM activity was higher than that of those coming as school groups. It is interesting to note that, of the parents attending, the majority (40%) did so because they felt that their children should attend rather than simply to have a good day out. To some extent they were driven by the view that this would be beneficial for their children's education, in this respect it is interesting to note that 40% of parent respondents had a Science/Engineering/Mathematics or Technology related degree. The enthusiasm for the event was despite parents expressing some ambivalence towards the helpfulness of the printed materials (32% *unhelpful*; 24% *not sure*; 44% *helpful*). Although negative responses generally referred to the printed material not arriving since, when it was present, parents generally expressed high levels of satisfaction with its format and contents. A general need for greater clarity in outlining practical issues such as parking would have helped.

The average time travelled was just over 70 minutes, with some people travelling for 3 hours to reach the event

Communication by email was felt to be useful (41%) by those who had received it but difficulties were expressed by filters blocking the "Big Bang" phrase. Email also provided a useful channel to sort out booking difficulties. Most parents (99%) did not know any of the competitors but came along and enjoyed the event which they regarded as friendly and informative with lots of things to do. the shows were a particular favourite.

A number of future improvements were suggested: catering was criticised as being unhealthy and of poor quality. It was also felt that the event should have opened for longer and over more days. Clearer information about admissions should have been given to prevent people from waiting around. It was also felt that more Mathematics projects could have been included, as well as more hands-on activity. However, the vast majority enjoyed The Fair (99%) and over 80% indicated that it had exceeded their expectations. Although many parents (64%) said they could not take part in everything they wanted to, they did believe (89%) that the activities were appropriate for their children. Nearly all (98%) were glad they came to The Fair.

Organisation of The Big Bang was thought to be good. Over 75% of people found their way around easily and a similar number found it easy to register at the desk. The Fair as a whole was felt not to be too busy (72%) and the venue was easy to find (95%).

Parents themselves learned from The Fair (60%) and nearly all the children (99%) enjoyed their visit. Although over 80% of parents said they would like to attend The Big Bang in future over 75% were unaware of The Big Bang Regional Fairs to be held in the summer.

See the appropriate appendix for descriptive statistics of the parent questionnaires and additional comments made.

### 3.5 Zone activities

The various industry stands were split into four zones - Body Talk, The Next Factor, Go Global and Power Up?. In order to assess the relative success of the various stands, the observational data collected at the event has been analysed graphically in Appendices 14a-14e. However, the data has also been categorised, with each activity stand being given a score out of five for busyness, engagement and interest. This gives three marks per day for each of the three criteria, and then three days worth of marks, making a total possible score for each activity of 45. This data is summarised in Appendix 14, along with further detail of this process.

Overall, the stand run by the **Manufacturing Institute** and the **Welding with Chocolate stand** were the highest scored, both obtaining 38 points from the possible 45. These were both very “hands on” activities. The **Intel stand**, the **National Academies Exhibition** and the **Flight Simulator** all scored 37 points. The final five activities in the top 10 are the **General Microbiology Society**, **ICE Bridge Construction Game**, **ILE**, the **Science Museum** and **Siemens**.

In the Body Talk section of the activity stands, **General Microbiology Society** comes out as the most successful stand, followed by **AstraZeneca** and **Exploring the Human Body**. For Go Global, the **Manufacturing Institute** was the highest rated event, followed by **Welding with Chocolate**, and the **National Academies Exhibition**. For Power Up? the **Flight Simulator** was scored the most highly, followed by **ILE**, **The Smallpiece Trust** and **E.ON**. Finally, in The Next Factor zone, the **Intel stand** was rated the most highly, closely followed by **Google**. **SEMTA**, **Researchers in Residence**, **Design Mark** and **Particle Accelerators** all drew in terms of overall points.

Using the pupil responses from the at-event data it is difficult to assess which activities the children liked the best, often because the activities that they highlighted are not easily linked to the particular companies/stand sponsors. This is particularly true of the activities where pupils were able to engage in hands on activities, such as making slime and glasses.

In addition, some of the more popular attractions such as the **Flight Simulator**, might not come out so well compared with some other activities using either observations or scoring, simply because of the nature of the activity. The **Flight Simulator** came first in its zone, but fifth overall. For example, not many children could participate at any one time, therefore the observations/score will show that interaction levels were not as good as for other stands, for example **Welding with Chocolate**, which meant that a larger number of could be interested in the activity at any one time.

The NWDA Zone was sampled less frequently. One score for the full three days (out of 15) was calculated, again, for busyness, engagement and interest (5 each). Highest scores went to **Primary Engineer** (13, although this was from observations carried out only on Saturday), **LUMARI** (12.73), **Catalyst Science** (12.51), **NW Aerospace Alliance** (12.12) and **Nowgen** (12.00). Full scores, including the breakdown against the three criteria, are found in Appendix 14d.

### 3.6 Workshops and Shows

Observational data was also collected on the Shows and Workshops. These received fewer observer visits than the zones, and as some of these events happened only once, there were insufficient observations of some of them to include them in the analysis. Observers scored the events for busyness, engagement and interest, and average scores for each (out of 5) were used to create an overall score out of 15. It must also be emphasised that the nature of some of the events involved periods where the pupils were merely watching a performance, and so observations occurring during these parts of the show or workshop would score low marks for engagement. Hence the overall marks for some events might appear low. Perhaps a better indicator of success is the Interest measure. In our view, an alternative method for observing/evaluating such events needs to be developed for use at The Big Bang in future.

Overall, the highest total scores were for **Accelerate**, and **BP** which both achieved a maximum mark of 15. These were followed **Brainiac Live!** (14.70), **Build your own jet engine** (13.57), and **Hydraulics for frolics** (13.34). For **interest**, the top 5 were **Accelerate**, **BP**, **Brainiac Live!**, **Power to the people** (each scoring 5) and **Journey of a fuel rod** (4.83). All scores, including **busyness** and **engagement** are given in appendix 15.

### 3.7 Analysis of The Big Bang using the STEM escalator rating

The STEM escalator rating is a measure of how much STEM enrichment and enhancement activity a particular school has taken part in. Not all STEM enrichment and enhancement activities are recorded in the STEMNET database, which creates the escalator rating, however enough information is stored to give an accurate picture on the level of engagement for individual schools. The higher the STEM escalator number the more STEM enrichment and enhancement activities a school has taken part in.

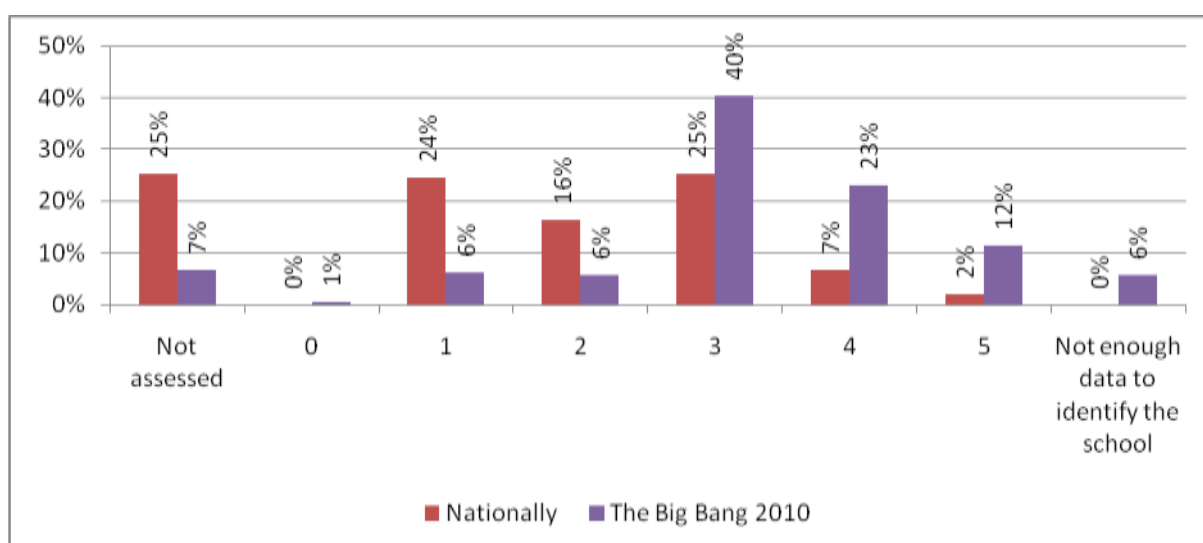
#### 3.7.1 Schools booked for The Big Bang 2010 versus all schools in the STEM escalator database

The booking system for The Big Bang 2010 recorded, in all instances the name of the organisation that was booking children in to attend the fair on the Thursday or Friday. In most instances, this was the school attended by the children; however, there were some non-school organisations, e.g. local councils, who also booked places. As well as providing their organisation name, all organisations who booked a place were also asked to provide their full address. Eleven schools provided a name and address that did not match any of the data in the STEM escalator database; as a result, the escalator rating for that school could not be identified.

Nationally, 7,396 schools have not yet been assessed for an escalator rating, although the vast majority of these schools are primary schools.

Figure 1 shows the proportion of all schools that attended The Big Bang 2010 by their escalator rating. This clearly shows that The Big Bang engaged a disproportionately larger number of schools at stages 3, 4 and 5 (highly engaged with enrichment and enhancement) with 75% of attending schools at stage 3, 4 or 5. Compared to nationally where the combined escalator proportion is 34%. Conversely The Big Bang engaged a disproportionately low percentage, 12% of schools at stages 1 and 2 and (those who aren't heavily engaged in STEM enrichment and enhancement activities) compared to nationally where the combined proportion is 30%.

**Figure 1 Proportion of schools at each stage of the STEM escalator rating**



Base (nationally – 29,381 and The Big Bang 2010 – 191)

### 3.8 The Big Bang Attendees and the Deprivation Index

The Index of Multiple Deprivation combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England. This allows each area to be ranked relative to one another according to their level of deprivation. Using the addresses supplied by the schools at registration it was possible to find the deprivation index for the area in which each establishment is situated. Those with a score of one are considered to be in the most deprived neighbourhoods, those with a score of 20 in the least deprived.

These scores show that a third of the schools who attended The Big Bang fall into the more deprived categories (1-5), with an additional 24% of schools on the 6-10 category. Eighteen per cent of schools are in areas that fall into the 16-20 deprivation index categories, the least deprived neighbourhoods. The data for this can be found in Appendix 3.

## 4.0 Comparison with 2009 event

The methodology for 2009 had significant differences to that used in 2010, and so only a proportion of the 2010 data can be compared to 2009. For instance, there was a qualitative element, which gave rise to a series of school case studies based on school visits by the evaluation team in 2009 that was not part of the 2010 evaluation. Also, in 2009, there was no pre-event data, and at-event data was only collected from teachers. No parent data was collected in 2009. There were also significant differences in the questionnaires across the two years, including a common questionnaire for teachers, whether primary or secondary, in 2009. This means direct comparisons are limited. Primary schools were much better represented in 2010, with over 20% of schools coming from this phase, compared to around 6% in 2009.

The number of visitors to The Big Bang 2010 was much higher than the 2009 event (23,500 in 2010 compared to 6300 in 2009). The layout of the event in 2010, where the majority of people at any one time were within the same space, led to an increased 'buzz', compared to 2009, where there was no single space that could accommodate the majority of visitors. There was a higher representation from schools in the lowest deprivation quartile than in 2009 (33% in 2010 compared to 25% in 2009). There was increased representation from schools from the host region (62% of attendees from the NW) compared to 2009, which was held in London. At this event 32% of schools were from the London region, with a further 26% from the South East. Average journey time in 2010 was around 70 minutes, compared to 2 hours and 5 minutes in 2009.

### 4.1 Teacher questionnaires

This comparison uses secondary and post-16 teacher data in 2010 as a comparison with the 2009 teacher data as there were only around 6% of schools from the primary sector in 2009, making comparisons of primary teacher views across the two years problematic.

There was a higher level of teacher enjoyment of the event (100% with positive responses) in 2010 compared to 2009 (94%). Although there was no comparable question regarding age-appropriateness of the event in 2009, this issue did arise in some teacher comments. In 2010 95% of secondary teachers and 78% of primary teachers thought there was a good match with the needs of their pupils' age groups. The evaluation team suggest that in 2010 there was a better match between the activities on offer, and the age ranges of the pupils. In 2010 there were over twice as many teachers reporting that they brought whole class or year groups than in 2009 (29% in 2010, 12% in 2009). In 2009 88% of teachers said they would want to attend the 2010 event. In 2010, 84% expressed this view, however, some written responses indicated an awareness that the 2011 event would be in London, which might have resulted in some teachers realising that the journey might be impractical, and therefore responded negatively to the question. Broadly similar results were achieved for questions relating to the value of events such as The Big Bang, and their use (eg as a source of ideas for lessons).

### 4.2 Pupil questionnaires

There was no differentiation in the 2009 questionnaire as to which age phase pupils were from. Due to the small proportion of attendees from the primary phase in 2009, the following short comparison makes use of the secondary and post-16 data from 2010 post-event questionnaire. Other than the questions relating to attitudes to STEM subjects (q1-20 in both years), there were few other common or comparable items. The overall change in attitudes between the pre- and post event secondary and post 16 student questionnaires in 2010 was not statistically significant, and matches findings from other studies of the longer-term impact of 'events'. The more positive response to STEM subjects shown by

the attendees compared to the non-attendees was at least maintained across the time period of the evaluation (January to May 2010). As young people's attitudes to STEM subjects tends to decline across the secondary age range, this 'retention of interest' should be seen a positive achievement. However, no comparison with 2009 is possible due to the lack of a pre-event study in that year. In 2009 around 86% of pupils indicated that they enjoyed the event, and around 90% in 2010. Given the high score in 2009, this would have been a difficult figure to improve upon, and so exceeding it must be seen as highly positive. In 2009 just over 71% of pupils indicated that they would like to visit such events again. This was exceeded 2010, with a figure of over 80%. 'Repeat business' is one of the indicators of a quality product, and the rise from 2009 points towards higher quality of pupil experience in 2010. Questions in 2009 relating to the self-reported impact of the event on matters such as careers awareness and overall view of STEM subjects were not repeated in 2010. However in 2010 around 70% of pupils suggested that the event had increased their understanding of STEM subjects, compared to 65% in 2009 who indicated that the event would help them with their study of STEM subjects.

## 5.0 Recommendations

The event was well received by the vast majority of participants and the overall structure of the event 'works'. Changes to the design and running of the 2010 event following the review (including evaluation) of the 2009 event, and the scaling up of delivery capability, all contributed to the improved nature of this year's event. What follows are recommendations based on the 2010 evaluation, and in the main represent fine tuning of what has become an effective enterprise.

### 5.1 The Event

- The eating area, and the price and quality of food on offer was criticised by a number of respondents (teachers and pupils). This is a difficult thing to get right, particular with different venues being used each year. However, we recommend that some effort is made to address this issue for the 2011 event.
- The number of opportunities for interacting with people and materials/computers etc was highly rated. However, scores were generally higher with older pupils, perhaps indicating that there was less for Primary pupils to effectively engage with. We recommend that a higher proportion of the exhibition stands and other offerings are focussed on Primary pupils, which may require some negotiation with exhibitors.
- Some teachers suggested that the pre-event information regarding the content of the workshops etc was not sufficient for them to make an informed choice. We recommend that this aspect of the emailing or hard copy materials sent out to schools is made more comprehensive, so that better choices can be made by teachers prior to the event.
- The amount of follow-up work back in schools reported by teachers was not considerable. Whilst some exhibitors and activity providers do provide take-away ideas for teachers to use back in school, we recommend that the need for such materials is highlighted more with potential exhibitors and workshop providers. A follow-up suggestion is that EngineeringUK (or through a third party supplier) produce a sponsored Follow-up Pack, funded perhaps by small donations from organisations wishing to be represented in the pack. The contents would be lesson plans and other activities (e.g. for STEM Clubs) based on the business of the sponsoring organisations. A Primary and a Secondary pack could be produced.
- The integration of the competitors into the main exhibition space was a vast improvement on the 2009 event.
- There were comments about the much lower proportion of Mathematics-based activities on offer. The centrality of Mathematics to any advanced study of almost all STEM subjects suggests that an important link is not being made here. We recommend that Mathematics, and the various Mathematics organisations, are brought more into the planning and execution of the event.
- The footfall in the North West RDA zone was significantly lower than in the four main zones. There were highly rated exhibition stands in the regional space that might have benefited from greater exposure. We recommend that any regional displays, stands etc. are integrated into the main area of the exhibition at future events.

- There was a lower than expected level of awareness of The Big Bang Regional Fairs. Recruitment of schools to regional events was the responsibility of regional contract holders, who would have their own routes to securing sufficient and appropriate attendance. This recruitment seems to be carried out separately to the effort to secure numbers for the national event. There is some merit in linking the two more closely and indeed, seeing both events as part of a sequence which begins with STEM activity/project work in school followed by a school STEM event, leading on to a regional event and finally the national event. To some degree this might be happening with the competition element of the whole enterprise, but we recommend that work is done to integrate more closely the recruitment efforts for the two 'levels' of The Big Bang. This might help contribute to a STEM 'enhancement and enrichment' culture in schools, and the development of a system of celebration events covering the whole country each year.

## 5.2 General points

- Particularly at the Secondary school level, The Big Bang attracts pupils who are already positively disposed to STEM in school (and beyond). Attitudinal aspects of the questionnaires indicate a more positive disposition towards STEM in attendees than non-attendees. To some observers, this might be a case of 'preaching to the converted', which might then lead to questions about the need for such an event, if the attendees are already more likely to opt for STEM subjects and careers. We do not share this view. Indeed, we suggest that the type of Secondary attendee The Big Bang attracts is entirely appropriate, and that the event should be seen by schools as one of a number of enhancement and enrichment opportunities that they plan into their STEM calendar.
- This and other evaluations (for instance the Lab in a Lorry evaluation by the University of Durham) show that the longer-term impact of a single, one-off event is not significant. As part of a planned programme of STEM activities, The Big Bang will make a contribution to 'recruiting and retaining' pupils in the STEM 'track'. The combined effect of inspiring teaching, access to a STEM/Young Engineers Club, contact with a STEM Ambassador, engagement with schemes such as CREST Awards, and visits to STEM venues (e.g. museums, Science centres), coupled with regional and/or national attendance at The Big Bang or The Big Bang Regional Fairs attendance will, in our view, have more chance at creating more positive, long term attitude shifts.
- The Big Bang provides teachers with access to a wide range of other STEM scheme providers, and increasing the uptake of such schemes is an aim of the event. We recommend that this aim be further strengthened, to become an objective to promote the development of school STEM calendars.
- This strengthening could be seen as one of the current jobs for STEMPOINT Brokerage contract holders. However, we perceive a more fragmented approach on the ground, with individual schemes getting promoted more than the notion of a planned STEM programme. Whose responsibility it might be to create a shift in this situation is perhaps problematic, but we recommend that the marketing of, and teacher information about, The Big Bang promotes the idea of a planned programme for the school. It should provide a vision of how different schemes can be integrated into school life, and show The Big Bang as perhaps the central, 'celebratory' element of the whole plan.
- Thusly, The Big Bang and The Big Bang Regional Fairs should be seen to inter-relate with other STEM enhancement activities, with the overall objective of inspiring pupils about STEM in their course and career choices, when the need for such decisions arise

- This leads to a further recommendation that there is 'mutual marketing' of schemes. For The Big Bang, this might be through STEM Clubs receiving tailored promotional materials about The Fair. Also, STEM Ambassadors, and schools hosting them, could receive similarly tailored materials, showing how each scheme (The Fair, STEM Ambassador, Club, for instance) could support the other. A reciprocal arrangement might involve promotional material about The Big Bang making suggestions to schools about seeking out a STEM Ambassador from their local brokerage. In a sense, this is a step towards a more coordinated marketing effort across the whole STEM landscape.