Executive Summary

Background

1. The purpose of the science, technology, engineering and maths (STEM) mapping review was broadly to:

- investigate whether STEM initiatives currently being taken forward address the concerns raised about the decline in demand of university places in STEM;
- investigate whether the perceived lack of supply of graduates and qualified technicians in the engineering and related professions including craft persons is being addressed;
- assess whether the recommendations of the Roberts' report 'SET for Success' are being taken forward coherently; and
- formulate recommendations for next steps based on the findings of the review.

2. Within the context of this review a STEM initiative means any teaching or learning initiative which supports the development of the supply of science and engineering graduates.

3. *It is not intended within the scope of this review to extend any of the findings and recommendations to the devolved administrations although there are some UK initiatives mapped. The data was collected for England only and analysis of the findings apply to England.*

4. The review was split into three phases. The first phase involved an extensive mapping exercise of teaching and learning initiatives/activities in STEM from primary to post graduate level and collection of soft and hard data where possible. STEM activity was collected across the DfES, from other Government Departments and externally from professional bodies/associations. The second phase of the project involved an analysis of the findings of the mapping exercise to assess whether the Roberts' recommendations had been taken forward coherently, identify gaps, assess activity going on externally, formulate recommendations on how the various activities might best be brought together and to draft a report on the findings. The third phase was to communicate and disseminate appropriate information on the findings of the review to opinion formers outside the Department. This will take place following completion of the Report.

Key findings

5. The review has highlighted the plethora of STEM initiatives/programmes being taken forward within the Department, by OGDs and by external organisations and the need for coherence and coordination of these. The review also identified several gaps in the initiatives being taken forward which include (a

full list is at section 3, paragraph 3.3):

- the lack of promoting and mainstreaming women/girls and ethnic minorities in STEM;

- the need for the better evaluation of initiatives in relation to supply/demand;

- the need for better links to be made across schools/FE/HE/employers so as to ensure that a seamless transition is made across the key stages to degree level; and

- to encourage more of a focus on adults upskilling/cross skilling/re-skilling particularly in the engineering field.

Key recommendations

6. A vibrant economy will encourage Job creation and wealth in the UK. World class scientists who pioneer cutting edge research which can then be translated into products will ensure that the UK can compete in the global market. That is why it is vitally important that the Government creates the means for the supply of the best science and engineering graduates, and supports this supply chain.

7. The programmes and initiatives mapped in this review go some way in supporting the development of this supply chain. However, to make an effective impact on the supply/demand of STEM graduates to meet the needs of the labour market it is recommended that:

- coherence and coordination are brought to these programmes/initiatives

- gaps identified in this review are addressed

- a cross cutting programme in STEM is developed to take this forward

- Government leads the way in taking forward a holistic approach to policy and strategy development in STEM

- Government encourages better joined up planning in relation to the delivery of future programmes and initiatives

- Government sets up a high level strategy group chaired by Alan Johnson, the Minister of State for Lifelong Learning and Higher Education, given that there are a number of DfES programmes and initiatives that need better coordination. The purpose of this group will be to set and agree overall priorities e.g. evaluation, and review progress from time to time, e.g. annually

- The high level strategy group includes representation from senior members from across Government, umbrella organisations and industry – notably the DfES; DTI/OST; British National Space Centre (BNSC); Treasury; Cabinet Office; the Engineering and Technology Board (ETB); the Advisory

Committee on Mathematics Education (ACME); the Science, Engineering and Manufacturing Technologies Alliance (SEMTA); the Association for Science Education (ASE); The Science Council; BAe systems; Glaxo Welcome, IBM etc

- The high level strategy group oversees three working groups which will take forward closing the gaps identified in this review and better coordination of programmes and initiatives across Government and external organisations. This high level strategy group will agree overall priorities and review progress of the working groups as necessary. It is important not to be over-ambitious. There are literally hundreds of organisations engaged in the promotion of STEM to the young across the UK and Government can only encourage co-operation and rationalisation, particularly with external organisations.

8. A full list of recommendations is at section 4 of the report.

9. The details of the above proposed structure is outside the scope of this review and will be taken forward in the next phase. However, the rationale for this proposed structure to take forward the recommended cross-cutting programme is based on and similar to a structure that has been tried and tested and was used to deliver the Department's 'Getting the Best from Each Other' project, part of the Supporting Better Delivery programme. This project was successful in achieving its outcomes. The proposal provides a workable structure which will be able to tackle the wide ranging tasks identified in the review and achieve the desired outcome.

Next Steps

10. There is a lot of work to be done in developing the cross-cutting programme. The next phase will involve the development of a programme plan with clear milestones. Terms of reference for each working group would need to be worked up and strand leaders identified. Policy leads from all departments would need to be involved in drawing up clear objectives for the TOR for each working group. The working groups will drive the programme forward and report progress to the high level strategy group. The high level strategy group will steer and advise on the work being taken forward. This structure will make 'joining up' and addressing the gaps identified in this review a reality. It will be part of the remit of the working groups to ensure that partners are signed up to this holistic approach to policy and strategy development in STEM. The programme would then have the added value of using Government and other resources available for STEM in the most efficient and effective way. There is also the potential for savings to Government Departments as a result of any rationalising and integrating of some of the initiatives and a re-focusing of available funding.

11. For the cross - cutting programme to maintain its credibility and add value to our partners both in industry and the education sector it is important for the outcomes to be comprehensive and cover the broad sweep of STEM activities. Success criteria would need to be identified early on in the programme as a means of fully evaluating the thrust of the programme.

12. There would be the potential for both Ministers, Alan Johnson and Lord Sainsbury to make a joint announcement in the new operational year about the cross – cutting STEM programme and to publish the STEM mapping report with a forward from both Ministers endorsing the programme. The cross – cutting programme would also provide the opportunity to engender a holistic approach and bring the work on women in information technology, engineering and computing (ITEC); ethnic minorities in STEM – the SET 4 Equality, Ethnic Minorities into Science, Engineering and Technology (EMSET) project led by the Science and Engineering Manufacturing Technology Alliance (SEMTA); and aspects of the Post - 14 Maths Inquiry under one umbrella.

13. Although there has been no formal consultation on this review, many departments and organisations have been contacted and consulted in the process of the mapping exercise, focus groups and meetings with stakeholders have taken place and many organisations are anticipating some action as a result of the review. The recommendations have generally been welcomed particularly in relation to bringing better coherence and coordination to the number of initiatives and is regarded as something that is long overdue.

REPORT ON THE SCIENCE, TECHNOLOGY, ENGINEERING AND MATHS MAPPING REVIEW.

SECTION 1

Introduction

1.1 The science, technology, engineering and maths (STEM) mapping review began in mid February 2003. 'In an increasingly knowledge-driven global economy, invention and innovation are critical to Britain's long term competitiveness,' (Investing in Innovation, July 2002). STEM initiatives work towards this end; promoting the supply and sustainability of graduates and qualified technicians in STEM professions. These initiatives span across education, academia and industry. The aim, objectives and scope of this review are attached at annex B, volume 2 but broadly the review aimed to:

- investigate whether STEM initiatives currently being taken forward address the concerns raised about the decline in demand of university places in STEM;
- investigate whether the perceived lack of supply of graduates and qualified technicians in the engineering and related professions including craft persons is being addressed;
- assess whether the recommendations of the Roberts' report 'SET for Success' are being taken forward coherently; and
- formulate recommendations for next steps based on the findings of the review.

1.2 *It is not intended within the scope of this review to extend any of the findings and recommendations to the devolved administrations although there are some UK initiatives mapped. The data was collected for England only and analyses of the findings apply to England.*

1.3 A stakeholders list is attached at annex C, volume 2 which is by no means exhaustive and the project plan at annex D, volume 2.

Methodology

1.4 The review was split into three phases. The first phase involved an extensive mapping exercise of teaching and learning initiatives/activities in STEM from primary to postgraduate level and collection of soft and hard data where possible. STEM activity was collected across the Department for Education and Skills (DfES), from other Government Departments (OGDs) and externally from professional bodies/associations in England. The second phase of the project involved an analysis of the findings of the mapping exercise to assess whether the

Roberts' recommendations had been taken forward coherently, identify gaps, assess activity going on externally, formulate recommendations on how the various activities might best be brought together and to draft a report on the findings. The third phase was to communicate and disseminate appropriate information on the findings of the review to opinion formers outside the Department.

What are the concerns and the evidence base

1.5 Within the context of the scope of this review the main concerns are:

- *The lack of supply of engineers at technician level.*

1.6 The following chart below shows the skills required in relation to skill shortage vacancies - that is vacancies that are proving hard to fill. It can be seen that the level of technical/practical skills is by far where the skill shortage is.

CHART 1

Source Employers Skills Survey 2002, Institute of Economic Research/MORI.

- *The lack of enthusiasm of pupils in STEM post 16.*

1.7 In the last ten years there has been a 32% decrease in the take up of A level Physics, 33% decrease in maths and 23% decrease in Chemistry. The regular Engineering and Marine Training Authority (EMTA) survey of attitudes

towards engineering as a career amongst secondary school age pupils (January – February 2001) indicates that one in seven pupils would choose a career in engineering, though the majority of these were boys. Engineering careers were the preferred choice for one in six boys but only 1% of girls wanted to become engineers, and only 4% felt they might consider this.

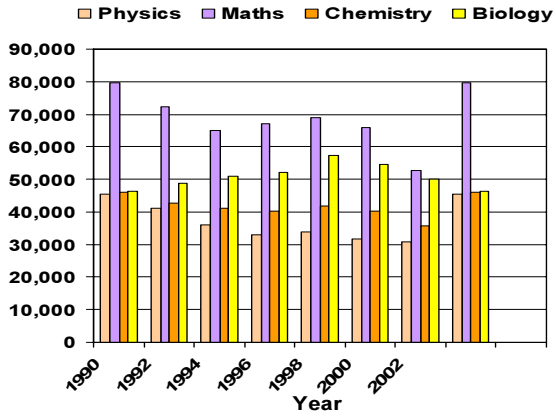
- *The declining numbers of pupils taking up science, maths and technology, particularly girls post 16*

1.8 The Digest of Engineering Statistics 2002 quotes around 23% of those taking 'A' level Physics recently have been female. Therefore only about one in five 'A' level Physics students are female. The chart below shows the decline in take up of physics, maths and chemistry.

Chart 2

Long-term Decline in Maths, Physics and Chemistry at 'A' Level Entry

Pupils Taking Maths, Sciences, Design and Technology at A or AS Level



Source: AQA Assessment & Qualification Alliance (Data applies to England, Wales and Northern Ireland)

- In ten years there has been a:
  - 32% decrease in physics A-level
  - 33% in maths A-level
  - 23% in chemistry A-level
  - 8% increase in biology A-level.

- *The lack of supply/decline in the numbers of graduates in STEM subjects. Although there has been an increase in the total enrolments in science related first degrees in the UK there has been a decrease in enrolments in science subjects including the physical sciences, engineering and technology.*

1.9 Between 1994/95 and 2000/01, total enrolments (i.e. the total number of students) on full-time science based first degrees in UK HE institutions increased by 12% from 328,100 to 367,700 – an increase of just under 40,000 students. However, these figures do not provide the full picture and tends to mask the trend that the numbers of students on particular courses and in some areas like the physical sciences and some subjects like chemistry have seen a decline in entrants. The following tables show the trends for undergraduate entrants,

providing a clearer picture of the through flow of students taking up particular subject areas.

TABLE 1

Undergraduate entrants (full-time and part-time) by broad subject area, 1994/95 and 2000/01

Broad subject area	1994/95	2000/01	Change	% change
Agriculture and related subjects*	**4786**	**4756**	**-30**	**-0.6%**
Business and Administrative Studies	**70160**	**67513**	**-2647**	**-3.8%**
Mathematical Sciences*	**6096**	**5712**	**-384**	**-6.3%**
Physical Sciences*	**21635**	**16900**	**-4735**	**-21.9%**
Engineering and Technology*	**47583**	**37129**	**-10454**	**-22.0%**
Architecture, Building and Planning*	**15281**	**11879**	**-3402**	**-22.3%**
Computer Science*	23913	38572	14659	61.3%
Medicine and Dentistry*	6566	7422	856	13.0%
Subjects allied to medicine*	38524	82860	44336	115.1%
Biological Sciences*	21538	25191	3653	17.0%
Veterinary Science*	537	786	249	46.4%
Social, economic & political studies	35266	39683	4417	12.5%
Law	15651	15775	124	0.8%
Librarianship and Information Science	4797	8649	3852	80.3%
Languages	27336	32435	5099	18.7%
Humanities	13947	19187	5240	37.6%
Creative Arts & Design	28430	38370	9940	35.0%
Education	26361	26912	551	2.1%
Combined	95731	130314	34583	36.1%
Total	**504138**	**610045**	**105907**	**21.0%**
Total science, engineering and technology	**186459**	**231207**	**44748**	**24.0%**

* Subject areas marked with an asterisk are totalled to produce the overall figures for science engineering and technology.
Source: HESA data

TABLE 2

Undergraduate entrants (full-time and part-time) in physical sciences, 1994/95 and 2000/01

Subject area	1994/95	2000/01	Change	% change
CHEMISTRY	**6802**	**4262**	**-2540**	**-37.3%**
MATERIALS SCIENCE	140	68	-72	-51.4%
PHYSICS	3769	2845	-924	-24.5%
ASTRONOMY	234	669	435	185.9%
GEOLOGY	1824	1615	-209	-11.5%
OCEANOGRAPHY	147	229	82	55.8%
ENVIRONMENTAL AND OTHER SCIENCES	4960	3555	-1405	-28.3%
COMBINATION WITHIN PHYSICAL SCIENCES	545	397	-148	-27.2%
Total excluding archaeology and geography	**18421**	**13640**	**-4781**	**-26.0%**
ARCHEOLOGY	376	472	96	25.5%
GEOGRAPHY (where this is solely as a physical science)	2838	2788	-50	-1.8%
Total	**21635**	**16900**	**-4735**	**-21.9%**

Source: HESA data.

- *The lack of supply of women and ethnic minority groups in science.*

1.10 Generally women and ethnic minorities are characterised as being under-represented in science and engineering. Anecdotal evidence shows that this situation is further exacerbated for ethnic minority women. Tables 3 and 4 below show the under representation of ethnic minority groups and women in science and engineering. From table 4 out of the 11,728 first degree graduates in the UK in the Physical sciences, 2001/02, only 116 were black and from table 3 only 15% were women graduates in engineering and technology in 2000/01 in the UK. Table 3 also shows that the proportion of women graduates in computer science is low at 20.6%, second to engineering and technology. It should also be noted that the percentage of women graduates varies quite widely between engineering disciplines and the percentage of women graduates in electronics for example is very low at around 6-8%. Despite the fact that Table 3 shows that women made up 49.6% of the total of SET graduates in 2000/01, only 20.6% and 15% of the total number of graduates for computer science, and engineering & technology, respectively were women. In addition in 2000/01 Engineering and Technology graduates accounted for only 6.1% of the total number of UK domiciled graduates. The Digest of Engineering Statistics 2002 published by the Engineering Council (UK) and the Engineering and Technology Board (ETB) also quotes that the proportion of registered engineers that are women is low – as at end 2001, 2.3% Chartered Engineers, 0.7% of Incorporated Engineers and 1.1% of Engineering Technicians were women.

TABLE 3

UK Domiciled Graduates & Masters in 2000/01

	Graduates			Masters		
	Total	% Female	% Total	Total	% Female	% Total
Medicine & dentistry	5545	53.0%	2.3%	1050	58.1%	2.5%
Subjects allied to medicine	19390	80.1%	8.0%	2255	72.9%	5.3%
Biological sciences	17555	63.6%	7.2%	2260	64.2%	5.3%
Veterinary science	520	69.2%	0.2%	35	71.4%	0.1%
Agriculture & related subjects	2100	58.3%	0.9%	315	52.4%	0.7%
Physical sciences	12425	39.4%	5.1%	1660	42.8%	3.9%
Mathematical sciences	4000	40.5%	1.6%	300	40.0%	0.7%
Computer science	**11335**	**20.6%**	**4.7%**	**3220**	**30.4%**	**7.6%**
Engineering & technology	**14735**	**15.0%**	**6.1%**	**2830**	**19.3%**	**6.7%**
Architecture, building & planning	5405	23.7%	2.2%	1000	37.5%	2.4%
Social, economic & political studies	20500	62.1%	8.4%	4995	59.3%	11.8%
SET Subjects Total	113515	49.6%	46.6%	19920	48.1%	46.9%
All Other Subjects	130030	61.5%	53.4%	22560	50.0%	53.1%
UK domiciled Total	243545	56.0%	100.0%	42485	49.1%	100.0%

Source HESA

Table 4

HOME FIRST DEGREE GRADUATES FROM UK HEIs 2001/02 BY ETHNICITY AND SUBJECT TAUGHT

	Numbers							Percentages of those of known ethnicity				
	White	**Black**	**Asian**	**Other**	**Total known**	**Not known**	**Total**	**White**	**Black**	**Asian**	**Other**	**Total**
(1) Medicine & dentistry	3785	74	1331	156	5346	272	5618	70.8%	1.4%	24.9%	2.9%	100.0%
(2) Subjects allied to medicine	16045	778	1791	288	18902	2241	21143	84.9%	4.1%	9.5%	1.5%	100.0%
(3) Biological sciences	14577	349	1138	332	16396	851	17247	88.9%	2.1%	6.9%	2.0%	100.0%
(4) Veterinary science	536	1	4	6	547	21	568	98.0%	0.2%	0.7%	1.1%	100.0%
(5) Agriculture & related subjects	1937	12	21	8	1978	128	2106	97.9%	0.6%	1.1%	0.4%	100.0%
(6) Physical sciences	**10190**	**116**	**606**	**125**	**11037**	**691**	**11728**	**92.3%**	**1.1%**	**5.5%**	**1.1%**	**100.0%**
(7) Mathematical sciences	3052	51	479	55	3637	174	3811	83.9%	1.4%	13.2%	1.5%	100.0%
(8) Computer science	8026	644	2905	265	11840	742	12582	67.8%	5.4%	24.5%	2.2%	100.0%
(9) Engineering and technology	11700	510	1425	235	13870	984	14854	84.4%	3.7%	10.3%	1.7%	100.0%
(A) Architecture, building & planning	4462	131	235	53	4881	455	5336	91.4%	2.7%	4.8%	1.1%	100.0%
(B) Social, economic & political studies	16078	799	1573	381	18831	1468	20299	85.4%	4.2%	8.4%	2.0%	100.0%
(C) Law	6373	513	1291	205	8382	477	8859	76.0%	6.1%	15.4%	2.4%	100.0%
(D) Business & administrative studies	20838	1012	3272	426	25548	1850	27398	81.6%	4.0%	12.8%	1.7%	100.0%
(E) Librarianship & information science	4020	214	263	87	4584	312	4896	87.7%	4.7%	5.7%	1.9%	100.0%
(F) Languages	12687	187	398	270	13542	950	14492	93.7%	1.4%	2.9%	2.0%	100.0%
(G) Humanities	8558	85	200	122	8965	631	9596	95.5%	0.9%	2.2%	1.4%	100.0%
(H) Creative arts & design	18420	435	782	390	20027	1017	21044	92.0%	2.2%	3.9%	1.9%	100.0%
(I) Education	10896	173	236	90	11395	695	12090	95.6%	1.5%	2.1%	0.8%	100.0%
(J) Combined/ Invalid code supplied	26293	689	1794	411	29187	2335	31522	90.1%	2.4%	6.1%	1.4%	100.0%
Total	198473	6773	19744	3905	228895	16294	**245189**	86.7%	3.0%	8.6%	1.7%	100.0%

Source: HESA

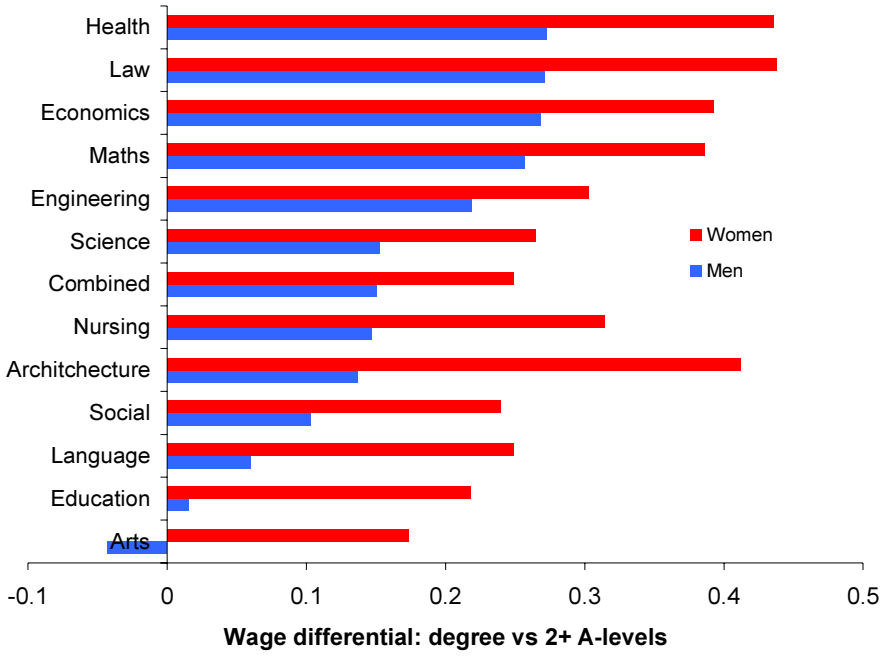
- *The relative lack of reward, pay and career structures/job design for science and engineering employees.*

1.11 The chart below shows the financial returns (i.e. wage differentials) of graduates over those who have two or more A levels as their highest qualification.

1.12 The highest returns, for both men and women are associated with subjects in health, law and economics. It can be seen that across all subjects, women enjoy higher wage returns than men. Female science and engineering graduates earn, respectively, around 25% and 35% more than those with 2 or more A levels, with both premia for men around 10 percentage points lower. However, this trend may be due to women with only two or more A levels earning relatively less than their male counterparts.

Chart 3

OLS Returns to Degree Types – Men and Women in Pooled LFS 1993-2000



- *That current public engagement with science activity might not be reaching sufficient numbers and a broad enough spectrum of the population.*

1.13 Adults' engagement with science is important for two reasons:

- they will only upskill/cross-skill/re-skill in science related subjects if they see personal benefit in doing so, either financially, from a job satisfaction perspective or both. An important factor for job satisfaction will be some sort of interest in/engagement with science. These can be encouraged by

creating opportunities to engage with science

- adults influence young people's study/career choices. Adults who see the relevance of science to their everyday life and value the role scientists and engineers play in society are more likely to encourage young people to study science and pursue scientific careers.

1.14 Much work is being done within Government and by others to create opportunities for public engagement with science. However, not enough is known about who this activity is reaching, how effective it is, and whether it is meeting a genuine public 'need'. The Office for Science and Technology (OST) is taking forward a number of projects to address these issues, including: the establishment of a database of science and society activities (which will include details of target audiences, audiences actually reached, and effectiveness of the activity); and a national public survey of participation in public engagement activities and barriers to participation. It will be working with OGDs and other stakeholders on these projects and other projects.

1.15 There is also some debate as to whether we understand what the real issues are with regard to the decline in graduate numbers in STEM. There is a mountain of statistical data available but considerable difficulty in obtaining the data in a format where it can be easily compared. There is a need to have a much clearer picture on what is happening at sub degree level and what the trends are. For example why first degree courses in the physical sciences, engineering and technology are experiencing falling numbers; why a large number of SET graduates opt not to take up SET occupations; why more pupils who do 'A' level Maths, Physics and chemistry don't choose these subjects for their degrees; and why more students with Maths 'A' level don't choose engineering/technology degrees. There needs to be a universal approach across Government Departments in the capturing and interpretation of the data on post 16 flows. Once this is established it will enable Government to have a robust evidence base on which to build a more consistent and effective approach in developing policy.

SECTION 2 - FINDINGS

2.1 An extensive mapping exercise of STEM initiatives was carried out over a three month period. Three maps were developed showing all the STEM initiatives being taken forward by the DfES, OGDs/Partners and external contacts such as subject associations and institutes.

2.2 The method used to analyse these maps was first, to look at the STEM activity in each of the primary, secondary, further education (FE) and higher education (HE) sectors and activities for adults. Secondly, where possible the types of initiative were grouped together. So for example all those initiatives for maths, science, technology, engineering, knowledge transfer etc respectively, were grouped together under each of those headings. This method made it easy to identify in which sectors there was a bulk of STEM activity, where initiatives overlapped and where there were gaps. For the purposes of the analysis Primary covers key stages (KSs) 1 and 2 initiatives/programmes; Secondary, KSs 3 and 4 and up to 'A' level; FE post 16, including 'A' level and up to degree level; HE under graduate, graduate and postgraduate; and separately initiatives for adults were identified.

2.3 Annex A, volume 2 contains a summary breakdown of initiatives/programmes by sector and type of initiative. It also summarises the extent to which activities are working well, those that are still awaiting evaluation and the progress on those that address the Roberts' recommendations.

DfES map

Annex E, volume 3 contains the STEM initiatives mapped across the DfES. Below are the findings.

2.4 *There are a wide range of initiatives across the primary, secondary, FE and HE sectors, ranging from small scale local projects to big national programmes* such as the National Numeracy Strategy (NNS), ca. £400m; the Key Stage 3 (KS3) Strategy, ca. £500m so far; the new GCSE in applied science, ca. £38m and Centres of Vocational Excellence, ca. £240m. The NNS was set up in 1999 to improve the learning and teaching of mathematics in primary schools. It has had a significant impact on the standards attained in mathematics and has brought together the various initiatives, improving the quality of learning and teaching of maths in all primary schools. The NNS has now been integrated as part of the National Primary Strategy from May 2002.

2.5 There is an immense amount of STEM activity going on across the DfES which is concentrated in the primary and secondary sectors. *There is not as much activity in the FE and HE sectors and even less for adults.* There is post 16 activity in teaching and learning with science and maths as two priority areas.

2.6 It is clear the reason for having the National Numeracy and KS3 strategies and indeed it is reasonably clear how these two big national programmes link together. *However, it is not clear how some of the initiatives join up/link with*

others or why we have some of the initiatives. For example it is not completely clear why we have the New GCSE Science pilot and the new GCSE in applied science. The GCSE in Applied Science is one of a suite of eight new GCSEs which were introduced for first teaching for September 2002. This suite of qualifications was specifically designed to provide pupils across the ability range at Key Stage 4 with a more hands-on approach to learning. The GCSE Science pilot was prompted by the 1999 National Curriculum review of the Key Stage 4 programme of study. The QCA review of the programme of study has built on the pilot. The pilot which started in September 2003 is intended to help test out different teaching and learning approaches to inform decisions on the new 'hybrid' suite of GCSEs, which are part of the 14-19 strategy. The pilot will run over five years from September 2003 to 2008. It can be seen that this could present quite a confusing picture to those outside the Department.

2.7 *It is not clear how initiatives link at GCSE and post 16 in schools with FE initiatives.* A huge investment is being made in Centres of Vocational Excellence (CoVE), some £240m to March 2006. However it is unclear how pupils make the transition from GCSE to FE and whether gaps are bridged for those students less successful at GCSE to move on to FE to take up a more vocational route. CoVEs primarily focus on adults although all offer progression routes for young people. The most obvious route is via MAs. The progression routes for young people to enter CoVEs are no different to that of mainstream FE (although it must be remembered that 20% of CoVEs are in private providers not FE colleges). However, we would expect CoVEs to have well developed links with schools and Connexions so that school pupils are aware of the vocational opportunities available to them and school/FE providers are geared up to make the transition smooth and focused on meeting the learners' needs. CoVEs differ from other FE provision in that they do not offer academic qualifications. CoVEs also cover the full range of economic sectors and thus some, not all, specialise in engineering and a limited range of science based occupations mostly around health based occupations. There is scope for the links between CoVEs and schools to be strengthened. It is also not clear how City Technology Colleges (CTCs) and Technology Colleges (TCs) under the Specialist Schools programme complement each other or indeed why we have both initiatives as they have common objectives. New Technology Institutes (NTIs) have been good in developing links between HE and FE and creating pathways for students to progress from FE to more advanced qualifications at NVQ level 3 and 4 and onto honours degrees. However, there are no clear links between CTCs and TCs that have technology activities that go on in schools and NTIs which have technology activities that go on in FECs and HEIs.

2.8 Generally from the mapping it can be seen that some of the Roberts' recommendations are being taken forward eg. improving school laboratories to meet the 2010 modernisation target. *However, there are a few areas that might need further development such as the role that employers play in improving pay, career structures and working experiences for scientists and engineers in research and development; and the monitoring of the impact of four year courses and increased student debt on student choices of courses.* These areas that need further development are being closely monitored by schools and HE implementation groups internally and by HMT. There are regular meetings with

HMT and Sir Gareth Roberts to discuss progress. Sir Gareth Roberts is satisfied with the significant progress being made.

2.9 There is very little in the way of promotion campaigns currently being run by the Department. Count On, the follow on from Maths Year 2000, is a small initiative - largely providing funding for the management of the Count On website; and Planet Science the follow on from Science Year, a larger initiative which ran until July 2003. *There would be mileage in building on campaigns being taken forward externally and by OGDs collectively to raise the profile in engineering and science and make engineering and science careers more attractive to young people, particularly girls and ethnic minorities.*

2.10 There is not much STEM activity with regard to initiatives at HE level. Where there is, it tends to be large national programmes eg. Capital for HE teaching laboratories. £60m from 2004-06 to refurbish science and engineering laboratories as part of the modernisation target by 2010; £72m to 2006 for Foundation Degrees (FDs) and £25m for NTIs. There is some rationalisation with regard to qualifications via the vocational route as HNDs are subsumed into the FD framework.

2.11 *There is even less STEM activity for adults apart from the activities implemented by the Adult Basic Skills Unit (ABSU) and Learning and Skills Councils (LSCs) in improving adult literacy and numeracy.* However, there is a large Government investment in Further Education - a rise of around £1.2bn by 2005-06 compared to 2002-03. The Government aims to improve FE/employer links and to ensure training provision is responsive to individuals' and employers' needs as part of its 'Success for All' strategy. 'Success for All' will also improve standards of teaching and learning in key curriculum areas where weaknesses have been found. Spending in this area will rise to £106 million by 2005-6. Science and Maths have been identified as priority areas. In 2003-4, 20% of inspection grades for science & maths in colleges were unsatisfactory or poor. Science is among the first areas to be tackled. The Department has produced innovative teaching and learning resources and methods for the following topics for 2003: AS/A2 Biology - molecular structures; AS/A2 Chemistry - "enthalpy" (the chemistry of heat); and AS/A2 Physics - algebra for physicists. However, this is confined to the science priority area at present, though work to tackle weaknesses in maths will start in September 2004. *Upskilling/re-skilling for adults in science as well as engineering and technology should be part of this investment.*

2.12 There are a number of smaller initiatives that support the national initiatives well. These tend to promote the national strategies or act as intervention activities to raise standards in maths, science and technology eg. Count On supports the NNS, Planet Science the KS3 strategy and Playing for Success supports numeracy and ICT at KS 2 and 3.

2.13 *There is a mixture of large scale national programmes and local projects.* Several of the local projects are delivered via Local Education Authorities (LEAs) and support the national strategies primarily as intervention programmes to raise standards eg. 'Booster Classes in Maths' to support year 6 pupils who need extra help in maths and; year 6 workshops targeted at year 6 teachers new to the year

group, school or in schools with low rates of progress. Different schools and LEAs have different requirements and they are given a suitable degree of local autonomy. The local projects reflect this.

2.14 *There are a number of initiatives that enhance the quality of teaching STEM subjects or act as interventions to raise standards.* All appear to make a positive impact on the quality of teaching and keep subject knowledge up to date in science, maths and technology. Examples of such initiatives include The Leadership programme with an investment of £21m supports the literacy and numeracy strategies, the Professional Development pilot programme for teachers in their second and third year of teaching - £25m over three years and the Professional Bursaries Scheme for teachers in their fourth and fifth years of teaching.

2.15 *It has been difficult to assess many of the STEM initiatives/activities because although the DfES is good at having evaluation systems in place, many programmes are in the process of being evaluated.* It would also be difficult to measure the value of programmes against each other without common criteria. *Where some evaluation is available it is not clear whether the initiative has increased the supply of numbers of pupils taking up STEM subjects at GCSE or 'A' level* e.g. under the Specialist schools Programme there are 472 technology colleges, 38 maths and computing colleges, 64 science colleges and 8 engineering colleges. A survey on specialist schools by OFSTED in 2001 which covered technology colleges confirmed that developing a specialism helped sustain or accelerated the pace of overall school improvement. However, it is not clear whether specialist status has increased the supply of numbers of pupils taking up STEM subjects at GCSE or 'A' level. Similarly it is not clear whether the CTCs programme has increased the supply of pupils taking up these subjects although there may be improved grades at GCSE generally. *Better evaluation of initiatives with regard to supply/demand and tracking of students and flows is required to assess the extent of the impact initiatives have on pupils. Supply/demand aspects of STEM need to be incorporated in the evaluation of STEM activity.*

2.16 *There are overlaps with some initiatives and it is difficult to assess whether there is benefit in rationalising some initiatives* e.g. The Leadership Programme aimed at professional development in leadership of teaching, learning and assessment of children's learning to raise standards in primary schools; and The Strategic Leadership of ICT (SLICT) programme aimed at headteachers to develop their understanding of the role of ICT in improving teaching, learning and pupil attainment and the implications of ICT in schools in relation to local and national strategies. One might question why these two programmes are not combined. Similarly CTCs and CLCs and Technology colleges under the specialist schools programme. Further investigation is needed as to whether these programmes can be rationalised.

2.17 *Other initiatives that support the supply of STEM students are those enhancing the supply of teachers in those subject areas* eg. one of the strands of the Student Associates Scheme encourages undergraduates to work in schools prior to taking an initial teacher training course, the 'Golden Hello' is a scheme

providing additional payment to teachers in shortage subjects and the Repayment of Teachers' Loans scheme is a scheme to pay off the student loan of new teachers of shortage subjects.

2.18 The Skills Strategy is a cross Government strategy that aims to ensure that employers have the right skills to support the success of their business, and individuals have the skills they need to be both employable and personally fulfilled. *However, to ensure the supply of STEM graduates/technicians/potential employees to meet skill needs and support economic growth requires links to be made right across the primary, secondary FE and HE sectors. Government needs to make these links explicit.*

2.19 There are numerous local initiatives with small scale funding which have a localised impact by raising attainment and improving the quality of teaching. These are demonstrated in the Excellence in Cities (EiCs) and Education Action Zone (EAZs) programmes. These programmes link and mesh together well with regard to delivery and support the national strategies. *Although these initiatives may make an impact locally one might question whether taken together they make an impact in achieving DfES/Government objectives. The question of measuring impact needs to be addressed.*

2.20 There is a whole host of programme/project mangers/directors, advisers and consultants whose activities overlap. This can be burdensome to LEAs and schools. SETNET was established, jointly by DTI and DfES following a study (Action for Engineering) some six years ago to investigate this situation. It has strong support in particular, from the Gatsby Trust and from industry to provide local and co-ordinated SETPoints UK-wide. It now has 53 SETPoints across the UK (including one in each LLSC area as part of the education business link consortia) and goes part way to addressing this issue. *However, It is currently unclear how these local contacts mesh with regional networks such as Government Offices (GOs), regional development agencies (RDAs), National Education Business Partnership (NEBP) and the current SET network (SETNET). A more up to date study on how best to rationalise these contacts/have their roles more clearly defined and how SETNET might be improved may be needed. The need for any future national or regional networks to be set up needs to be examined closely and would benefit by building on existing regional links/networks* e.g. the science learning centres and National Centre of Excellence in maths. It is anticipated that the National network of science learning centres will improve coordination by working closely with other existing local initiatives and information points. An important priority will be to link the centres with the work of the Centre for British Teachers (CfBT), KS3 science consultants and the 'Standards Unit regional support model'.

2.21 *There is little evidence of initiatives being joined up but where there is it works well* e.g. the Science and Engineering Ambassadors (SEAs) programme, co-ordinated nationally by SETNET, delivered locally by the SETPoints and funded by the Department of Trade and Industry (DTI) and the ETB, creates a resource of science, technology, engineering and maths professionals to work in schools to support teachers and inspire pupils and provides a quality-assured framework of properly-trained people in whom schools can have confidence.

DfES was involved in the planning of SEAs as a Science Year project.

2.22 There is some activity of FECs, HEIs and employers working together eg. in delivering Foundation Degrees (FD) s; and some activity of FECs, HEIs and schools working together eg. in delivering the HE strategy of the Aim Higher programme *but no activity of schools, FECs, HEIs and employers working collaboratively together across the piece to bridge gaps across the KSs and further and higher education. These links need to be made explicit to ensure the supply chain (flow of students from primary education, secondary education to further and higher education) of potential students in STEM. The Government should endorse this as best practice and publicise this widely through good practice guides, conferences and on websites.*

2.23 *There needs to be more activity that spans across the KSs to graduate level that encourages and embeds a culture of innovation and enterprise which is particularly needed at graduate level in STEM subjects.* The need for this is demonstrated in KT and embedding this early on will enhance entrepreneurship later on. Currently the Science Enterprise Challenge scheme run by DTI/OST is being incorporated into the Higher Education Innovation Fund (HEIF2). HEIF 2 supports enterprise training for undergraduates. This sort of activity can be mainstreamed in the curriculum. Entrepreneurship can be taught as part of Citizenship, a national curriculum subject in secondary schools from September 2002. Government has responded to Sir Howard Davies's report, Enterprise and the Economy in Education, with a new £60m Enterprise Education entitlement which from 2005/6 will provide all KS4 pupils with the equivalent of five days' enterprise activity which develops enterprise capability – innovation, creativity, risk-management and risk-taking, and financial and business understanding. 150 Pathfinder projects were approved for September 2003 start, embracing nearly 400 secondary schools. In addition, £16m over two years will fund Enterprise Advisors, who will work alongside head teachers in 1,000 secondary schools in the most disadvantaged areas, to encourage enterprise practice among teachers and pupils – following priorities agreed with heads.

2.24 *There is no activity to change the image that vocational qualifications are second rate.* For example why are the vocational degrees called 'Foundation' degrees which could be confused with HE foundation courses. There is some work to be done in building and changing this image. This can be done by building on activities already being taken forward outside the Department. For example by taking a more coordinated approach and building on improving the image of engineering and vocational qualifications of engineering technicians that the ETB are taking forward.

OGDs/Partners Map

Annex F, volume 4 contains STEM initiatives mapped across OGDs/partners. Below are the findings.

2.25 There is a wide range of national and local STEM activity similar to the DfES map but as one would expect there is more of a slant towards STEM activity

in secondary, post 16, HE and adult sectors with much more activity at HE compared to the primary and secondary activity in the DfES map. This goes someway to complementing the STEM activity going on in the DfES.

2.26 The Learning and Skills Development Agency have a number of initiatives for post 16 and adults and are researching good practice in the promotion of engineering technician careers to inform the LSC. *There would be mileage in making more of an impact on a national scale by combining or integrating this promotion with other promotional campaigns that the DfES, ETB, IOP, DTI or other organisations might be doing.*

2.27 There are a number of initiatives to train proposed STEM teachers and for continued professional development (CPD) to enhance recruitment and retention of STEM teachers. These are largely delivered via the Teacher Training Agency (TTA) and *there is evidence that the DfES works collaboratively with the TTA* e.g. repayment of the student loan scheme for those qualifying and continuing to teach science is a DfES initiative where there is collaboration with the TTA. *There is benefit in publicising this as best practice to encourage OGDs and external organisations to work collaboratively with the TTA.*

2.28 There is no doubt that SETNET and SETPOINTS make an impact at a local level and there is good collaboration with Education Business Partnerships (EBPs). Nor is there any doubt that industry thinks this activity is worthwhile and it is notable that a number of major employers, such as BAe Systems, IBM and Ford, have made significant commitments to SETNET. *However, it is not clear taken as a whole whether the programmes delivered by and through SETPOINTS and which address all young people between 5 and 19, do increase the supply of STEM students' post-16.* There is currently an evaluation under-way of the impact of STEM activities and, especially, of the work of the SETPOINTS, funded by Gatsby and the ETB. Elements running now (after a desk research stage that DTI funded) include a teachers' survey and work with resource providers. A longitudinal survey of young people will take place first in 2004. Inevitably, especially as some are new to their evolving role, the quality and effectiveness of SETPOINTS can be patchy and the network is still developing its effectiveness. Current opinion within the DfES, teachers and from subject associations based on anecdotal evidence is that the quality and effectiveness of SETPOINTS can be patchy and there is some question as to their effectiveness in relation to coordination activities on a national scale. *The results of the current evaluation should inform on how the role of SETPOINTS may be developed to improve their effectiveness.*

2.29 *Similar to the DfES map there is not much STEM activity for women.* There is the national programme, Women in Science and Engineering (WISE) and following the Greenfield Report, the Government has committed itself to a substantial amount of work. DTI has in hand initiatives aimed at women in Information Technology, Engineering and Computing (ITEC) including the EQUALITEC website and has announced a new Strategy to promote STEM to Women and ethnic minorities. This includes a commitment to setting up a new Resource Centre for women. The Science and Engineering Ambassadors programme (SEAs) is being notably successful in attracting young women and

DTI is presently considering proposals from SETNET to increase the targeting of women and ethnic minorities. *More work still needs to be done in developing a more coordinated approach in promoting STEM for women and ethnic minorities.*

2.30 *Similar to the DfES map there is overlap with initiatives and scope for rationalisation, if only to reduce the number of funding streams. There are several Knowledge Transfer (KT) initiatives and it is unclear how they link up* e.g. DTI's Link, Foresight Link, Science Research Investment Fund, Faraday Partnerships programmes and the DfES/DTI HE Innovation Fund (HEIF)/knowledge transfer programme. Another example where initiatives overlap is the DTI's Joint Infrastructure Fund and DfES' capital for HE science laboratories.

2.31 The DTI make a huge investment in the Research Councils (RCs). Funds pass via the RCs to institutions for knowledge transfer. It is not clear how these funds fit or mesh with funding from other knowledge transfer programmes such as HEIF. *At least this requires investigation and whether this reinforces the case to reduce bureaucracy by there being a single funding stream for all KT activity. There is scope to ensure that funding and initiatives are more joined up.*

2.32 The RCs fund a number of STEM regional and local projects for schools and some collaborate with SETPOINTS. These tend to support the teaching and learning in STEM e.g. the Researchers in Residence scheme, supported by the Engineering and Physical Sciences Research Council (EPSRC) where PhD students assist in local schools and act as role models. 250 PhD students are placed each year via this scheme. This scheme is similar to the Science and Engineering Ambassadors programme. There is co-operation between the Researchers in Residence scheme and SEAs and the DTI has worked with and taken advice from Sheffield Hallam University in the design of SEAs. *There is further scope to bring these types of initiatives together.*

2.33 *There is evidence that the RCs are taking forward the Roberts' recommendations that fall to them* eg. 4.2 of the Roberts' recommendations on PhD training elements are being implemented by schemes such as the UK GRAD Programme. This programme is managed by EPSRC on behalf of all the RCs and Arts and Humanities Research Board (AHRB). The Careers Research and Advisory Centre (CRAC) administers the programme. Apart from the UK GRAD Programme, RCs also provide funding directly to higher education institutions to use on transferable skills training.

2.34 The Learning and Teaching Support Networks fund several small scale teaching and learning initiatives via their subject centres. *It is difficult to assess their impact taken as a whole in the absence of evaluation. Although they may make an impact locally it is unclear whether they support the supply of undergraduates/graduates into STEM careers.*

2.35 *There is good collaboration and links with the Qualifications and Curriculum Authority (QCA) and the DfES* in developing the science and maths curriculum. The QCA are taking these initiatives forward with some DfES funding.

2.36 There is major Government investment in the HE sector. There will be an

increase in spending on research in 2005-06 by £1.25 billion compared to 2002-03. HEFCE take forward several programmes at HE level which include STEM activities, delivered via the Learning and Teaching Support Network (LTSN). The work of the LTSN is monitored through the LTSN annual report against annual plan. An evaluation has been undertaken and a further one is planned for 2004. There is good collaboration between HEFCE and the support networks. Programmes include enhancing teaching quality, widening participation projects and fellowship schemes. *However, from the mapping there is limited evaluation available for each programme – either currently being undertaken or not available. Therefore it is difficult to assess the impact of these initiatives on the supply of STEM graduates. HEFCE may need to review their evaluation systems.*

2.37 *Similarly the evaluation available from the DTI on their programmes was limited.* From the mapping it would appear that DTI do not have these systems in place and on occasion put evaluation in place at a much later stage in programmes. *The DTI may need to review their evaluation systems with the view of having evaluation in place at the start of programmes/pilots.* The DTI is already looking to enhance evaluation of the projects it funds in the science education and public engagement areas. Science education - SETNET is undertaking a major evaluation of its work. This is in terms of the impact that it, and its agents, the 53 SETPOINTS in the UK, and the resources provided by organisations have on influencing students in schools to become, at the very least STEM literate and at best to follow a course leading to a career in a STEM related environment. Public engagement: OST's Public Engagement with Science and Technology Team (PEST) will be funding a project with the Research Councils to establish best practice in evaluation for both funders and deliverers of public engagement activity. In addition, meaningful evaluation will be an even more important component of the projects the PEST Team funds through its grant scheme.

2.38 The National Physical Laboratory (NPL) run many initiatives related to the medical field and work with the DTI, DoH and universities. The DTI fund some of their schemes. Two of their schemes impact on KT i.e. hosting MSc/Sandwich students and PhD training involve students being placed in industry or NPL to undertake research as part of their degree, *but there are no clear links to other KT programmes. The DTI needs to ensure these links are made and best practice is exchanged.*

2.39 The RDAs fund several local initiatives working with local FECs and employers to meet local economic needs. These tend to be vocational STEM training initiatives for post 16 students and adults to up-skill. RDAs are also encouraged to join up with regional higher education Associations. SETNET holds regional SETPOINT meetings. The RDAs and GOs are invited to attend but not all do so. There is a growing trend for SETPOINTS to work together regionally, sharing expertise. *Government can encourage a joining up of RDAs with other regional networks such as the SETPOINTS, EBPs, Learning and Skills Councils, Small Business Service and LTSN by running regional networking conferences for contacts in each region.*

External contacts map

Annex G, volume 5 contains the STEM initiatives mapped across external organisations such as subject associations, industry and institutes. This list is by no means exhaustive. Below are the findings.

2.40 There are a variety of STEM initiatives on a regional and local rather than a national scale being run by external organisations. The bulk of the activity seems to be in the HE and secondary sectors. *As with the DfES and OGDs/partners maps there is a lack of readily available evaluation to make an assessment on impact. Evaluation when it is done does not generally incorporate supply/demand aspects so it is extremely difficult to assess whether the supply of STEM graduates is being addressed.*

2.41 External organisations, subject associations and institutes are autonomous and although there is a willingness to collaborate it would be difficult to coordinate STEM activity to plug the gaps in STEM initiatives. Part of SETNET's role is to coordinate STEM activity but it appears from the mapping there is still a lot more work to be done in this area. *Mapping work by SETNET, which is still under-way has shown a massive disparity between the resources and schemes available for science and those for mathematics. SETNET has been working with the Association for Mathematics and its Applications and ACME to stimulate more initiatives in this field.* The ETB has also formed a Communications Partnership of key STEM organisations to work together to add value, share best practice and to fill any gaps in current or future promotional activities. *Government would need to lead, support this work and send a strong message out about better collaboration between organisations. Better coordination of initiatives by external organisations can be taken forward by working with umbrella organisations like the ETB.*

2.42 The DfES works through various external contacts who have received funding on a small scale e.g. the ASE's Post Graduate Skills Record and Red Hot Science which targets hard to reach schools funded by Planet Science are DfES initiatives. The DfES has also provided a one-off grant to part fund Imperial College's Inspire programme which recruits post- doctoral research scientists to work in schools to support teachers and inspire pupils similar to the Science and Engineering Ambassadors programme. *There is scope to bring these two programmes together.*

2.43 The Institute of Physics (IOP) has developed an 'A' level course for the 21st century which is steered to attracting more girls to do physics. The DfES with the QCA are already strengthening links with other GCSE pilots including the Salters-Horner Physics A level syllabus with regard to lessons learnt. The IOP have also developed a one-stop shop for any question on physics. *It would be sensible to consult the IOP when setting up new websites. The ETB are consulting with the IOP on many matters including their website, www.scenta.co.uk and will be hotlinking their website to other STEM websites and the IOP website.*

2.44 The IOP are launching a programme to support women in Physics including a new website aimed at women. *There is scope for any promotion*

campaign for women/girls in science to link with the IOP programme and to ensure links are made with DTI's new strategy for women.

2.45 The Institute of Chemical Engineers are running a promotion campaign (to end in 2003) to generate awareness in chemical engineering targeting teachers and students in high performing schools, the evaluation claims to have reversed the decline of students taking Chemical Engineering at university over the life cycle of the campaign. *This is the only initiative that has accounted for the supply of STEM students in it's evaluation and it is worth investigating how this assessment was made with the possibility of including the same criteria in future evaluations of STEM initiatives.*

2.46 Generally, with all the maps, no tracking appears to be done on the impact of the initiatives to assess whether as a result more primary, secondary, FE or HE students are taking up STEM careers. *Some form of tracking outcomes should be incorporated in all STEM evaluation.*

N.B. All the findings are based on an extensive mapping exercise carried out between March to end May 2003. Entries recorded at the time were correct but will be subject to change since end May 2003. The mapping exercise was by no means exhaustive.

Overview of the summary analysis of the maps

2.47 Annex A, volume 2, contains the full summary analysis of each map in relation to initiatives/programmes, sector, type of activity, evaluation and response to Roberts' recommendations. Generally:

- There are a total of 120 initiatives mapped from the DfES map, 217 from the OGDs/Partners map and 130 from the External contacts map;
- the most activity recorded is in the primary and secondary sectors for the DfES map, and in the HE sector for the OGDs/Partners and External contacts maps;
- the largest number of initiatives being taken forward from the DfES map is in maths followed close behind by science, science for the OGDs/Partners map and engineering for the External contacts map;
- there is a lack of readily available evaluation. For all maps less than 50% of the initiatives have had some sort of evaluation with 48.33% of initiatives having some sort of evaluation for the DfES map, 37.78% for the OGDs/Partners map and 22.31% for the External contacts map; and
- 40 initiatives can be classified as addressing the Roberts' recommendations for the DfES map, 40 for the OGDs/Partners map and 4 for the External map.

Overview of the initiatives contributing to the Roberts' recommendations

2.48 Below is a table showing the numbers of initiatives by sector in each map and how they contribute to responding to the Roberts' recommendations. It should be noted that, although there are not as many initiatives as expected that have been identified in the maps as commissioned to address the Roberts' recommendations many have a positive impact on taking the recommendations forward. Several had already been established, particularly those that relate to knowledge transfer and those taken forward by Research Councils. Some of the Roberts' recommendations have not been mapped because they are not linked directly to STEM initiatives such as those that relate to skills planning for businesses and the Sector Skills Councils. **A full summary analysis of the initiatives addressing the Roberts' recommendations is at annex A, volume 2.**

Roberts Recommendation	**Total amount of initiatives supporting this rec.**	**Breakdown of the Initiatives**		**How the initiatives contribute to the recommendation**
School and Further Education				
2.1: The participation of women in science and engineering	21	**DfES** Primary Secondary FE **OGD** Primary Secondary FE HE **External** HE	**Number** 4 6 1 2 3 2 2 1	All the initiatives contribute to responding to the Roberts Recommendation. One example is the computer Club for girls which is a primary and secondary Initiative. It encourages the participation of girls in ICT and girls to take up ICT as a career
2.2: The participation of ethnic minority groups in science and engineering	9	**DfES** Primary Secondary FE	**Number** 4 4 1	All the initiatives contribute to responding to the Roberts Recommendation. Eg. the DfES Ethnic Minorities into SET programme aims

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				to raise the representation of Ethnic Minorities in SET sectors.
2.3: Primary school teachers	18	**DfES** Primary Secondary FE **OGD** Primary Secondary FE HE	**Number** 7 6 1 1 1 1 1	All the initiatives contribute to responding to the Roberts Recommendation. One example being the National Network of Science learning Centres, a joint DfES and Wellcome trust project to provide training to science teachers.
2.4: Secondary school science teachers' training	19	**DfES** Primary Secondary FE **OGD** Primary Secondary FE HE	**Number** 2 12 1 1 1 1 1	All the initiatives contribute to responding to the Roberts Recommendation. The national network of Science Centres as above is a good example of responding to this recommendation.
2.5: Teachers remuneration	9	**DfES** Primary Secondary FE **OGD** HE	**Number** 3 3 1 1	All the initiatives contribute to responding to the Roberts Recommendation. Two examples being the DfES Training Bursary's and Golden Hello Payments to shortage subject teachers (including STEM)
2.6: Secondary	12	**DfES**	**Number**	All the initiatives

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
school teachers' Continuing Professional Development (CPD)		Primary Secondary FE **OGD** Primary Secondary FE HE	2 3 1 1 1 1 3	contribute to responding to the Roberts Recommendation. A good example is the science strand of the Key Stage Three national strategy which invests heavily in teachers CPD.
2.7: School laboratories	7	**DfES** Primary Secondary FE	**Number** 2 4 1	All the initiatives contribute to responding to the Roberts Recommendation. Planet Science is a DfES initiative delivered by NESTA to improve attainment and interest in Science, through providing additional equipment to schools and arranging activities. Also the prioritisation of capital investment in laboratories initiative where LEAs prioritise investment through asset management planning to address the most urgent needs of their schools
2.8: Teaching assistants	11	**DfES** Primary Secondary FE	**Number** 3 3 3	All the initiatives contribute to responding to the Roberts

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
		HE	2	Recommendation. For example the Students associates scheme places undergraduates into schools as teaching assistants.
2.9: The science curriculum	20	**DfES** Primary Secondary FE **OGD** Secondary	**Number** 1 14 1 4	All the initiatives contribute to responding to the Roberts Recommendation. The new GCSE's in 21st century science and engineering contribute well to this recommendation.
2.10: Transition from GCSE to A-level	4	**DfES** Primary Secondary FE	**Number** 1 2 1	All the initiatives contribute to responding to the Roberts Recommendation. The Post 14 maths inquiry is important here – a UK wide independent inquiry, recently published.
2.11: Difficulty of subjects	5	**DfES** Primary Secondary FE **OGD** Secondary	**Number** 1 1 1 2	All the initiatives contribute to responding to the Roberts Recommendation. The QCA run a Innovative Design and technology project which looks at innovative approaches to Design and

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				Technology.
2.12: Enhancing the Curriculum	16	**DfES** Primary Secondary FE **OGD** Primary Secondary FE HE	**Number** 1 2 2 4 5 1 1	All the initiatives contribute to responding to the Roberts Recommendation. An example being the EAZ and SETpoint Coventry CAD/CAM project which is a design and make project based upon F1 Challenge, which enhances the curriculum in an exciting way.
2.13: Improving the perception of careers in science and engineering	21	**DfES** Primary Secondary FE OGD Primary Secondary FE HE	**Number** 3 4 1 4 5 2 2	All the initiatives contribute to responding to the Roberts Recommendation. The joint DTI/DfES initiative the Science and Engineering Ambassadors Scheme, improves the perception of careers in these fields by inspiring and supporting students using professionals already working in the field.
Undergraduate Education				
3.1: Quality of SET A-level students as degree level entrants	3	**DfES** Secondary FE HE	**Number** 1 1 1	All the initiatives contribute to responding to the Roberts

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				Recommendation. One example being that HEFCE were asked by DES to pilot and evaluate different approaches to bridging the gap between A-level and degree study.
3.2: Undergraduate course structure	17	**DfES** HE **OGD** FE HE Adult **External** HE	**Number** 2 1 12 1 1	All the initiatives contribute to responding to the Roberts Recommendation. An example being the Learning and Skills Council's Graduate Apprenticeships Scheme, to develop and deliver a broad portfolio of teaching and learning modules in conjunction with SMEs.
3.3: University teaching laboratories	1	**DfES** HE	**Number** 1	This initiative contributes to responding to the Roberts Recommendation. DfES are contributing through providing capital for HE science labs – 60 million by 2005/06.
3.4: Recurrent funding for teaching	4	**DfES** HE **OGD** HE	**Number** 1 3	All the initiatives contribute to responding to the Roberts

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				Recommendation. The repayment of student loans for science teachers is important to this recommendation.
3.5: Undergraduate student funding				
3.6: University careers advisory services				
Postgraduate Education				
4.1: PhD stipends	1	**OGD** HE	**Number** 1	This initiative contributes to responding to the Roberts Recommendation, as the National Physical laboratory (NPL) support PhD studentships.
4.2: PhD training elements	2	**OGD** HE **External** HE	**Number** 1 1	Both the initiatives contribute to responding to the Roberts Recommendation. The Post Graduate Skills Record for example is a CPP Framework tailored to Post graduates by the Royal Society of Chemistry.
4.3: Length and nature of PhD programmes	1	**OGD** HE	**Number** 1	This initiative contributes to responding to the Roberts

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				Recommendation as the NPL takes staff and students to work in their laboratories on PhD projects. The NPL work closely with the Universities involved.
4.4: EU PhD students				
Employment in Higher Education				
5.1: academic Fellowships				
5.2: Industry secondments for postdoctoral researchers	4	**OGD** HE Adult	**Number** 3 1	All the initiatives contribute to responding to the Roberts Recommendation. For example MSc students or students on 1year placements are placed a NPL to work on Science projects.
5.3: A vision for postdoctoral researchers				
5.4: Postdoctoral researchers' salaries				
5.5: academic salaries				
Scientists and Engineers in R&D				

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
6.1: Attractiveness of careers in R&D				
6.2: The challenge to employers				
6.3: Skills planning				
6.4: Skills dialogue	1	**External** HE	**Number** 1	This initiative contributes to responding to the Roberts Recommendation. The Undergraduate Skills Record is a PDP framework designed in line with Progress Files for HE – A means to reflect, record and develop skills for career planning.
6.5: business involvement in higher education	2	**OGD** HE **External** HE	**Number** 1 1	Both the initiatives contribute to responding to the Roberts Recommendation. The DfES Innovations Fund for example funds projects to boost relations between business and universities.
6.6: Research collaboration between business and higher education	3	**DfES** HE **OGD** HE	**Number** 1 2	All the initiatives contribute to responding to the Roberts Recommendation. For example the DTI Teaching Company Scheme facilitates

Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				Knowledge Transfer between the science base and business. The DfES/OST Higher Education Innovation Fund which funds higher education institutions to develop their capacity for knowledge transfer and to form links with business and the community.
6.7: Innovation partnerships for collaborative research	2	**DfES** HE **OGD** HE	**Number** 1 1	Both the initiatives contribute to responding to the Roberts Recommendation. The Faraday Partnerships for example are business friendly , knowledge base/industry partnerships. These are recognised as centres of expertise and collaboration.
6.8: Migration and work permits	1	**DfES** HE	**Number** 1	This initiative contributes to responding to the Roberts recommendation. The Science and Engineering Graduates scheme provides a new entitlement for non-EU

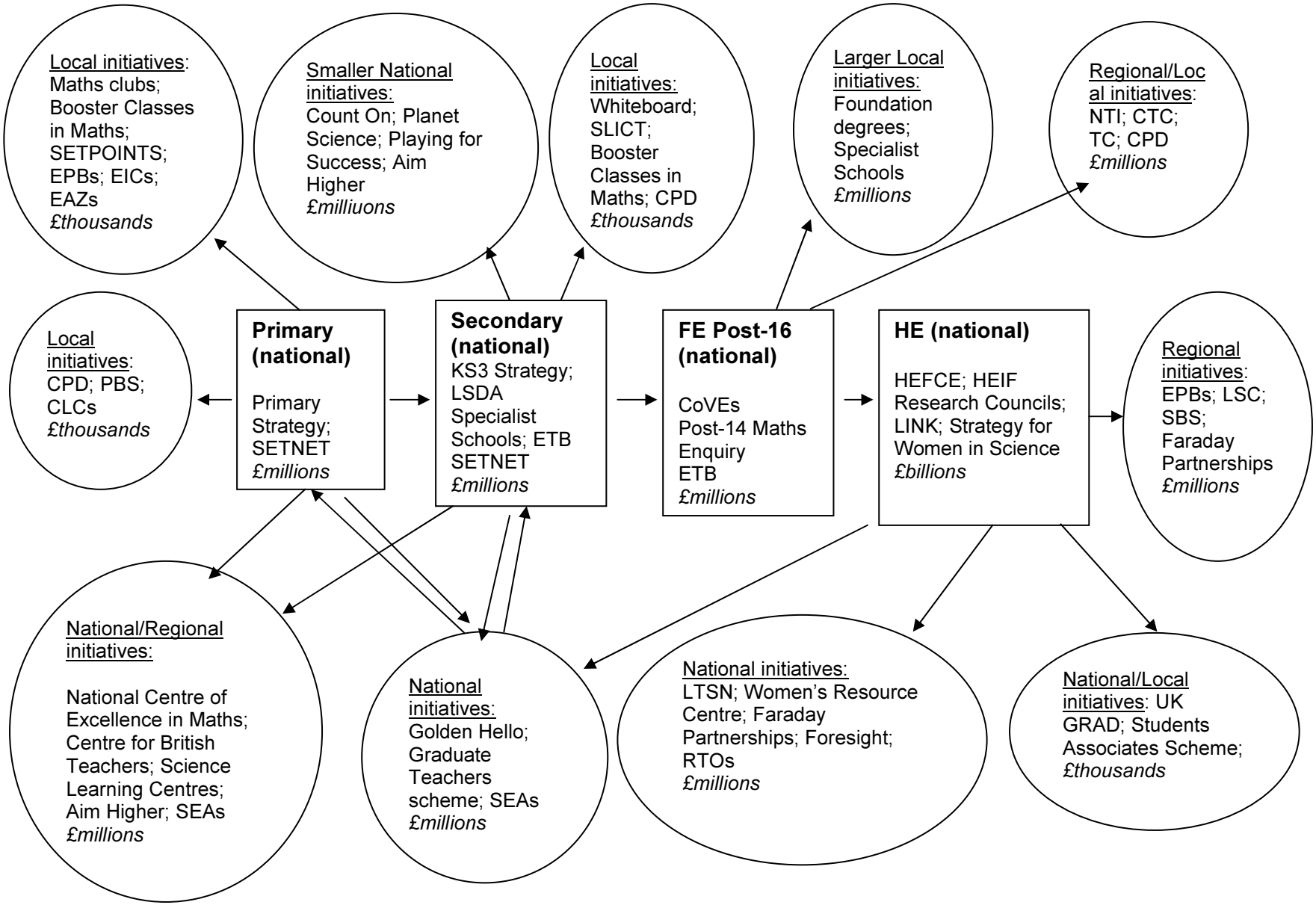
Roberts Recommendation	Total amount of initiatives supporting this rec.	Breakdown of the Initiatives		How the initiatives contribute to the recommendation
				students in Roberts shortage subjects to work in the UK for twelve months following graduation from a UK institution.

Overview of the linkages for the DfES and OGDs/Partners maps

2.49 The diagram on the next page attempts to encapsulate the linkages between the sectors; national strategies and regional and local initiatives; and the magnitude of funding attached to the initiatives. It shows that many of the national strategies/programmes generate local and regional initiatives or smaller national initiatives. The national programmes are funded in the region of millions of pounds whereas the local initiatives can be a few thousand pounds. It should be noted that all the initiatives are **NOT** shown on the diagram.

DfES & OGDs/Partners MAP

NB: *This diagram does not show all the initiatives mapped from DfES and OGDs/Partners.*

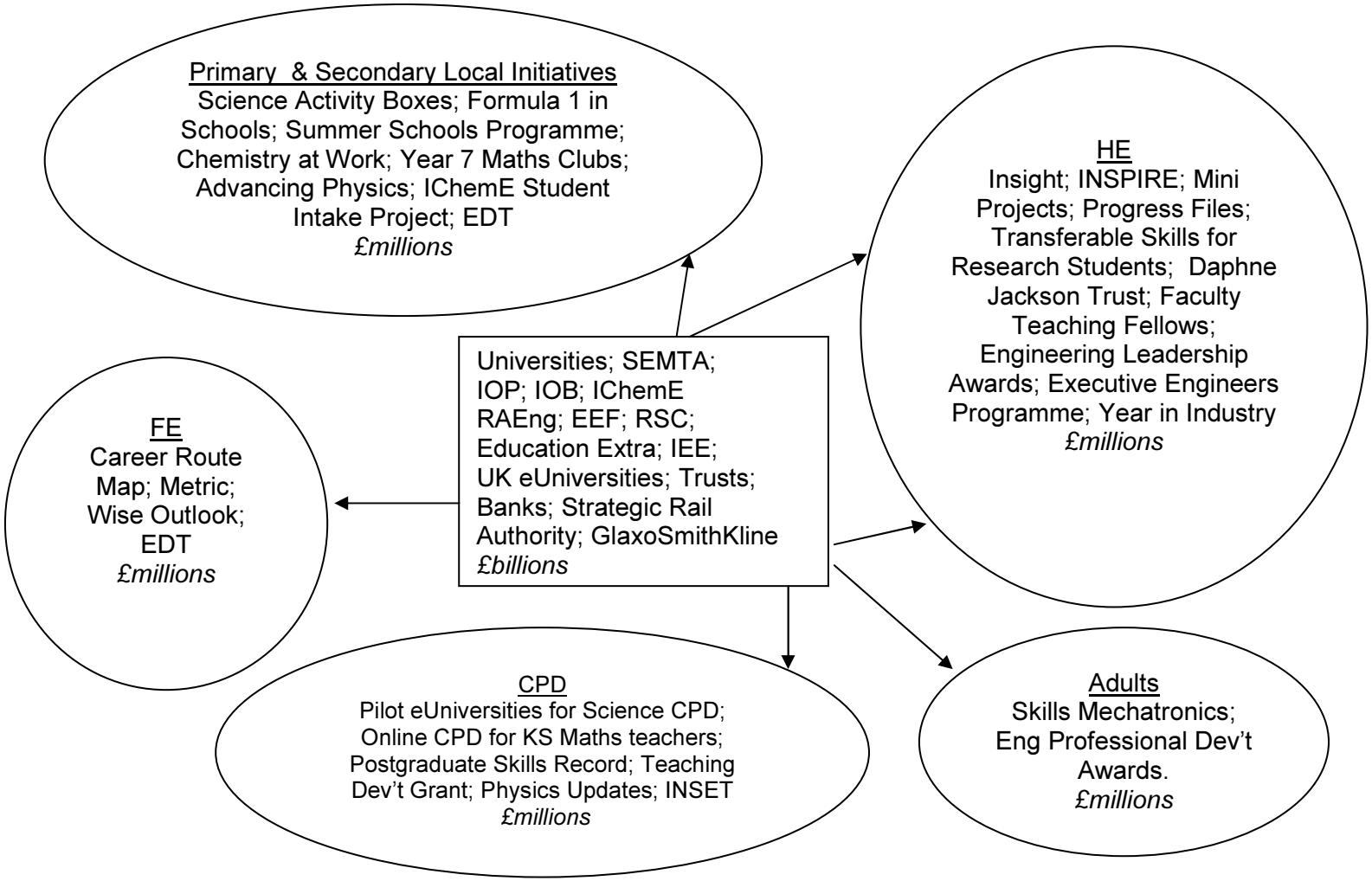


Overview of the linkages for the External contacts map

2.50 The diagram on the next page portrays the emerging picture from the mapping carried out on initiatives from External Contacts. The main players are external organisations such as subject associations, institutes or businesses. The diagram shows the sorts of initiatives going on in the respective sectors; primary; secondary, FE, HE and Adults; the linkages; and magnitude of funding. It should be noted that all the initiatives mapped are **NOT** on the diagram.

External Contacts Map

NB: *This diagram does not show all the initiatives mapped from External Contacts.*



SECTION 3

How are we managing the whole in relation to STEM?

3.1 The implementation of the Robert's recommendations has been managed effectively through various working groups which include the Knowledge Transfer; science in schools and colleges; and the science skills in HE education groups. HMT has monitored the work of these groups and significant progress has been made in implementing the recommendations.

3.2 Currently there are several national strategies in primary, 14-19, post 16 and HE in place. These include the National Primary Strategy, the Key Stage 3 Strategy, the Skills Strategy, the HE White paper, Success for All and the Post-14 Maths Inquiry which has recently just reported, to mention a few; but there is no forum to ensure that these strategies are joined up and are coordinated. There is a trend within the Department and across other Government Departments to reduce bureaucracy and rationalise planning. The Skills Strategy aims to create a new skills alliance which will link up the work of key Government departments involved with economic and skills issues – the Department for work and Pensions (DWP), DfES, DTI and Treasury which will go some way to achieving a joined up approach to policy development in the skills area. However, in relation to STEM there is no Government 'watchdog'/strategy group that might go some way to preventing programme/initiative overload, ensuring the quality and effective impact of initiatives on supply/demand and the coherence of the plethora of initiatives currently being taken forward within the Department, OGDs and by external organisations.

What are the gaps in relation to STEM?

3.3 From the findings of the review the following gaps have been identified.

- The need for better evaluation of initiatives in relation to supply/demand.
- The need for better coordination of all programmes and initiatives and to adopt a more holistic approach (an approach which looks at the whole/totality/the bigger picture and is a comprehensive approach) in order to bring coherence and make more of an impact.
- To combine, integrate, rationalise programmes and initiatives where necessary and build on initiatives already in place.
- The need for better coordination of initiatives promoted by external organisations. It is important to note that Government can only encourage cooperation and rationalisation of initiatives taken forward by external organisations. Umbrella organisations such as the ETB will be instrumental in taking this forward by encouraging networking and dissemination of good practice.

- Better links across the piece needed. The links across schools, FE, HE and employers to be made explicit to ensure a seamless transition across the KSs and bridge any gaps.

- To encourage promotion campaigns in engineering, science, maths and IT for girls/women/ethnic minorities and to integrate and build on existing campaigns collectively in order to make more of an impact.

- To focus on adults upskilling/re-skilling/cross-skilling, particularly in the engineering field and women returners to engineering.

- The further development of the role of employers with regard to training, development and career and pay structures for STEM employees.

- To further enhance the work underway in embedding a culture of innovation and enterprise from KS1 to graduate/post graduate level

- To take steps to change the poor image of vocational qualifications and raise their profile.

- To encourage better joint working between Government Departments, particularly between DfES, DTI including OST and the British National Space Centre (BNSC).

- To encourage regional organisations to work better together

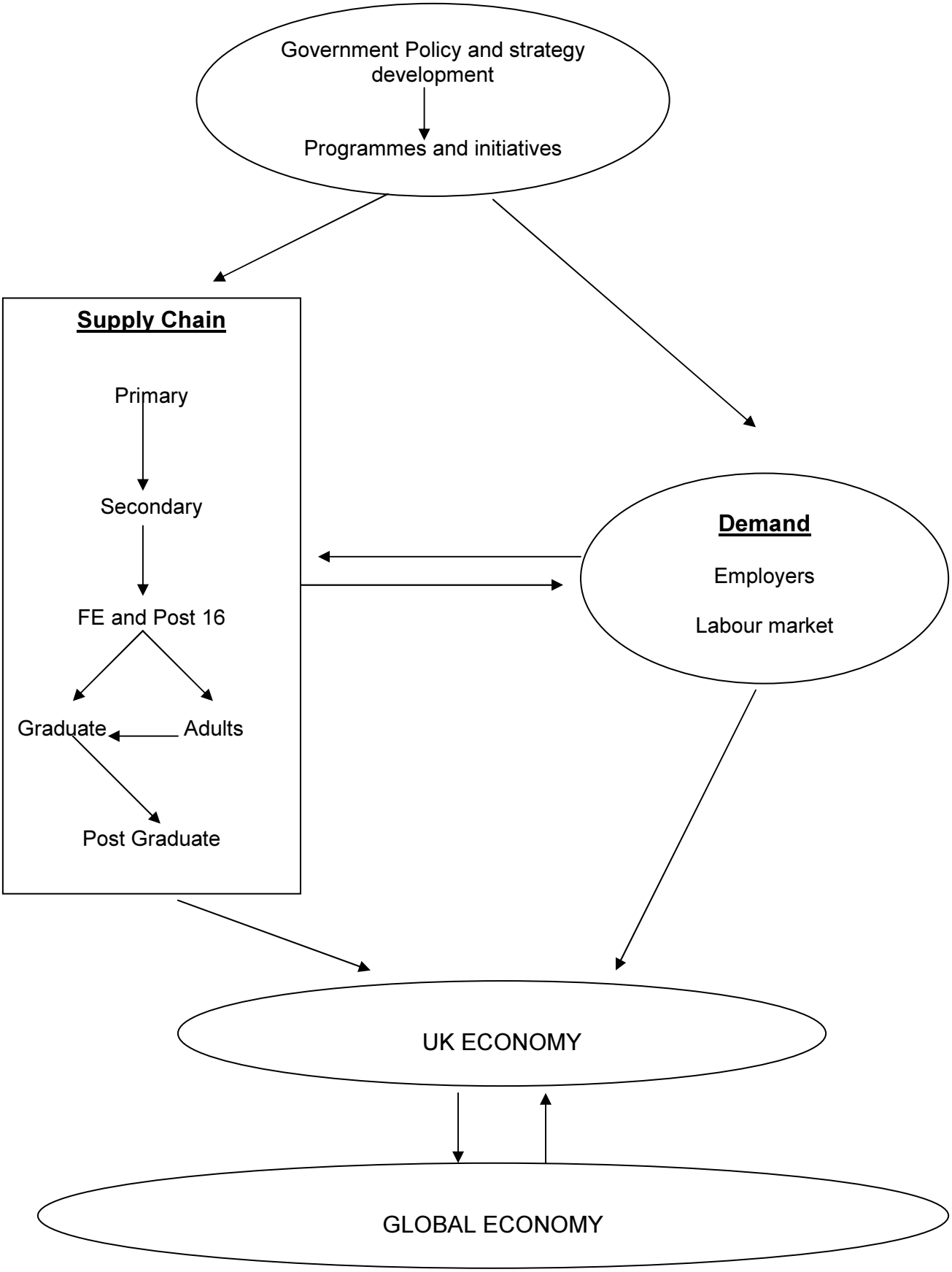
- Rationalisation of local contacts.

Supply/Demand

3.4 Job creation and wealth in the UK is dependent on a vibrant economy. A vibrant economy relies on the UK producing world class scientists and engineers who pioneer cutting edge research which can then be translated into products in order that the UK can compete in the global market. It is vital that we ensure the supply of the best science and engineering graduates. It is not enough to inspire graduates as the supply chain starts in primary school and possibly in pre-school where children need to be inspired and develop a passion for the sciences and engineering. The importance of a highly developed and competitive science and engineering base is widely acknowledged and accepted for economic growth and inward investment. Some countries have a cabinet Minister solely dedicated to lead on science and technology giving credence to the importance of science and technology.

3.5 The supply/demand model below demonstrates how Government policies, programmes and initiatives can impact on the supply chain and UK and global economy.

Supply/demand model



The STEM picture in the devolved administrations

3.6 It is helpful to see if there are similarities in the STEM picture in Scotland, Northern Ireland and Wales and what is being done to address declining numbers of graduates in STEM.

The Scottish Position

3.7 The Scottish Executive's Science Strategy commits the Executive to ensuring that enough people study science to enable Scotland's future needs to be met. The UK-wide Roberts Review indicated that, with the overall participation rates in higher education in Scotland being higher than in the UK, and with industrial R&D being relatively low, the problem of supply of scientists in Scotland was less than in the rest of the UK. The Executive is however considering commissioning its own analysis of the supply and demand for people with science qualifications in an attempt to further update and inform discussion on this issue, which continues to generate concern.

3.8 The trends in take-up of science as a subject at both school level and in tertiary education do not offer a simple picture. Although the overall number of applicants being accepted to study science and technology subjects, including mixed courses, at university is on the increase, there is a decline in the take-up of pure sciences, such as physics and chemistry, and engineering which is being offset by take-up of biological sciences and mixed science disciplines.

3.9 Many of the specific recommendations in the Roberts review about school education do not apply directly to Scotland because this is a devolved issue. However, the Executive considers that as a result of Scotland's Science Strategy it has been making good progress with the promotion of science education. In particular, significant new funding has been made available to Education Authorities (£18 million over 4 years from 2003/04) to employ additional science teachers, up-skill existing teachers and develop the science education infrastructure. The Executive is also: working with Learning Teaching Scotland to prepare exemplar material for teachers of science in primary and early secondary; promoting a major national programme of high quality professional updating and up-skilling for teachers with the support of the Scottish Science Equipment Research Centre; supporting the British Association for the Advancement of Science which delivers a UK-wide database of individuals and organisations who can provide science shows and talks to young people in schools; working with Careers Scotland to develop a 10 day Festival of Science and Enterprise; supporting the Scottish Space School Foundation which allows young people to have access to on-line NASA education materials and have the opportunity to meet NASA personnel in Scotland and Houston Texas; working in partnership with NESTA and Careers Scotland and has launched a small grant scheme in November 2003 to encourage young people to become more involved in science; and is working with SETPOINTS Scotland on the creation of a Handbook for Science Teachers which will provide a range of contacts from organisations that can provide help and support within the science curriculum.

3.10 Further Education colleges in Scotland have been involved in a number of key initiatives to promote SET and develop courses to provide Scotland with the skill base to support SET jobs. Amongst these are a number of innovative collaborative ventures: the Institute of Applied Technology (IAT) in Fife (a joint venture between Fife and Glenrothes colleges); the Scottish Colleges Biotechnology Consortium (SCBC) (involving Falkirk, Bell (now designated as an HEI), Fife and James Watt colleges); and the proposed Technician Training Centre of Excellence (a joint venture between Cogent, SEMTA, two private training providers and Falkirk College).

3.11 IAT delivers a broad engineering curriculum, providing skills for the growth in SET industries in the area and across Scotland, and has been closely involved in supporting the DTI's initiatives to encourage the participation of women in SET. In 2001-02, IAT saw an increase of 12% in the number of women attending courses. The project has been funded by a combination of Scottish Further Education Funding Council (SFEFC) grants, European Regional Development Funding and college resources.

3.12 SCBC was set up, supported by Scottish Enterprise under their 'cluster strategy' funding in conjunction with biotech companies (Avecia, Scotia, Beatson Cancer Therapies and Boots), SFEFC and the colleges involved. The scheme has established state-of- the-art centres with all the necessary facilities and expertise to train technical staff to work in any sphere of the biotechnological industry, from medical diagnostics to environmental biotechnology.

3.13 The Technician Training Centre of Excellence will, on completion in 2004-05, provide training for the petrochemical and related industries. This aims to be a cross-Scotland project, drawing in trainees from industry in all parts of Scotland and eventually using college provision and expertise from colleges other than Falkirk. The project also aims to recruit students from overseas.

3.14 Since 2000, SFEFC has organised and encouraged the practice of supply and demand studies to map provision of courses in FE across Scotland. Most recently, three Lanarkshire colleges (Cumbernauld, Lanarkshire and Motherwell) commissioned research which will help to inform links and synergies which can help subject areas like electronic engineering to sustain a drop in uptake to ensure the skills are not lost in the future.

3.15 In Higher Education, major increases in funding for science and research have been announced at a UK and Scottish Executive level. This includes boosting SHEFC's budget for research by 20% over the next 3 years; a further £70 million is expected to be won by Scotland as a result of increased funding of the UK Research Councils. These increases will reinforce the message that science is a high priority area.

3.16 The independent Scottish Science Advisory Committee is planning to advise the Executive on priorities for science education in Scotland in the form of a report, which it plans to publish in early 2004.

he Northern Ireland position

3.17 In contrast to the position in England, the supply of scientists and engineers in Northern Ireland exceeds demand, leading to graduate migration mainly to GB. However, this analysis conceals the fact that there is a potential shortfall in the supply of skilled labour, particularly graduates, in the priority skills areas of the IT, electronic engineering and mechanical engineering sectors. An exploratory study1 by Shuttleworth and Osborne (2003) of the patterns of uptake of maths and science at GCSE and A-level concluded that solutions to this shortfall might include attracting back graduates who left NI for jobs elsewhere in the UK or gaining skilled labour through immigration from outside the UK. The study also found that, while females were more successful in maths and science at GCSE level, far more males than females chose to study these subjects post-16.

3.18 At degree level, compared with an increase in entrants of 65.5% in 2000/01 over 1994/95, STEM entrants have increased by 63.7%. However, this, again, conceals substantial variations. In common with England, there has been a marked decline in uptake of chemistry (62.3% or 66 fewer entrants) and physics (39.6%, 32 fewer entrants), contributing to a decline in uptake of physical sciences of 28% (132 fewer entrants). This compares to an increase in uptake of computer science of 217.4% (935 entrants) and in languages of 279.3% (902 entrants).

3.19 The Department for Employment and Learning are implementing the increased postgraduate stipends recommended by Roberts, in line with GB students in receipt of Research Council stipends. The following rates now apply: £9,000 (2003/04 AY), £10,500 (2004/05) and £12,000 (2005/06). In addition, as a result of recommendation 4.3 of the Roberts Review additional support for research student training in transferable skills will be made available to both universities in Northern Ireland from the 2003/04 academic year in line with Research Council support.

3.20 At the school level, the Department of Education (NI) are involved with the UK-wide 14-19 Maths Inquiry which is due to publish shortly. DE was also involved in Science Year which was extended to June 2003 and which sought to raise the profile of science in schools, colleges and with the general public. The Northern Ireland Council for Curriculum, Examinations and Assessment (CCEA) is piloting a new Occupational Studies qualification from September 2003, which amongst a range of occupational areas includes units on Engineering and Digital Technology. All units are offered at Entry Level and Levels 1 and 2 of the National Qualifications Framework. CCEA has also developed GCSEs in Applied Science and Engineering (first teaching September 2002, first award summer 2004).

[1] Potential Skills Shortages and Inequalities in Educational Uptake (DEL: Labour Market Bulletin no. 17)

3.21 The broader picture of government funding of HE research in NI as a whole has improved markedly over the past couple of years. QR funding for 2003/04 has been increased by 33% over the baseline for 2002/03, while the Support Programme for University Research will invest a total of £93million over the years 2001 to 2007, of which some £69million will support projects involving STEM including those identified as priority skills areas (see the DEL website for more details). DEL has also supplemented the SRIF 2 OST allocation with an additional £7.7.million. It is also committed to working closely with the OST and other stakeholders as the other recommendations of "Investing in Innovation" are implemented.

The Welsh Position

Teaching

3.22 The Wales position largely mirrors that of England. The main issue is the difficulty in recruiting maths/ science teachers in schools, which is compounded in Wales by the added problem of finding teachers capable of teaching through the medium of Welsh.

3.23 In respect of teachers' professional development (para 2.14) the Welsh Assembly Government's Leadership programme is not explicitly linked to literacy and numeracy as it is in England. Continuing Professional Development (£5m in 2003-04) funds a variety of developments with the emphasis on raising standards of teaching and learning, but not specifically targeted at science, maths and technology.

Learning- Basic Skills

3.24 The Assembly Government takes an all-age approach to improving basic skills in Wales. In the current year a £12.6m programme supports a range of developmental and promotional activity to improve numeracy and literacy for pre-school children, school and college pupils, for those in employment and other adults. The Skills and Employment Action Plan for Wales has a specific action point to raise standards of numeracy and interest in maths, including the appointment of a national co-ordinator to encourage and organise activities that promote positive attitudes to maths and support the professional development of teachers.

SET - Links with Business

3.25 The UK-wide scheme, *Knowledge Transfer Partnerships,* (aimed at transferring technology into companies by utilising the expertise of a University or college and a suitably qualified graduate or NVQ level 4 student (Associate)) is highly successful, and usually results in employment for the Associate at the end of the project. Wales mainly sponsors technology transfer within business and has recently extended the scope of the scheme to look at wider areas such as health, education, community regeneration etc.

3.26 *Wales Innovators Network* is a project recently established by the Welsh Assembly Government to provide free expert advice to lone inventors to assist them to exploit their ideas. The Assembly is working with Headstart (an organisation funded by the Royal Society of Engineers to promote the importance of engineering) to target those graduates or post graduates living in Wales who may have ideas they wish to pursue as individuals.

3.27 *WISE in Wales* is a voluntary committee which aims to promote SET to young girls. The Welsh Assembly sponsors various activities, eg, it plans to run University Taster days this year (12-13 year olds spend the day at University learning about science and engineering as a career). For primary school girls Headstart and Techniquest have been commissioned to run a pilot series of science activity days. Previous students from the Headstart programme will act as role models and mentors for the day. If successful the Assembly will l seek funding for future delivery.

3.28 *Student Innovation Awards* is a scheme that celebrates design and technology projects in schools. WDA have undertaken workshops to ensure that Design and Technology teachers are aware of the latest industrial techniques and patenting legislation.

Buildings

3.29 Under the School Buildings Improvement Grant (SBIG) arrangements, local authorities each receive an annual formula share of grant for school buildings. It is up to each local authority to decide how to prioritise. Building or refurbishment of science labs is eligible expenditure and some authorities have used grant funding for that purpose.

3.30 More generally local authorities are seeking to address deficiencies in science lab provision as part of the overall drive to improve school buildings and their fitness for delivery of the national curriculum. Some authorities are funding this through their own capital resources or through use of SBIG or a mixture of the two.

3.31 The Welsh Assembly Government does not have a dedicated fund for investment in science labs. Funding of new or renovated science labs in voluntary aided schools is eligible for funding under the Assembly's voluntary aided schools programme.

FE Institutions

3.32 In 2002 Fento published a report: 'The Skills Foresight Survey of FE Colleges in Wales 2002', which found no overall recruitment difficulties. However it did identify problems in recruiting FE teachers in engineering, computing and IT, applied sciences and business and management.

3.33 The Assembly is surveying Welsh FE institutions regarding the success of the PGCE (FE) teacher training bursary incentive scheme, and several Welsh

FEIs have suggested targeting this bursary at graduates in shortage subjects, such as IT or engineering.

Sector Skills Council

3.34 The Skills for Business Network Wales represents all SSCs under licence in Wales. Many of the SSCs are taking forward work in the STEM areas, and information they yield is used by ELWA to determine the planning and funding provision for the post 16 sector.

SECTION 4 – RECOMMENDATIONS

Recommendations

4.1 The DfES, OGDs and external organisations are already very active in developing programmes and initiatives to support the development of the supply chain. However, this review has highlighted the plethora of programmes and initiatives available and the distinct lack of coherence and coordination in taking these forward. The Government needs to take the lead, have a strong voice and be more proactive in ensuring a holistic view in the development of policy and strategy in STEM is taken forward. This will ensure that an effective impact is made on the supply/demand of STEM graduates to meet the needs of the labour market. It is recommended that:

- A cross – cutting programme in STEM is developed to take forward better coherence and coordination of programmes and initiatives within the DfES, within OGDs and external organisations, and to address the gaps identified in this review;

- Government should lead the way in taking forward a holistic view on policy and strategy development in STEM;

- Government encourages better joined up planning in relation to delivery of future programmes and initiatives;

- Government sets up a high level strategy group chaired by Alan Johnson, the Minister of State for Lifelong Learning and Higher Education, given that there are a number of DfES programmes and initiatives that need better coordination. The purpose of this group will be to set and agree overall priorities e.g. evaluation, and review progress from time to time, e.g. annually.

- The high level strategy group includes representation from senior members from across Government, umbrella organisations and industry – notably the DfES; DTI/OST; British National Space Centre (BNSC); Treasury; Cabinet Office; the Engineering and Technology Board (ETB); the Advisory Committee on Mathematics Education (ACME); the Science, Engineering and Manufacturing Technologies Alliance (SEMTA); the Association for Science Education (ASE); The Science Council; BAe systems; Glaxo Welcome, IBM etc.

- The high level strategy group oversees three working groups which will take forward closing the gaps identified in this review and better coordination of programmes and initiatives across Government and external organisations. This high level strategy group will agree overall priorities and review progress of the working groups as necessary. It is

important not to be over-ambitious. There are literally hundreds of organisations engaged in the promotion of STEM to the young across the UK and Government can only encourage co-operation and rationalisation, particularly with external organisations.

- An officials' working group 'A' takes forward systematically the task of improving coherence and coordination across Government and externally in STEM and includes representatives from umbrella organisations and Government. It is suggested that DfES/DTI Government officials jointly chair this group and the work of the group includes:

    - rationalising, integrating and building on current programmes and initiatives. The information provided in the findings from this review is a good starting point as well as lessons to be learnt from the Royal Academy of Engineering's 'Best' programme which is a unique tiered programme offering schemes starting from primary education, through secondary to undergraduate and postgraduate. This group will effectively oversee the coordination and rationalisation of initiatives to address and avoid the current scatter gun approach and initiative overload;

    - ensuring that this programme of work feeds into the Skills Strategy;

    - ensuring that the quality and effectiveness of the impact of programmes and initiatives are properly considered and better standard evaluation systems are in place across Government which incorporate supply/demand impact;

    - ensuring that this work is joined up with the work of the DTI's Science and Society Directorate which will be taking forward best practice in evaluation; and

    - ensuring better joint working between DfES, DTI and BNSC at official level.

- Working group 'B' is chaired by a DTI official and the work of this group includes:

    - establishing a common statistical evidence base in STEM across Government which can be easily compared, developing a clearer understanding of what the underlying issues are so that Government is better informed to develop future policy. This work may need to be commissioned, carried out by consultants and managed jointly by DfES and DTI;

    - identifying the most appropriate way to make explicit links across schools, FE, HE and employers to ensure that pupils/students are able to make a seamless transition across the key stages through to FE/HE and that any gaps are bridged. This maybe through the further development of SETPOINTS/EBPs and the science learning centres;

- identifying how regional organisations can best collaborate and work together, whether this maybe through the establishment of a national network of regions/regional contacts; and

- commissioning a study to investigate further the rationalisation of local contacts.

- Working group 'C' will include representatives from Industry, Sector Skills Councils, umbrella organisations and Government. It is suggested that this group is chaired by SEMTA's CEO or by a subject association/umbrella organisation such as the IOP, ETB or CBI. This group would be invited to include work on:

    - taking forward any promotional activities with regard to campaigns to raise the profile of engineering, science and IT for girls/women/ethnic minorities, adults upskilling, the image of vocational qualifications and marketing science and engineering courses;

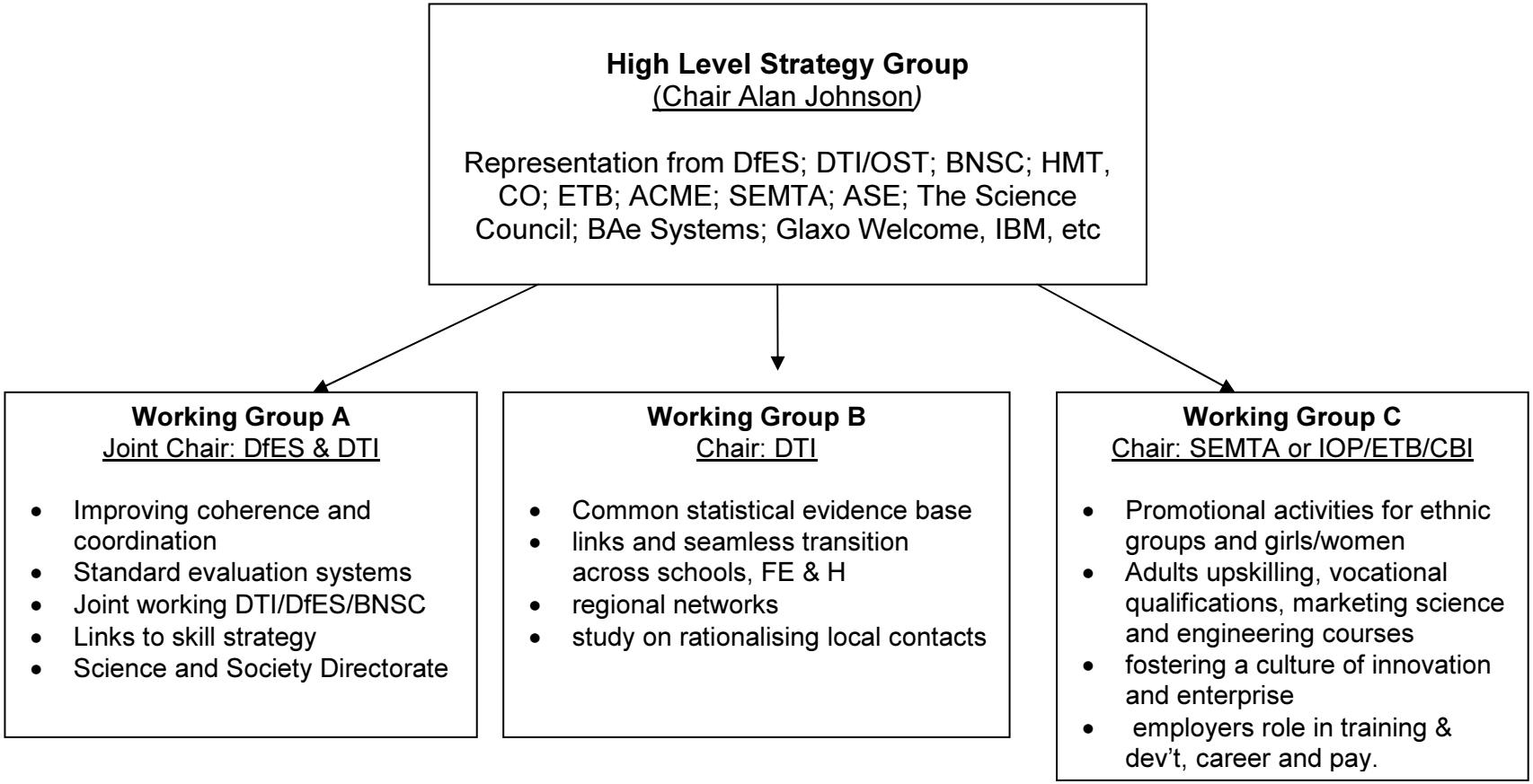
    - ensuring there is a focus on promoting engineering and science to girls, women and ethnic minorities and a coordinated approach is adopted, activities are integrated, building on what is already being taken forward to maximise the impact and make a real difference and good practice is disseminated;

    - enhancing the work already underway on fostering a culture of innovation and enterprise from KS1 to graduate/postgraduate level; and

    - developing further the important role that employers play with regard to the training and development, and career and pay structures of their employees.

4.2 The details of the above proposed structure is outside the scope of this review and will be taken forward as the next phase. However, the rationale for the above proposed structure for the cross-cutting programme is based on and similar to a structure that has been tried and tested and was used to deliver the Department's 'Getting the Best from Each Other' project, part of the Supporting Better Delivery programme. This project had a high level strategy group which was chaired by Ivan Lewis and was successful in achieving its outcomes. This proposal provides a workable structure which will be able to tackle the wide ranging tasks identified in the review and achieve the desired outcome.

ORGANISATIONAL STRUCTURE FOR CROSS-CUTTING PROGRAMME



Next Steps

4.3 There is a lot of work to be done in developing the cross-cutting programme. The next phase will involve the development of a programme plan, with clear milestones. Terms of reference for each working group would need to be worked up and strand leaders identified. Policy leads from all departments would need to be involved in drawing up clear objectives for the TOR for each working group. The working groups will drive the programme forward and report progress to the high level strategy group. The high level strategy group will steer and advise on the work being taken forward. This structure will make 'joining up' and addressing the gaps identified in this review a reality. It will be part of the remit of the working groups to ensure that partners are signed up to this holistic approach to policy and strategy development in STEM. The programme would then have the added value of using Government and other resources available for STEM in the most efficient and effective way. There is also the potential for savings to Government Departments as a result of any rationalising and integrating of some of the initiatives and a re-focusing of available funding.

4.4 For the cross - cutting programme to maintain its credibility and add value to our partners both in industry and the education sector it is important for the outcomes to be comprehensive and cover the broad sweep of STEM activities. Success criteria would need to be identified early on in the programme as a means of fully evaluating the thrust of the programme.

4.5 There would be the potential for Ministers, Alan Johnson and Lord Sainsbury to make a joint announcement in the new operational year about the cross – cutting STEM programme and to publish the STEM mapping report with a forward from both Ministers endorsing the programme. The cross – cutting programme would also provide the opportunity to engender a holistic approach and bring the work on women in information technology, engineering and computing (ITEC); ethnic minorities in STEM – the SET 4 Equality, Ethnic Minorities into Science, Engineering and Technology (EMSET) project led by the Science and Engineering Manufacturing Technology Alliance (SEMTA); and aspects of the Post -14 Maths Inquiry under one umbrella.

4.6 Although there has been no formal consultation on this review, many departments and organisations have been contacted and consulted in the process of the mapping exercise, focus groups and meetings with stakeholders have taken place and many organisations are anticipating some action as a result of this review. The recommendations have been run past other Government Departments and several organisations. These have generally been welcomed particularly in relation to bringing better coherence and coordination to the number of initiatives and is regarded as something that is long overdue.

GLOSSARY

ABSU – Adult Basic Skills Unit

ACME – Association for Mathematics and its Applications

AHRB – Arts and Humanities Research Board

ASE – Association for Science Education

BNSC – British National Space centre

CBI – Confederation of British Industry

CCEA – Council for Curriculum, Examinations and Assessment

CfBT – Centre for British Teachers

CoVE –Centres of Vocational Excellence

CLC – City Learning Centre

CPD – Continued Professional Development

CRAC – Careers Research and Advisory Centre

CTC – City Technology College

DE – Department of Education (NI)

DEL – Department for Employment and Learning

EAZ – Education Action Zone

EBP – Education Business Partnership

EIC – Excellence in Cities

ELWA – Education and Learning, Wales

EMTA – Engineering and Marine Training Authority

ESPRC – Engineering and Physical sciences Research Council

ETB - Engineering and Technology Board

FD – Foundation Degree

FE – Further Education

FEC – Further Education Colleges

GO – Government Offices

HE - Higher Education

HEFCE – Higher Education Funding Council for England

HEI – Higher Education Institute

HEIF – Higher Education Innovation Fund

HMT – Her Majesty's Treasury

HESA – Higher Education statistics Agency

IAT – Institute of Applied Technology

IOP – Institute of Physics

ITEC – Information Technology, Engineering and Computing

KS – Key Stage

KT – Knowledge Transfer

LEA – Local Education Authority

LINK – LINK Collaborative Research programme

LFS – Labour Force Survey

LSC – Learning and Skills Council

LSDA – Learning and Skills Development Agency

LTSN – Learning and Teaching support Network

MA – Modern Apprenticeship

NASA – National Aeronautics and Space Administration

NEBP – National Education Business partnership.

NESTA – National Endowment for Science, Technology and Arts

NNS – National Numeracy Strategy

NPL – National Physical Laboratory

NTI – New Technology Institute

NVQ – National Vocational Qualification

OFSTED – Office for Standards in Education

OGD – Other Government Department

OLS – Overseas Labour Service

OST – Office of Science and Technology (DTI)

PGCE – Post Graduate Certificate in Education

PSET – Public Engagement with Science and Technology Team (OST)

QCA – Qualifications and Curriculum Authority

QR – Quality Related

RC – Research Council

R & D – Research and Development

RDA – Regional Development Agency

SCBC – Scottish Colleges Biotechnology Consortium

SFEFC – Scottish Further Education Funding Council

SHEFC – Scottish Higher Education Funding Council

SEA s – Science and Engineering Ambassadors

SEMTA – Science, Engineering and Manufacturing Technologies Alliance

SET – Science, Engineering and Technology

SETNET – SET Network

SETPOINTS – 53 point UK programme established by SETNET

SFEFC – Scottish Further Education Funding Council

SHEFC – Scottish Higher Education Funding Council

SLICT – The Strategic leadership of ICT

SRIF – Science Research Investment Fund

SSC – Sector Skills Council

STEM – Science, Technology, Engineering and Maths

TC – Technology College

TTA – Teacher Training Agency

WDA – Welsh Development Agency

Key to Maps, Tables and Figures

SCI - Science

TECH - Technology

ENG - Engineering

MATHS - Mathematics

STEM - Science, Technology, Engineering and Maths

IT - Information Technology

KT - Knowledge Transfer

TEA - Teaching

TEA (. . . subject of teaching initiative)

“Pri only” – primary initiatives or programmes covering key stages (KSs) 1 and 2

“Sec only” – secondary initiatives or programmes taking place at secondary level and covering KSs 3 and 4 and up to ‘A’ level

“FE only” – initiatives taking place at post-16 level including ‘A’ level and up to degree level

“HE only” – initiatives taking place at university level including undergraduate, graduate and postgraduate

“Adults only” – initiatives for adults.

"Adults+" - Initiatives or programmes taking place in the Adults sector plus the other sectors of education at the same time.

“Pri+” - Initiatives or programmes taking place in the primary sector plus the other sectors of education at the same time.

"Sec+" - Initiatives or programmes taking place in the Secondary sector plus the other sectors of education at the same time.

"FE+" - Initiatives or programmes taking place in the FE/Post 16 sector plus the other sectors of education at the same time.

“HE+" - Initiatives or programmes taking place in HE sector plus the other sectors of education at the same time

"Adults++" - Initiatives or programmes taking place solely within the Adult sector, plus adults initiatives involving the other sectors of education as in "Adults+" above.

“E+” represents initiatives or programmes evaluated and appear to be working or producing positive results

“E” means some sort of "evaluation" ongoing including end of year reviews to check whether programme is worth pursuing further

“NE” means not evaluated for any reason

“NEA” - no evaluation anticipated

R - Initiative or programme commissioned by DfES in response to a Roberts recommendation

R% - percentage of programmes pursuing a Roberts recommendation in sectors of education. Please note that this is column-specific.

LIST OF TABLES

LIST OF CHARTS