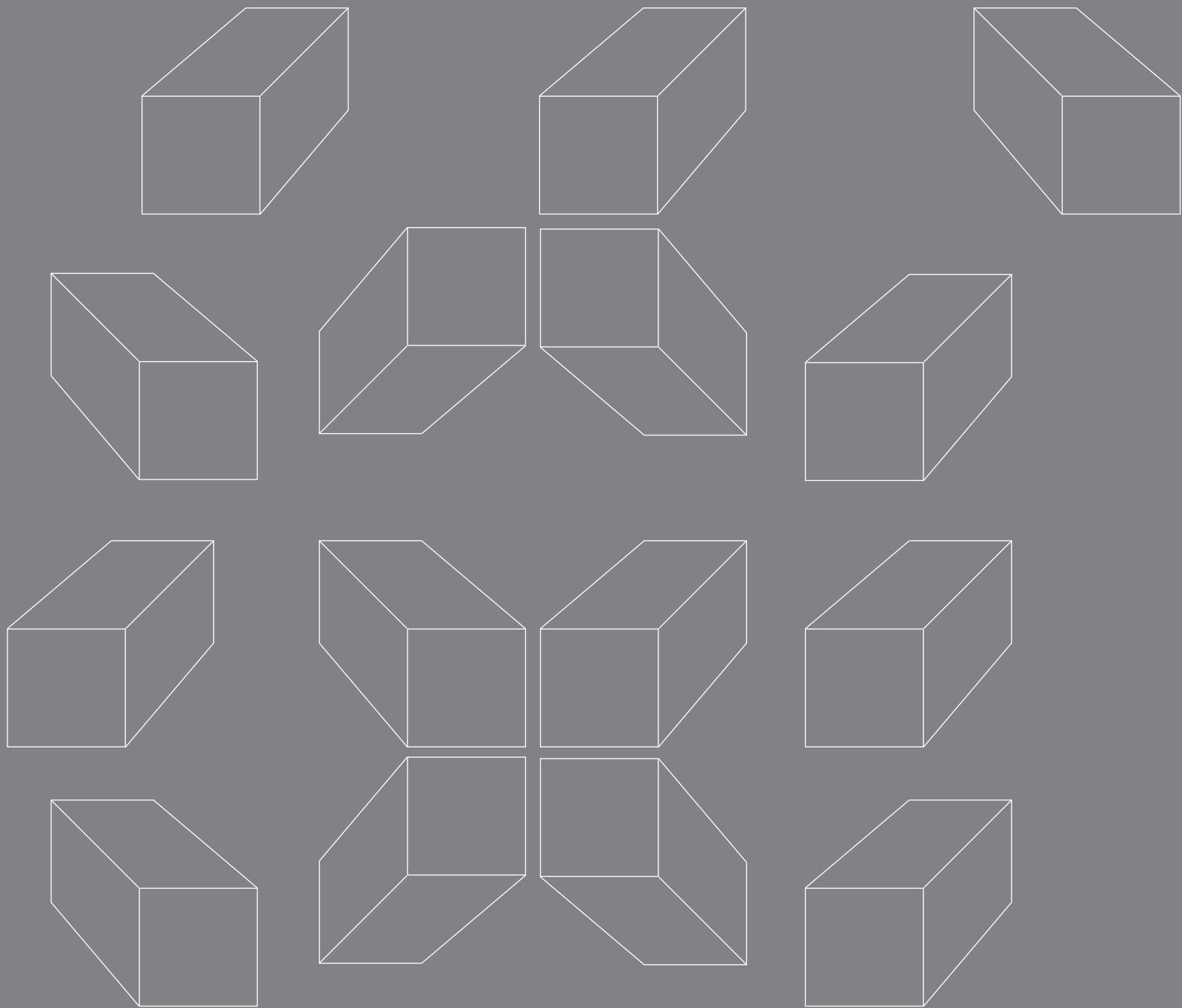
National HE STEM Programme

Lessons Learned and Achievements from the National HE STEM Programme Higher Level and Graduate Skills Development Projects

Jay Consulting (Jane Kettle and Judy Smith)



National HE STEM Programme

UNIVERSITY OF BIRMINGHAM

STEM Education Centre

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About this document

In September 2011, the National HE STEM Programme identified six priority areas of activity for its final year of operation. One of these areas focused upon capturing the collective learning that emerged from the Programme and its projects in order that it might be further utilised by the higher education sector in the future. This report was commissioned in support of this aim, and seeks to explore the achievements and findings from the National HE STEM Programme activities concerned with higher level skills, workforce development and graduate skills within the STEM disciplines. The findings it contains will be relevant to anyone seeking to undertake and embed curriculum innovations or enhancements in these areas. The National HE STEM Programme is grateful to the authors of this report for their hard work and dedication, and to thoseproject leads who contributed by willing sharing a range of information, advice and experiences.

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Summary

This publication has been researched and produced by Jay Consulting (Jane Kettle and Judy Smith) on behalf of the National Higher Education Science Technology Engineering Maths (HE STEM) Programme. It reports on the achievements of the National HE STEM activities concerned with higher level skills, workforce development and graduate skills developments in the STEM disciplines. Its focus is projects funded through two strands of the programme: the Legacy Projects and Regional Action Plan Projects. Information was provided to Jay Consulting by those who facilitated the projects in the six regional spokes and from the central Hub for the HE STEM Programme. Jay Consulting has synthesised significant learning from these projects into a thematic framework. The report should be read in conjunction with the companion publication, the 'National HE STEM Programme Higher Level and Graduate Skills Development Projects: A Contextual Compendium' which provides a background literature and policy review on employer engagement and employability developments in the Higher Education sector.

The report is arranged as follows:

Part One introduces the report and accounts for the approach taken by Jay Consulting to gather the material. It explains the background to the projects, outlining the importance of employer engagement, workforce development and lifelong learning, and graduate skills and locating these within the STEM specific disciplinary contexts and the National HE STEM Programme.

Part Two provides a brief description of the projects to describe their purpose and locate the thematic discussion in practice.

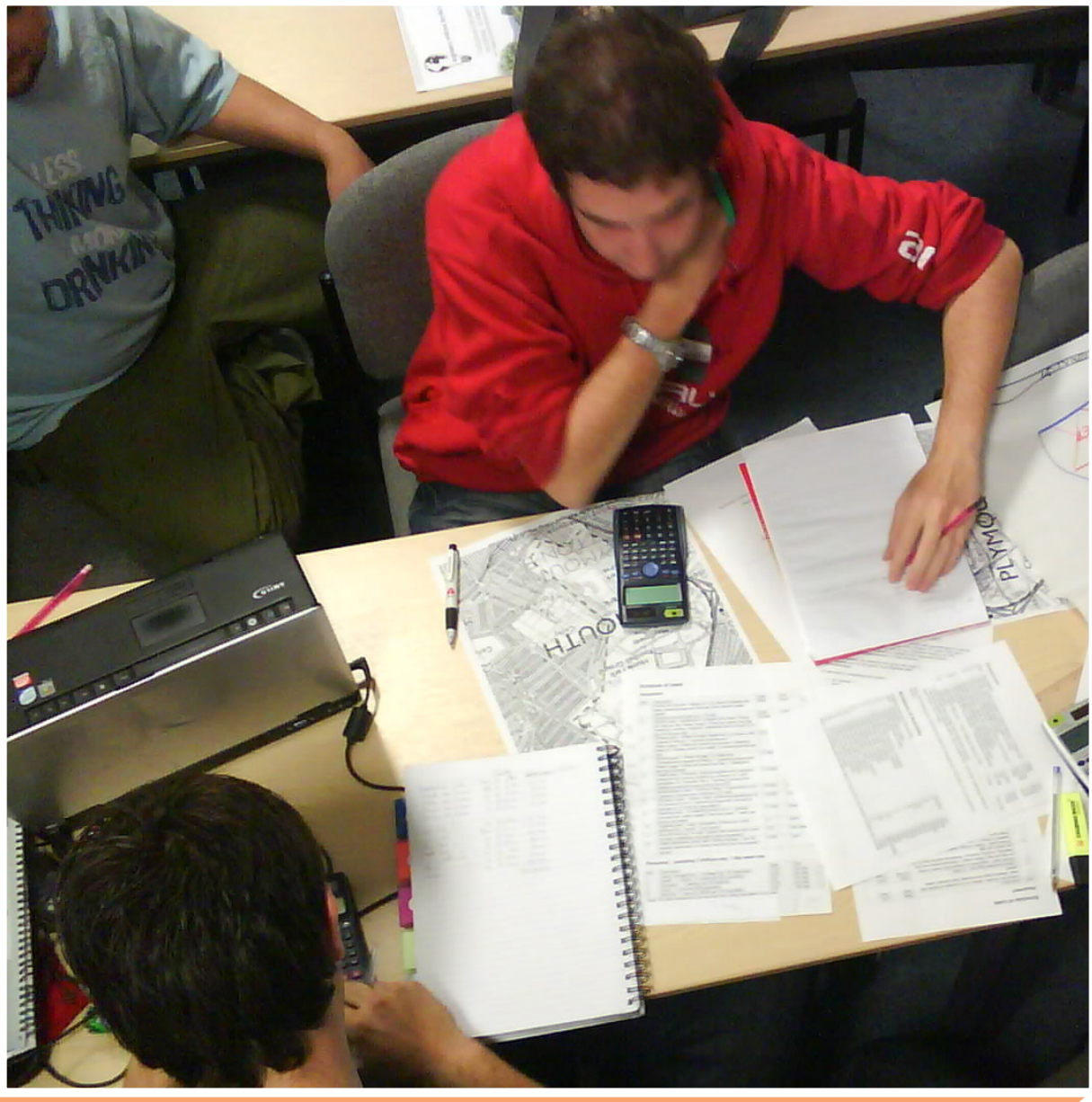
Part Three explores the extent to which projects introduced change within an institution, and highlights impact, whether at a department level, pan-faculty, or across the entire university. For some projects, this type of activity was a new direction. For others, there was an institutional history and track record of supporting this type of endeavour, albeit not necessarily in STEM departments. The evidence here indicates that the strategic priority of the university has had an influence on the direction of change and on whether developments have been viewed as a peripheral activity or as a central function of the HEI.

Part Four reflects on how the projects approached workforce development, employer engagement and lifelong learning. This section reviews the activities of the projects and the learning achieved, by noting significant processes, challenges and successes. Two main themes illustrate the approach projects have taken, firstly how employer alliances have been developed including the types of engagement, work with employer and industry sector groups and collaborations for effective employer engagement, and secondly curriculum and pedagogic developments with a focus on models of flexible and responsive HE provision.

Part Five addresses the graduate skills initiatives. The HE STEM Programme directed projects to explore ways for employers to contribute to undergraduate teaching, learning and project work and involve them in course design and delivery. The emergent themes include how projects ensured the relevance of HE programmes to the world of employment, the development of placements and work experience, improved career advice and management, and student engagement with graduate skills initiatives.

Part Six summarises some of the challenges that the projects have grappled with and explores how their achievements might be sustained in terms of pedagogy and dissemination.

The report concludes with a reflection on evidence of innovation, regional differentiation, and potential influence on the STEM sector in the context of the changing landscape of higher education.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Part One: Introduction and Background

This report summarises the outputs and highlights the key achievements of six regional Spoke Legacy projects and 50 regional projects (48 Regional Action Plan Projects and 2 Hub Projects, now all referred to as RAP projects) funded through the National Higher Education Science, Technology, Engineering and Maths (HE STEM) programme. Its purpose is to synthesise the activities and outcomes of the Legacy and RAP projects for the Higher Education (HE) sector and other stakeholders. It provides evidence of innovative approaches, and transferable models and programmes of activity across the disciplines of Chemistry, Engineering, Mathematics and Physics, with specific reference to learner access, skills development and employer engagement.

The report provides a fresh and insightful synthesis of the range of projects undertaken by institutions across six regions who have worked both independently and together to address local issues. The report is a distillation of the experiences of those who delivered the projects and is not intended to be a comprehensive record of the many activities which have been carried out. It notes, however, some of the common approaches that are influencing the way higher education institutions (HEIs) through their faculties and departments engage with employers to provide learning opportunities that support workforce development for higher level skills. It also explores how HEIs ensure that students graduate with the skills and work-related knowledge required by local, national and international STEM employment sectors.

Report Background

The report is the outcome of work carried out by Jay Consulting (JC) on behalf of the National HE STEM Programme and six regional spokes[1]. The purpose of the JC project was to:

- Provide a qualitative but evidence-based account to showcase to the sector the achievements of the projects in the 6 regions that were funded through the National STEM Programme
- Demonstrate to the STEM academic community and beyond how cultural change in Higher Education can be influenced through the development of collaborative and sustainable processes and opportunities that benefit students, HEIs and employers
- Assess how the activities undertaken by the projects will enhance and sustain STEM learning across education providers and employment sectors
- Provide an evidence-based resource to support sustainable development and future-proofing in STEM education and learning activities
- Produce a publication which captures the issues identified above to provide a resource that highlights innovative and transferable models of working for the sector.

Jay Consulting's remit was to highlight those areas of development that would demonstrate the range of activities undertaken by the Legacy and RAP Projects. A detailed national evaluation of all the HE STEM projects is underway at the time of writing and this report is not intended to be seen as part of that evaluation. Rather it provides additional evidence to support the rich picture emerging from the Programme. To do this, information was sought from all the projects to identify and collate outputs that could add to the national understanding of HEI experiences of engaging with employers and building effective alliances in support of graduate skills.

Information was obtained through a number of ways:

- Project report proposals
- Project interim and final reports
- Attendance at RAP and Legacy project workshops and steering group meetings
- Desk research scrutinising resources and project outputs
- Direct communication with project leads

All 56 individual Legacy and Regional Action Plan project leaders were contacted and asked to complete a schedule of questions, either in writing, or via a virtual meeting. The topics for discussion were agreed beforehand with the 6 regional directors and the national director. The qualitative questioning and structured discussions enabled Jay Consulting to develop a thematic reflection and offered the project leaders the opportunity to emphasise specific areas of their activity and to share the most significant aspects of their work. Individual responses were received from all but ten of the projects. We do highlight aspects of each project but acknowledge that where our material has been obtained from secondary sources it is less rich.

The research was carried out between January and December 2012. The report explains some of the processes and approaches that projects have followed, how they have engaged with a range of stakeholders including employer communities, academics and students, and how they are influencing on-going cultural change within institutions by working to embed and sustain project developments. It provides a narrative and context to the developing projects

1 The National HE STEM programme was managed as a "hub and spoke" model from the University of Birmingham. There were six regional spokes: London &South East, South West, Midlands & E. Anglia, North West, North East and Wales

and collates the learning into a synthesis framework to present a structure within which to reflect on the many strands of activity across the different geographical regions.

Projects that have addressed particular discipline areas of chemistry, physics, engineering and maths are noted. However less emphasis has been given to specific discipline communities as an overarching aim of the national project has been to disseminate the benefits, lessons learnt and the potential opportunities and challenges for integrated STEM development.

Explanation and definitions: an overview

The HE STEM programme aim is two-fold with respect to the higher level skills strand: to provide opportunities for people already in work to develop enhanced knowledge and skills through higher education, and to improve undergraduate higher education programmes for students to develop the range of knowledge skills and competencies to better prepare them for the workplace. These objectives require partners to develop their own understanding of the issues and concerns around these topics. Table 1 above provides an explanation of the key concepts referred to throughout this report. A literature and policy review providing further detail of the background and context for these developments can be found in the partner Contextual Compendium developed by JC.

Employer Engagement

The term employer engagement has been described as "the process through which employers directly participate in activity facilitated by an external organisation in pursuit of shared objectives"[2].

In the HE context engagement is a relatively new term. It has been subject to different interpretations, from the rather simplistic Higher Education for the Workforce[3], to knowledge transfer activities such as those supported by Higher Education Innovation Fund (HEIF) activity.

The recent Wilson Review[4] makes clear that business-university collaboration and employer engagement is variable across the HE sector including employee up-skilling, collaborative programme developments, business innovation and meeting business needs, applied research, or skills development for high performance working. Such approaches provide a landscape of variety and interest yet within and across HEIs the different elements often work separately or one can dominate at the expense of the other.

The concept of employer engagement in HEIs has been problematic. One reason for this is the inherent tension between the use of commercial and academic language among the different stakeholders. The university emphasis is on promoting qualifications and credit recognition which are generally attractive to employees. Employer organisations however may be seeking more general business solutions which are often reactive and more closely aligned to training needs and improved employee and organisational efficiency[5].

Employer engagement in the context of this report has a focus on employer responsive development for employee up-skilling or on developing undergraduate student skills and attributes to enhance employability across the STEM sector. Partnerships and collaborations with employers are central to the objectives of the projects.

Workforce Development and Lifelong Learning

There is no common definition of what workforce development really means in the context of Higher Education. In general workforce development involves providing the opportunity for people to undertake higher level learning, develop knowledge, vocational, professional and technical skills and competency development and their application and utilisation in the workplace. The learning is relevant to the requirements of the employer and involves skills development and up-skilling for the workforce but also for individual career progression through self-directed and lifelong learning. Professional development may be needed for compliance, and to develop and maintain generic, productivity, and technical attributes relevant to that profession for continued employability and professional recognition. Learning may lead to qualifications at Level 4 or above: degrees, foundation degrees, higher national diplomas, NVQs Level 4 and 5 and other professional qualifications. Increasingly this may also include non-accredited higher education learning.

Workforce Development as both a concept and an activity has been on the agenda of a number of HEIs certainly over the past 25 years, with universities working with employers to meet a variety of organisational requirements and challenges, including for example, increasing efficiency and productivity, improving staff loyalty and retention, addressing skills shortages, recruitment and talent management.

Much of the workforce development provision by HEIs over the last ten years has been driven by the national skills agenda, in particular the Leitch targets, but there have been other imperatives. One of these is business support needs to improve innovation, enterprise and creativity with the widening participation agenda also a driver. One means to increase participation in HE is through vocational or work-

based qualification routes, and increasing social diversity at certain HEIs through developing provision for targeted employees aims to address Government targets relating to social mobility improvement.

Workforce development and lifelong learning may take place at work rather than in an HEI but often these two elements are combined. Higher level study is often delivered in and around existing commitments of employees.

Becoming more responsive to the needs of employers and businesses presents HEIs with a number of challenges in relation to communications, flexible provision and sustainability and the STEM projects in this report have addressed some of these.

Graduate Skills

What constitutes graduate skills and the attributes that should be developed through higher education is contentious. Some HEIs argue it is not the place of a university to develop skills for employment: the approach is instrumentalist and universities are not training providers. Others recognise that HEIs do have a role to play in encouraging students in the development of the skills and attributes. All would agree that students leaving HE are attractive for recruitment by employers because of their particular subject knowledge and attributes such as critical thinking skills, problem solving and analysis, advanced techniques and application of evidence based solutions, and their broad understanding of ethical, social, cultural, environment and professional conduct issues[6]. These attributes it could be argued is what makes graduates distinctive and especially in the world of work.

There is increasing pressure from employers to ensure employees have the skills and competences to maintain global competitiveness. This places the skills and capabilities of UK graduates under scrutiny, with questions asked about their level of competence, understanding of the world of work and ability to step into work and quickly take on responsibilities at a level that reflects their educational qualifications[7]. In this context there is some dissonance between concepts of graduate attributes and the skills employers say they need for graduates to function effectively in the workplace. Such skills include self-management, team working, business and customer awareness, problem solving, communication and literacy, application of numeracy, application of information technology, entrepreneurship/enterprise and a positive 'can-do' attitude[8].

In the UK shifts in education and labour market policy have given increasing focus to this issue with universities accused of producing graduates deficient in skills deemed essential for enhanced productivity and innovation in the workplace. Although 82% of employers surveyed recently say they feel graduates are prepared for work but sometimes this criticism is levelled at the design, content and structure of HE programmes.[9] Consequently universities and HE providers are being urged to ensure that students leaving their institutions have attributes to be able to enter the graduate job market successfully.

It would appear that STEM graduates already have many of the skills that employers say they need and this is probably why many gain employment with non-STEM employers[10] yet there is also evidence that recruitment needs to improve into STEM professions and that STEM graduates need to be more reflective of their skills and capabilities and become more focussed on where the demand is for their skills and the requirement employers are looking for. This usually includes a stronger focus on the softer skills for employment and to understand business needs. It is important that graduates leave HE with an understanding of the many innovations technology, engineering and science will impact on employment in future years and the requirements for flexible skills and capabilities to respond to these changes The projects discussed here have addressed some of these issues of graduate employability.

Employability in this context is defined as *'a set of achievements, skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupation.'*[11]

Table 1: Explanation of the key concepts

2 Sector Skills Development Agency (2007) Employer Engagement Guidance, Astrid Flowers Ltd & Simpson Consulting Ltd p3

3 Wedgwood M. (2008) Higher Education for the Workforce: Barriers and Facilitators to Employer Engagement, DIUS Research Report, 08 04, p8.

4 BIS (2012) A Review of Business–University Collaboration, Professor Sir Tim Wilson DL, February 2012 http://www.wilsonreview.co.uk/review/

5 McDonald H. (2008) A Report on the Relevance of Language Barriers to Work Based Learning/Employer Engagement, LSDA

6 QAA Scotland (2009) Graduates for the 21st Century: Integrating the Enhancement themes http://www.enhancementthemes.ac.uk/docs/publications/graduates-for-the-21st-century-institutional-activities.PDF

7 CBI /UUK (2009) Future fit: Preparing graduates for the world of work, CBI http://www.universitiesuk.ac.uk/Publications/Pages/Futurefit.aspx

8 Ibid

9 Institute of Directors (2007) Graduates' employability skills, Skills briefing December 2007 http://www.iod.com/MainWebSite/Resources/Document/policy_paper_graduates_employability_skills.pdf

10 BIS (2011) STEM graduates in non-STEM jobs, BIS Research Paper number 31, March 2011

11 HEA (2006) Pedagogy for employability. Learning and Employability Series One. York: ESECT and HEA. http://www.heacademy.ac.uk/assets/York/documents/ourwork/employability/id383_pedagogy_for_employability_357.pdf

Higher Level Skills sub strands addressed by the Legacy and Regional Action Plan Projects	
Workforce Development and Lifelong Learning	The aim is to undertake activities to encourage those currently in the workforce and society to engage with further study to develop enhanced knowledge and skills and support enhanced engagement of employers within HE sector activity.
Graduate Skills – Development and Delivery	The aim is to provide opportunities for HEIs to work with employers to ensure undergraduate students develop the knowledge skills and understanding to be adequately prepared for participating in the contemporary and future workplace.

The National HE STEM Programme for Higher level skills, Workforce development and Graduate skills

The National HE STEM Programme ran from August 2009 to July 2012. The primary aim was to contribute to the development of a national higher education (HE) STEM sector, and to increase and enhance employees with knowledge and skills in these areas. The Higher Education Funding Council for England (HEFCE) provided £20 million of funding and the Higher Education Funding Council for Wales (HEFCW) provided a further £1 million for Wales. The programme engaged the following professional bodies: The Royal Society of Chemistry, Royal Academy of Engineering, Institute of Mathematics and its Applications and the Institute of Physics.

The National HE STEM Programme has been managed through a 'hub and spoke 'model with project activity led by the central hub or through six 'spoke' institutions that have regionally focused activities. The University of Birmingham was the central hub for the national coordination of the programme as well as undertaking regional activities (Midlands and East Anglia region), with the Universities of Bath (South West region), Bradford (North East region), Manchester Metropolitan (North West region), Southampton (South East region) and Swansea (Wales) managing regional projects.

The specific work around higher level skills, workforce development and graduate skills aimed to leave as a legacy 'a more flexible sector better prepared to meet the higher level STEM skills needs of the global workplace for the 21st Century'[12]. The legacy should make a contribution towards enhanced knowledge of effective practices and approaches to initiating changes in policy, institutional management, and teaching and learning practices across the HE sector. This includes not only influencing curriculum and teaching and learning practices but also outreach and developing relationships and networks with a range of stakeholders.

The Programme funded two strands of activity to deliver this ambition: the Legacy Projects (LP) and the Regional Action Plan Projects (RAPP). The call for proposals for these activities opened in September 2010 with projects beginning from January 2011. Each of the six spoke institutions identified one project to be developed as a Legacy and within each region participating Higher Education Institutions (HEIs) were invited to submit proposals for Regional Action Plan projects. HEIs included universities and Further Education Colleges (FECs) that provide Higher Education courses. A total of 50 projects have been funded to address employer engagement and graduate skills developments that are responsive to regional and local issues. The short timescale framed the scope and extent of the activities.

All the projects were activity-led, developing and testing out ways of working that will bring long-term benefit to the sector. The Legacy projects in particular had a remit to disseminate, transfer and embed learning and practices more widely across the HE sector. The RAPPs enabled Programme Spokes to develop regional activity plans that involved their local HEIs and other providers. Regional activities respond to *local* skills needs and priorities and implement the strategy at a *local* level. This is particularly important if HEI engagement with Small and Medium Enterprises (SMEs) is to be enabled.

The National HE STEM Programme Strategy 2010-12 identified the following objectives for all of these projects. These are central to this account.

12 National HE STEM Programme Strategy: 2010 – 2012 p20 Available at http://www.hestem.ac.uk/sites/default/files/national_he_stem_programme_strategy.pdf

Higher Level Skills	Workforce Development and Lifelong Learning	Graduate Skills
HS1 Disseminate models and examples of previous practices and approaches, and stimulate and support their transfer and adoption by the higher education STEM sector	**WDL1** Stimulate demand amongst employers, employees and those within wider society for engagement with HEIs at a local level to meet identified needs and priorities	**GS1** Embed experiential learning into STEM undergraduate Programmes to provide students with real world industrial and occupational experience
HS2 Develop and apply models of delivery that are transferable across the higher education STEM sector	**WDL2** Work collaboratively with existing local, regional and national organisations to apply and develop workforce-related practices within the STEM disciplines	**GS2** Enable opportunities for employers to contribute to undergraduate teaching, learning or project work
HS3 Build expertise within HEIs to enable the sector to better respond to the current and future needs and priorities of the UK and its economy	**WDL3** Develop models of flexible and responsive HE provision to enable more accessible entry into HE and to respond to immediate employer sector skills shortages while building longer-term ways of working for the HE sector	**GS3** Involve employers, or employer groups, in higher education STEM course development, design and delivery where a need or benefit exists
HS4 Build and sustain effective HE relationships with employers, employees and those within society	**WDL4** Explore new models of delivery and assessment for HE provision, and increased recognition of prior experience and of the provision provided by others while ensuring quality standards are maintained	**GS4** Enable higher education Institutions to provide enhanced opportunities for students to develop their wider skills as part of their undergraduate programmes of study
HS5 Influence institutional approaches to the higher skills agenda by informing institutional policies and practices.	**WDL5** Articulate the benefits of engagement with HE and successful practices to act as a stimulus for encouraging further uptake of provision by those within the workforce and society	**GS5** Encourage Professional Body accreditation of undergraduate programmes of study to include enhanced recognition of wider skills development

Part Two: Overview of the Projects

All the projects in these two funding strands had a focus on higher level skills, workforce development, lifelong learning and graduate skills development and delivery. The framework developed for this report captures some of the significant activities projects have had to address in order to do the following:

- Be responsive to employers
- Bring new employer influences into programmes of learning within an institution
- Provide new learning and approaches to meet employer needs for their current and future workforce
- Capture pedagogical issues relating to programme content, mode and means of delivery and engagement with learners.

There are six Legacy projects referred to in this report. Led by each of the spoke institutions, they include three projects with a focus on employer engagement/ workforce development and three involving graduate skills developments. One of the projects (London and South East) led by the University of Southampton (L4LSE) has included cross-over activities that informed employer engagement for workforce development and graduate skills developments. The six projects varied in their approach and targeted activities.

There are 50 RAP Projects included. Of these 19 address employer engagement and workforce development, 25 have a focus on graduate skills issues and 6 consider both areas of development. Possibly because of the timescales involved and the amount of funding available, the ambitions of the projects have been constrained and this was reflected in face-to-face discussions with project leaders.

Several of those setting objectives to work more closely with employers across the two strands have used the STEM funding to find out more about what employers' workforce development needs are and what they require from HEIs. Others have set themselves objectives simply to improve systems for communicating better with employers. Those with more experience of employer engagement have been able to progress the development of bespoke HE curriculum to meet employer needs, with several projects addressing flexible employer responsive provision.

Developing relationships with employers to find out what they want and mapping this with what graduates need has been important for those projects addressing graduate skills issues. Some have considered aspects of their curriculum for employability and others have focused on enhancing work experiences through placements and work-related learning or co-curriculum activities. Some have reviewed career management issues for undergraduates and have produced new information and guidance to support graduate entry into STEM related careers. Others have used information gathered through improved employer engagement to inform the undergraduate curriculum. This has been particularly relevant for those projects with provision delivered to adult learners, in part-time study or entering HE for the first time.

The Legacy and RAP projects were led by 37 universities from a variety of different mission groups, one Further Education College and two university associations but several projects included partnerships with other institutions and organisations including professional bodies and sector skills councils. The projects included:

- 12 in the Midlands and East Anglia region involving 8 universities
- 14 in the North East region involving 10 universities and 1 FE college
- 5 in the North West region involving 3 universities and the cross regional university association (NWUA)
- 11 in London and South East region involving 8 universities and one Sector Skills Council
- 5 in the South West region involving 4 universities
- 7 in Wales involving 4 universities and UHOVI (the strategic partnership between the University of Glamorgan and University of Wales, Newport.)

To simplify the narrative each of the projects has been allocated a number/letter and these are used throughout the report. In the tables overleaf projects are organised by region and they are colour coded as follows

- Yellow: graduate skills projects
- Pink: workforce development projects
- Green : combination of graduate skills and higher level skills projects

Legacy Projects

Key	Host institution	Funding	Project
L1M&EA	University of Birmingham	£149,835	STEM Skills @ University of Birmingham: Grand Challenge
L2NE	University of Bradford	£170,006	Greening STEM
L3NW	Manchester Metropolitan University	£124,744	Developing STEM up-skilling services for the process industries in the NW – widening HE provision and income generation
L4L&SE	University of Southampton	£149,133	Graduate Skills Development for the Energy Industry: STEM conversion courses - filling the void and keeping the lights on
L5SW	University of Bath	£152,500	Strengthening, extending and embedding employer engagement across the undergraduate STEM curriculum: the provisions of "real world" experiential learning for students
L6W	Swansea Metropolitan University	£154,850	Fast track level 4 progression pathway in mathematics and engineering science for students with appropriate experience and skills
6 projects	Funding Total	£901,068	

Regional Action Plan Projects

Midlands & East Anglia			
Key	**Host institution**	**Funding**	**Project**
1(i)M	Aston University 1	£11,100	Innovation in the Academic / Vocational Interchange: Developing and Achieving Good Practice in Employer Engagement
1(ii)M	Aston University2	£29,162	What do Engineers Do? Aligning the Curriculum to Practice to Enhance Employability
1M	University of Birmingham	£20,950	2020 Vision: a Curriculum for Mathematics Graduates for the Next Decade
2M	Coventry University	£40,170	Part-time students in the workforce – enhancing practice in course provision and increasing participation
3M	University of Leicester 1	£32,900	Unemployment of Engineering Graduates: The Key Issues
4M	University of Leicester 2	£25,520	Identifying skills gaps of employers and maths undergraduates
5M	University of Lincoln	£11,542	Developing graduate's employability skills through industry led touch points
6M	Nottingham Trent University 1	£21,000	Enhancing Graduate Employability and Skills: Building Effective STEM Graduates
7M	Nottingham Trent University 2	£21,000	Supporting workforce/graduate transitions in Mathematics
8M	University of Warwick 1	£7,591	Real World STEM
9M	University of Warwick 2	£20,103	SME Too: How can HEIs and SMEs interact more effectively?
11 projects	Total Funding	£241,038	

North East			
Key	**Host institution**	**Funding**	**Project title**
10NE	University of Bradford	£17,901	Maths Support in the National Health Service: Applying Proven Practices to Workforce Upskilling
11NE	Gateshead College	£37,000	The science of low-carbon vehicle technology
12NE	University of Huddersfield	£32,090	Succeeding in Tomorrow's Engineering world of work
13NE	University of Leeds 1	£55,000	Mathematical modelling and problem solving
14NE	University of Leeds 2	£30,400	Engaging with employers and stakeholders to enhance employability for Mathematics graduates
15NE	Leeds Metropolitan University	£28,266	Employer-led STEM Fd development, flexible learning options to aid new and emerging technologies
16NE	Northumbria University 1	£50,000	An investigation to examine if the accreditation of in-house training is a flexible/responsive model for up-skilling STEM staff
17NE	Northumbria University 2	£12,860	Can the Employability of undergraduates be enhanced through raising curriculum content awareness and relevance in the workplace?
18NE	University of Sheffield	£23,804	Creating an employer liaison group to enhance employability and higher level skills in Science students
19NE	Sheffield Hallam University	£15,000	Developing Employer Engagement in STEM through Career Mentoring
20NE	University of Sunderland	£48,540	Flexible CPD to meet needs of Healthcare Science workforce in response to Modernising Scientific Careers
21NE	Teesside University	£33,037	Open Learning for Engineering Design
22NE	University of York	£46,102	Connect to Science
13 projects	Total Funding	£430,000	

North West			
Key	**Host institution**	**Funding**	**Project title**
23NW	Liverpool John Moores University	£91685	The Big Question? What influences career progression for STEM Graduates?
24NW	North West Universities Association 1	£110,400	" STEM Business University Gateway - STEMBUG
25NW	North West Universities Association 2	£240,800	Meeting Industry Needs for a Highly Skilled Workforce in Science, Technology, Engineering and Maths
26NW	University of Central Lancashire	£52635	Stand-Out STEM Students
4 projects	Total funding	£495,520	

London & South East			
Key	**Host institution**	**Funding**	**Project title**
27SE	Anglia Ruskin University	£31,950	Accredited bit-sized learning to upskill chemical industry employees
28SE	University of Brighton	£11,227	Undergraduate placements: smoothing transition from education to the workplace
29SE	University of Greenwich 1	£24,500	Business Innovation in STEM centres by workforce up-skilling
30SE	University of Greenwich 2	£10,000	Making maths graduates more employable: an enhanced role for tutors.
31SE	The Open University	£31,977	Unclear about Nuclear
32SE	University of Reading 1	£35,136	Work placements for Maths & Stats Undergraduates
33SE	University of Reading 2	£35152	Flexible training for the analytical services industry
34SE	University of Reading 3	£35,490	Enhancing employability through improved understanding
35SE	University of Southampton	£84,145	Bringing together HEIs and local STEM businesses
36SE	University College London	£49,860	SET for Leadership – Supporting Female Undergraduates into STEM Careers
10 projects	Total funding	£349,437	

South West			
Key	**Host institution**	**Funding**	**Project title**
37SW	University of Bournemouth	£149,799	Get STEM working: innovation with employer and student engagement
38SW	University of Exeter	£157,500	Progressing from labour market intelligence to HE level provision that is well supported by employers
39SW	University of Plymouth 1	£73,000	The Hydrographic Academy
40SW	University of Plymouth 2	£30,000	Adult returner journeys through HE to STEM careers
4 projects	Total funding	£410,299	

Wales			
Key	**Host Institution**	**Funding**	**Project Title**
41W	Bangor University 1	£60,904	UPSKILL-User-driven photonics skills improvement via lifelong learning
42	Bangor University 2	£49,525	Enterprise by Design
43W	Cardiff University	£45,000	Developing Enterprising STEM Graduates
44W	Cardiff Metropolitan University	£79,944	ENGAGE: STEM work-based learning and employer engagement
45	Universities Heads of the Valleys Institute (UHOVI)	£61,809	STEM employer engagement and workforce up-skilling in the South Wales Valleys
46W	Swansea Metropolitan University	£69,859	The Steel Academy: Part time flexible degree in materials engineering
6 projects	Total funding	£367,041	

Hub			
Key	**Host institution**	**Funding**	**Project title**
47H	Imperial College London and Cogent Sector Skills Council	£112,500	Building the Nuclear Island
48H	University of Wolverhampton	£100,000	Gearing-up for Industrial Growth
2 projects	Total Funding	£212,500	

Overall total £3,406,903

Part Three: Influencing institutional approaches

The imperative for UK universities to take their place as world leaders in business support was highlighted in the recent Wilson Review of university-business collaborations. The Review recommended a *"new covenant between business and universities: a covenant that generates partnerships and collaboration, a covenant that can only be achieved through greater communication and understanding."*[13] The Review also asserted the need for greater engagement with the variety of businesses and employers including in particular SMEs. The HE STEM Projects have aimed to address these themes in different ways.

The Contextual Compendium compiled by Jay Consulting provides a comprehensive account of recent initiatives and activities undertaken in the HE sector to enhance employer alliances. This type of activity is not without its challenges, but it does provide an excellent opportunity for teaching staff to deepen and expand on the relationships they already have with employers. It can encourage dialogue with employers, who can help ensure programmes of study remain relevant and with the currency necessary to enhance the learner experience. This in turn meets the requirements of industry and society, thus furthering the reputation of the university.

The National HE STEM workforce development projects overlapped to a certain extent with the HEFCE funded Transforming Workforce Development Programme[14]. Projects in that programme researched approaches to employer engagement which may help to take forward pedagogical and curricula innovation. They addressed the implications of introducing new ways of working, of operating across institutional and organisational boundaries, and how to develop flexible provision to align with the needs of a different learner constituency. Some of the HE STEM projects included here were led by institutions that had received substantial funding under the HEFCE programme (Bradford, Leicester, Northumbria, Southampton, Coventry, Teesside and York universities, Open University, and the NWUA via the North West Higher Level Skills Pathfinder). This provided the opportunity for drawing on learning and good practice and extending knowledge. Without doubt for some institutions and especially within STEM departments this type of activity was novel and required projects to reflect on the requirements necessary to make any impact on the HE culture and attitude to employer engagement (although the communication processes necessary to effect this were not always evident).

This section highlights the different approaches HE STEM projects have taken in influencing institutions to enhance relationships with employers. The project activities discussed here provide additional evidence of changing attitudes and responses to meeting employer needs. Projects have taken measures to influence cultural change within the institution by challenging and modifying processes and procedures and involving staff in ways that ensure impact is made on approaches to employer engagement within STEM departments and across HEIs.

Stimulating cultural change

The Legacy and RAP projects have all determined to have an impact on an institution by introducing change in practice whether at local department level, across a faculty or across the whole university. For some projects, this type of activity was a new direction. For others, there was an institutional history and track record of supporting employer alliances, albeit not necessarily in STEM departments. There is ample evidence that the extent to which this type of activity related to the strategic priorities of the university was important in determining whether it was seen as a peripheral activity or a central function of the HEI. Just where the activity fitted in with HEI structures had an impact on its operation.

Projects have taken active measures to improve institutional responses to employers through:

- reviewing strategies and approaches including quality processes
- improving information, resources and development for staff for building relationships with employers
- enhancing cross-departmental involvement in employer engagement

The Legacy projects in particular, explored how to work across the boundaries within institutions and with external organisations and other HE providers for mutually beneficial objectives.

Change, both within and outside the academy has become a way of life, a constant condition for those of us working in higher education. Academic leaders are called on to not only be a leader of change but to be sensitive to the many reasons why change in programmes or procedures are not only needed but becoming more urgent. Pennington (2003)

13 BIS (2012) A Review of Business–University Collaboration, Professor Sir Tim Wilson DL, February 2012 http://www.wilsonreview.co.uk/review

14 HEFCE Website: Employer Engagement, http://www.hefce.ac.uk/whatwedo/kes/ee/

argues that there are a number of preconditions for change to take place. These include that:

- it must be seen as relevant
- there must be sufficient confidence that the changes will result in benefits for all the stakeholders
- the nature of the changes and their implications must be understood by everyone involved
- all underlying values and justifications for the changing situation must fit in with those of the main participants
- the change must be feasible in terms of the resources available[15]

Outram (undated) puts forward a range of reasons why colleagues and institutional leaders might resist change. These include inertia, self-interest, "future shock", lack of trust and fear of failure as well as excessive pressure. There are, however, motivators to supporting change. The STEM projects are based on an understanding that

- needs are not currently being met
- change will make it easier for needs to be met
- the benefits outweigh the risks
- the change is necessary
- the change process is being handled properly
- the change will work
- the change is consistent with personal and institutional values
- those responsible for the change are trusted[16]

Consequently any projects introducing changes in approach to provision and delivery will inevitably face some opposition and resistance and this has been the case for some of these STEM projects. It is beyond even the most optimistic perspective that institutional change would be embedded at the end of the lifetime of projects. It is perhaps fairer to consider how small changes have occurred and been led from a department or a faculty level and consider how projects may be able to use their experiences to stimulate interest beyond their own limited field. The STEM projects have demonstrated ideas and developments that have been picked up both within the institutions and outside and in some cases 'adopted' by other similar departments or faculties in other HEIs.

15 CHSRF (2003) The Theory and Practice of Knowledge Brokering in Canada's Health system, available at http://www.chsrf.ca/migrated/pdf/Theory_and_Practice_e.pdf Outram, S. (undated) Understanding how we accomplish change in higher education institutions, Discussion paper 6: 53 Interesting ways in which colleagues resist change, available at www.heacademy.ac.uk/.../id554_complex_change_in_heis_paper6.d

16 Outram, S. (undated) Understanding how we accomplish change in higher education institutions, Discussion paper 7: 53 Ways of managing resistance to change, available at www.heacademy.ac.uk/.../id555_complex_change_in_heis_paper7.d.

The project has been sustainable – the project will be over but staff have learned such a lot that will embed approaches within the curriculum. We will not be able to recreate the programme but it will be easy to take lessons learned forward. The Head of the Teaching and Learning development unit had early involvement with project and further evaluation next year may result in further T&L developments. (Project lead, Greenwich, 30SE)

The culture change influenced by the Wales Legacy Project (L6W) is being evidenced by the fact that the universities involved (Swansea Metropolitan and Glyndŵr) are adapting to industry by producing relevant content in the right way at the right time. This project involved the development of a fast track, flexible progression pathway at Level 4 in mathematics and engineering science, for experienced people within or potentially within the workforce. Two pilot programmes were developed, hosted by Swansea Metropolitan University and Glyndŵr University.

There is a growing acknowledgment that universities have to be more like other businesses and more business-like in developing their offer. The firms are their clients and customers and the ethos of the university has to encompass flexibility to respond to their requirements. This project was testing out a new mode of delivery to meet employer needs and developing closer working relationships with employers. (Project lead, Wales Legacy, L6W)

Further cultural changes have taken place within the university in teaching outside usual term times, the recognition by academics that delivering programmes of this kind requires them to rethink their approach to teaching, learning and assessment and to carefully design support mechanisms and resources to meet the needs of industry-based learners.

For the London and South East Legacy project (L4LSE) there is evidence of culture change at departmental level but also within other HEIs. The project had a focus on the Electrical Power Engineering industry and developed resources to assist in up-skilling the current and future workforce and also to provide materials for use within HEI degree programmes. A series of work packages have been produced to develop a range of specialist skills and knowledge, using 'real world' examples available for both undergraduates and people in the workplace. The work packages are supported with a series of new simulations, virtual experiments and recorded lectures.

This has had a big effect on the Electronic and Electrical Engineering (EEE) group in Southampton as they are now considering the techniques for use in the roll out to

overseas training and used as part of the Masters and PhD training. Many aspects of our approach are being taken up within Southampton and at other institutions. Both of the adopter's projects are used within the legacy project to contribute to the final products. They have seen a lot of demand and are being taken up when spaces are available even by institutions that have not received funding. (Project lead, London & SE Legacy, L4LSE)

Outside of the specific teaching sphere the techniques are being used for health and safety and induction processes where repeated sessions need to be delivered and the recorded tutorials are saving staff time along with computer aided assessment, to ensure the knowledge has been taken in, smarter ways of working and efficiency gains.

I wanted to do a formal project management qualification before I started at the university, the switchboard informed me they didn't do that here and recommended a private training provider, which I used. Two weeks after I started at the university I discover the project management training course is taught on the floor below my current office. It is no wonder private training providers take over 95% of the £5 billion spent each year on CPD. (Student, Southampton, 35SE)

Reviewing strategies and approaches including quality processes

The projects have endeavoured to use a variety of tools and techniques to embed the project within and beyond institutional life. Engaging senior management with the project and involving cross-departmental teams that effect systems and processes within the university has been a common area for development. It should be stressed that the projects have been operating in a context of rapid change but have been raising awareness of specific issues related to the project objectives by for example producing benchmarking information and auditing existing provision to inform appropriate and timely responses to curriculum change. The work of the projects can be seen as key for any business review process and the knowledge and expertise they have fostered in for example, managing placements, ensuring consistency of delivery, is central to quality assurance and enhancement issues.

With respect to the graduate skills projects and the means to engage employers, activity has happened at a time of increased strategic interest in employability and the STEM developments have influenced approaches. At the University of Bath for example, the South West Legacy (L5SW) project has informed the institutional Placements Business Review Process and fed into the newly formed Careers & Employability subcommittee of the University Learning & Teaching Quality Committee, which has been set up to ensure that employability considerations feed directly into the University's governance structure. Similarly, the UCLAN project (26NW) was developed at a time of change when the issue of graduate skills was being addressed from a whole curriculum perspective. The activities and outputs from the project contributed to a broader shift in institutional culture.

The STEM projects involved in developing employer responsive provision for higher level skills have faced many of the institutional barriers experienced by the HEFCE funded projects mentioned earlier but have worked with processes and procedures to enable the sustainability of activities. The RAP project led by Exeter University (38SW) reported extensive institutional buy-in and it was developed at a time when employability and employer engagement were high on the agenda. It is hoped that, because of this, the project outcomes will be sustainable. It reviewed employer engagement processes, developed and trialled new responses to employer engagement and produced tools and resources to share practice internally as well as across collaborating HEIs. Staff will now be better informed about activities that support employer engagement and employers will have access to better and more appropriate information about the services and support available within universities and colleges.

The project was developed at a time when employability and employer engagement are high on the agenda, and has meant that the institutional buy in was very strong and this means that the project outcomes will be more sustainable going forward. (Project lead, Exeter, 38SW)

The Southampton RAP project (35SE) both raised institutional awareness and understanding of the reality of current university-SME business engagement within the region, in particular the communication barriers and the resources required to maintain this type of activity effectively. It focused its efforts on the senior management teams within the HEIs to investigate current engagement activities while looking at how the institutions plan this activity going forward. Senior management buy-in and academic support was needed to provide solutions for incoming enquiries and the desire to foster new relationships with businesses with no previous university partnership experiences.

Senior management buy-in from each of the partner institutions and from the business sector including their supporting organisations …has shown the commitment from the institutions and specifically highlighted the need for the type of brokering service that targets the majority of the

employers within the region who do not currently engage with universities. The business sector support highlighted the interest and the need for the brokering service and the knowledge base that understands the university capabilities with respect to university services on offer to the business community. (Project lead, Southampton, 35SE)

The academics' involvement was partly in response to their interest in business engagement and partly in response to the changing landscape of university funding and with respect to impact within the Research Evaluation Framework (REF). Motivating staff to engage in workforce development activity and recognising their contributions will, it is hoped, produce better results.

One of the challenges for the Northumbria project (16NE) was that the university did not have a system in place to develop smaller sized units and it was hampered by this lack of flexibility. The project developed a framework that provides recognition for in-house learning for scientific technicians covering health and safety, and risk assessment. Learners can undertake work-based projects. However university systems still limit units to a minimum of 60 credits, so the challenge has been aligning different and conflicting requirements. There is on-going developmental work as the project has demonstrated that there is a demand from employers for bite-sized learning for technicians: they want 10/20 credit units. This illustrates amply the tensions inherent in developing employer alliances that are not necessarily aligned with the strategy for delivering learning to the traditional student body. But the impact of changing processes albeit limited cannot be underestimated in challenging institution culture for responding to employer needs.

Overall where senior staff have engaged with projects there has been an improvement in approaches and understanding of the benefits of employer alliances. The Gateshead College (11NE) initiative has seen a new interest and commitment in the college itself to developing the role of business growth managers who will work with employers. A new post relating to business development initiatives in IT and engineering has happened as a result of the project success. The Swansea Metropolitan Project (46W) was an important initiative that has sparked enthusiasm and interest from all personnel, including the Vice-Chancellor. Visibility and commitment has been significant. A new Engineering Research Group has been set up and the Project Director has been invited to be a member of the HEA Engineering Special Interest Group (SIG).

The North West Legacy project (L 3NW) focused on a cultural shift to engender in staff a changing approach to income generation. 'Applied training'- learning that is more flexible and employer focused, provision that can be done in small chunks, and that might not even be accredited - was given a prominent role in the project. This shifted the notion of what university learning can be that it can be related to specific skills development, that the packaging of the product is as important as the product itself.

The project model is one of organic growth, it has indicated that it is financially viable and can generate income so the models are sustainable. The model of working relies on an understanding of the user community and how people learn so the distinctive products will be responsive to the user community. Any future user groups will have the links with FECs already established so CPD for staff will be readily facilitated. (Project Lead, NW Legacy, L3NW)

Improved information, resources and development for staff

Generally STEM academic staff were hesitant to engage in approaches to embed employability in the curriculum. One explanation is the need to manage the tensions inherent in an already crowded curriculum where students need to cover the specific discipline content. In such a situation is not always easy to facilitate change through the imposition of generic topics but there is evidence here of projects working to engage colleagues in new approaches that bring benefit and efficiency to programme delivery. For some of the RAP projects changes introduced into the curriculum, such as those developed by the University of Leeds Maths Modelling project (13NE), have stimulated interest across the faculty. In the Sheffield Hallam RAP project (19NE) the engineering faculty staff have seen the benefit of weaving the mentoring scheme through the engineering undergraduate student journey and this has been accepted by other academics. The Gateshead RAP project (11NE) has provided the opportunity for staff to gain knowledge and experience of new industrial techniques and have been able to introduce these elements into the curriculum. The South West Legacy (L5SW) project has undertaken staff development to introduce them to the new guidance for making placements more effective and the South East Legacy project (L4LSE) has involved front line staff in producing the virtual experiments and the dynamic questions so this does not become just an interest of a few enthusiasts but is accepted more widely.

At Swansea Metropolitan University, because the Legacy (L6W) and Steel Academy RAP (46W) project team are enthusiastic, they have been sending staff information about other video materials and it has both become a conversation piece and a catalyst for changing the teaching style. Fears that

using video lectures would result in a drop-off in attendance, have been unfounded. Informal networking is a powerful but undervalued technique. Conversations with staff can have a surprisingly positive impact. (Project Lead, Wales Legacy, L6W)

The Aston University RAP project (1(i)M) has reported on the production of a toolkit for STEM academics that identifies key features for effective employer engagement. The Toolkit is designed to provide a starting point for academics who want to build on employer- university relationships to enhance graduate employability and has been developed from research undertaken by the project to find out what skills employers are looking for in graduates. The project built on the existing good practice in the university for working with employers particularly in reference to Power and Electrical engineering but the outcome is relevant across the sector. Seven features of good employer-academic relationships have been identified for staff to build on within their own practices.

The Nottingham Trent RAPP (6M) has stimulated a curriculum review. Staff involved in the project, and across departments, have seen the benefits from the changes introduced.

The staff have been developed through it too; it has opened their eyes, it is going to be rolled into other years. It is prompting discussion across the university. (Project lead, Nottingham Trent University, 6M)

Enhanced cross-departmental involvement in employer engagement

The North East Legacy (L2NE) project took the approach to involve senior staff and build on the "champions" for employer engagement appointed within each department. In this way the project became a cross-institutional development and the word spread about the project activities related to STEM.

This project hooked into senior academic communities to drive forward initiatives that had to be achieved in a very short time frame. This led to communication and collaboration between centres and departments who were previously separate. The multi-facetted nature of this project meant that all staff including facilities management, technicians and administrators have been involved. This embedded STEM as a pan-university presence. Senior and instructional level support drives culture change. (Project lead, NE Legacy, L2NE)

The Legacy projects overall have demonstrated collaboration with staff across university departments such as employability and careers services, the Alumni Office to identify external/employer contributors, technicians, and facilities management staff. Guides for staff have been produced, for example by the South West project (L5SW), and other projects have run staff workshops delivered to STEM and non-STEM academics.

The Legacy project has been a stimulus for other university developments relating to employability and graduate outcomes in the context of the potential impact of variable fees. While it is hard to separate the impact of the legacy work from other initiatives in the institution it has provided space and opportunity and a focus for discussion and clarification. So the Legacy project has informed a "whole institution" approach in a subtle but significant way as key team members have participated in the development of new institution strategies. Materials have been written for staff on making placements more effective and CPD workshops held for staff. Documents were developed in collaboration with Placement Managers across all faculties and will sit alongside, and in support of, the University's QA documents. (Project lead, SW Legacy, L5SW)

The Sunderland project (20NE) had support from many key university stakeholders who contributed to the activities. The faculty and departmental management team supported the project and helped to drive it forward by leading up publicity events, ensuring that the course was allowed to be developed and approved, allocating work-loading activities against the module leaders. Business Development support staff helped with the dissemination and formal reporting of the project. The e-learning support and development staff in Learning Development Services helped to convert material into open learning format, provided study skill support and advice and provided all of the technical support underpinning the delivery by the university's VLE. Academic colleagues provided the learning material, attended employer meetings and will contribute to the delivery of the course. Administrative staff supported the course administration. The project director concluded that for any similar project to succeed it must align to the departmental strategy otherwise the work is isolated and marginalised and becomes unsustainable.

There is evidence that more staff are recognising that the drivers behind the projects are increasingly informing core business and there is an emerging perception that academic roles are changing. Some staff from beyond the projects have availed themselves of CPD provided by National HE STEM. For example, across Wales a series of workshops have been delivered to enhance approaches to employer engagement. Some of the teaching and learning developments have enabled the localisation of the development of reusable resources, avoiding

the need to rely on central IT services. Staff involved in the projects are learning new skills themselves as evidenced by the North West Legacy projects and those involved in coordinating employer groups such as for the RAPPs in Northumbria, Sheffield and Huddersfield.

'The interactive meetings between employers, staff and students …..gave an opportunity for open discussion between the three constituencies and appears (based on comments) to have benefited each.' (Project lead, Sheffield 18 NE)

Overall project leads have reported that staff engagement in these activities has been better than expected. Where new resources have been developed staff have engaged with them and on staff 'away days' and workshops attendance has been good with positive responses about the approaches HEIs can take to engage employers.

The support and interest we have received from academic staff in favour of what we are seeking to achieve has been fantastic, and has signalled the beginning of a unified front between placement staff and academic staff which is an excellent platform for us to build from' (Project lead, Brighton, 28SE)

The involvement of cross-faculty groups has been enjoyed by those participating. Some projects have involved the internal Teaching and Development Unit and given guidance on embedding approaches within the curriculum and the developments for employer contributed projects and real world scenarios has been very well received. Understanding the issues about part-time/WBL is being used to improve retention in some HEIs.

For me, this was by far the most interesting and satisfying teaching experience. The shared approach towards the planning and delivery has the benefit in producing better ideas for the course planning, reduced stress in working towards deadlines and a better quality of delivery of the course during sessions. (Dr Jeremy Hall, School of Engineering, Cardiff, 43W)

Spreading the word beyond the project: the extent of collaboration

New networks and partnerships within, between, across and beyond HEIs have been established through carrying out the multi-institution projects funded by the Programme. Additionally, the dissemination and promotion of these projects at various HE STEM events across the country has enabled more people to learn about the projects, and the work interests of people associated with these projects. This therefore facilitates people with similar interests to come together and collaborate in the future, on future projects and other funding calls.

Partnership working was a highlight of this project- the sub-partners involved …were all at different stages in their thinking about employer engagement and faced different issues. The process of partnership working enabled us to identify common issues and to learn across the sub projects. (Project lead, Exeter 38SW).

The STEM projects have demonstrated that ideas and developments can be picked up both within the institutions and outside and in some cases 'adopted' by other similar departments or faculties in other HEIs. Projects were highlighted through internal newsletters, and through short articles in university publications as well as through the national STEM website and events. This appears to have led to greater take-up of using new materials and resources by other academics, and in some cases, staff from other HEIs have received training on the use of materials. The London and South East Legacy project (L4LSE) now has nine other HEIs 'adopting' ideas and the Leeds RAPP maths modelling project has expanded widely.

The driver for the Leeds University (13NE) maths modelling project was to respond to employer requests for more graduates with knowledge of Newtonian mechanics and its application in the workplace. Partners in the original project included the Universities of Leeds, Keele, Manchester and the University of West of England. The project was designed to introduce modelling appropriate for engineering, mathematics and physics students and each of the four partners have introduced a new module or units of study. The future aim is to involve existing and new local employers and introduce more examples of 'live' problems for students to solve. The project brought together new collaborators including the University of Manchester, Swansea University, the University of Bradford, Loughborough University and the University of Portsmouth as well as other departments in Leeds.

The key lesson from this was the value of collaborative development of curriculum and pedagogy. In particular the adoption of innovative assessment techniques such as video presentations, wikis and reflective discourse would have been less likely in the absence of the collaboration through the project. (Project lead, Leeds, 13NE)

The cross-institutional aspect of STEM-funded projects encouraged colleagues from different institutions, with similar interests, to work together. New networks have also been established within HEIs. The Imperial/Cogent (47H) project enabled a holistic approach in a staged manner. The Sector Skills Council had the resources to ensure that marketing and communications were effective and the project management skills to pull

together a complex initiative. Its networks meant that it was able to broker new relationships between very different institutions for example Bridgwater College. Its interface with industry facilitated collaboration and its approach also encouraged inter-departmental collaboration within Imperial College, most notably between the civil engineering department and the materials area.

The University of Wolverhampton project (48H) has collaborated with a SSC, SEMTA, but utilised also the services of an employer network, the Engineering Employers Federation (EEF). This helped give greater access to SMEs and also supported the project in its ambitions to provide progression routes for apprentices. This project has also collaborated extensively with large employers such as Jaguar Rover and Siemens in developing the content of the new Engineering Manufacturing B. Eng. degree and has worked closely with the Black Country University Technical College[17]. The aim here has been to recognise the progression pathways of learners through school, college and work-based learning into the new degree with consideration of progression agreements that are supported by the university. The development has been supported by the Black Country Local Enterprise Partnership (LEP) and this has provided a partnership opportunity to gain further funding for the project ambitions for sustainability.

The trust and foundations developed through the ……project have proved that even competing local academic providers can work together to ensure regional development. (Project lead, Huddersfield, 12 NE)

Learning Summary: Effective Institutional approaches for employer engagement

- Develop a strategic approach to communications with employers
- Successful engagements are usually long-term processes rather than quick-fix solutions
- Ensure senior management involvement
- Develop a place for a cross-institutional working group
- Collaborating with other HEIs enhances sharing of information and ideas between partners
- Collaborations identify common issues to learn from each other
- Senior manager buy-in from each supporting partner shows commitment to the collaboration
- Good communication between stakeholders is crucial

17 A University Technical College is 'A college for students aged 14 to 19 which specialises in technical studies and is sponsored by a university. It offers full time courses which combine practical and academic studies. Employers are involved from the start in shaping the curriculum.' http://www.utcolleges.org/


SPORTS
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ABOUT ME
ME AT SCHOOL
GOING TO UNIVERSITY
ME AT WORK

Part Four: Workforce Development and Higher-Level Skills Projects

Three of the HE STEM Legacy projects and twenty nine RAP projects were identified as being specifically concerned with workforce-development, higher level skills and flexible learning. The data gathered presented a rich picture of different engagements with a wide range of employers and from our survey we found that the themes aligned with the Wilson Review's recommendations, in that they had a focus on partnership, communication, collaboration and enhanced understanding of developing employer alliances. This part of the report reflects on the activities of the STEM projects and the learning achieved, by illustrating significant processes, challenges and successes.

Some projects were concerned with meeting the needs of people working at different levels, in different sectors, and responding to employer-led demand for flexible provision. Others sought to work more closely with employers and industry to ensure that provision is aligned with current needs in the STEM sectors. Significant learning from these STEM projects has been in relation to how HEIs have formed alliances and collaborations with employers and other stakeholders. In addition the projects have explored the issues around developing employer responsive provision and the flexible learning issues required for developing such provision including the pace, place and mode of such delivery.

Our structured questioning of the project leaders asked them to firstly comment on the different drivers for developing these projects, and two key themes emerged. These have been arranged as follows:

- Developing employer alliances
  - Types of engagement
  - Working with employer and industry sector groups
  - Collaboration for effective employer engagement
- Developing models of flexible and responsive HE provision

Key drivers for developing the projects

Drivers for wanting to get involved in the workforce development initiatives varied. The Legacy projects in particular were motivated by internal institutional reviews of strategy for employer engagement and graduate employability. The HE STEM funding provided the opportunity to find new ways to test out approaches and implement change.

For example, the North West Legacy project (L3NW) led by Manchester Metropolitan University, was designed to implement potential change in programme delivery through an approach of 'applied' training that is more flexible and employer/employee focused. The project also facilitated the development of more extensive relationships with FECs in a local context where collaboration and competition are in tension. The South East Legacy project (L4LSE) also considered new approaches to 'training' for work based learners as a result of a direct approach from a company wanting bespoke training to bring electrical engineers up to standard. The learning and curriculum developments were already underway, and there was an existing "Power Academy" providing access both to the university department and key personnel active in the power industry but this new approach provided a novel challenge for the team involved. The university already had experience in electrical engineering and applied research which added value to the proposition. The focus of the project was on electrical engineering specifically the need for training engineers designing, building and maintaining the national grid.

The Wales Legacy project led by Swansea Metropolitan University (L6W) also came about as a result of requests from businesses in Wales for workforce development in engineering skills. These companies were looking to up-skill staff to maintain a competitive edge but the university was also interested in developing provision to improve access to higher education for adult learners in response to the Wales Government's higher level skills agenda.

The Regional Action Plan projects also had a variety of drivers for their developments including the opportunity to explore new markets for learning. The Southampton project (35SE) was in part a response to a lack of understanding of the appropriate methods of effective engagement by both HEIs and businesses. The main focus of the project was to raise the awareness of the opportunities, services and facilities for business available at HEIs within the Solent sub-region and further develop a portal for businesses (BizzUp) to access resources for workforce training and development.

Projects in the Universities of Wolverhampton and Sunderland were designed to respond to developments occurring within regional and locally-based industries and businesses. The University of Wolverhampton project (48H) for example, responded to local employer needs where the manufacturing engineering community have critical concerns regarding the demand and supply of engineering graduates and this project has been working to address some of these issues. The University of

Sunderland's project (20NE) was a direct response to the Department of Health's new graded career programme known as Modernising Scientific Careers which is mapped against accredited university programmes of study. This is particularly challenging for universities as the Department of Health (DH) specifies the curriculum exactly including work-based learning and has a very strict accreditation process. The focus of this project was on developing provision that could meet the needs of the employers for higher level skills, consider the requirements of learners unfamiliar with the required level of learning and also fit within the university offer.

Projects reviewed existing provision in partnership with employers. The Coventry University RAP project (2M) was designed to test the attractiveness of the existing part-time provision to a wider audience. It drew on the experiences of employers who had already engaged with the university to gain feedback on the value of that provision for employees and the businesses. The Northumbria Project (16NE), exploring the accreditation of short units of learning, was motivated by the need to address transition from Level 3 to Level 4 in STEM subjects. The employers required a way of recognising skills training in addition to what their existing frameworks recognised: this was an assessment of the reflection or application of learning. The Open University project (31SE) had two drivers. It was both a vehicle for exploring new strategies for re-versioning OU science short course resources with a new market. At the same time it provided opportunities to increase the team's expertise in working with mobile technologies for learning.

For Leeds Metropolitan University, the project (15NE) aimed to engage with employers but this was inextricably linked to issues of financial viability and market considerations. During the time of the project another institution developed its own similar qualification, so an overlap had to be negotiated. The project when complete had also to fit within the framework of the Sector Skills Council. This project acknowledged and accepted the significant input of industry and what they wanted in the current climate, and subsequently changed the game plan.

In the North West, the project (24NW) aimed to develop an online resource to support and reinforce access to HEI services for employers coordinated by the North West Universities Association (NWUA) and this was a direct response to the demise of "Business Link". Business Link had been very focused on providing a brokerage and intermediary service between providers and purchasers, and with the removal of that link in the chain, employers needed to be able to access clear and contemporary information. Research carried out by the HLSP had said industries were calling for this kind of facility to become available, so the project filled a gap but was predicated on sound market intelligence.

Developing employer alliances

These higher level skills projects had a specific remit to improve relationships with employers and different approaches have achieved different outcomes. Projects worked with both their existing and new employer clients to explore where they could make effective higher level skills interventions. Some adopted proactive and sophisticated approaches to workforce development activities. This involved a range of techniques including acquiring an understanding of marketing and sales interventions (not least to ensure that an appropriate overhead level is used in costing a workforce development). It also included working through intermediaries such as the Chambers of Commerce, Sector Skills Councils (SSCs), and other employer-facing bodies to access, for instance, the SME market. There has been a spectrum of types of engagement and a strong focus here on using brokers and working with employer groupings. Collaboration with other institutions has also proved beneficial.

Types of engagement

Projects were able to demonstrate a 'state of readiness' to respond to employers' needs by adopting a range of engagements. One reason that an employer will engage with an HEI is because they have a track record of working successfully with other employers to meet higher level skills needs within their workforce and a number of the STEM projects have built on existing relationships or built on their experiences by adopting different approaches.

The London and SE Legacy project (L4L&SE) already had a strong relationship with the National Grid, mainly with respect to research and development but also extending to CPD: the university had a relationship with an existing electronic and electrical engineering group. These two links proved central to the Legacy project approach. The group were generally suppliers and partners of National Grid with Mot Macdonald, an engineering consultancy company being one example. Involving this company has resulted in a raised awareness of the skills and competences demanded by these employers at the recruitment stage. In this sector many electrical/electronic engineers are recruited to manage large projects for major employers. They demand specific skills and competences and an aim of the Legacy project was to develop learning to upskill employees and develop graduates to meet the specific requirements of employers.

The Wales Legacy project (L6W) also built on existing relationships but extended its reach to open up learning to other companies. The project has provided the resources to expand the university's knowledge of local employers by developing a Customer Relationship Management (CRM) data-

base to identify local companies and contacts and better manage communications with these.

For some of the RAPPs there has also been a focus on expanding knowledge of local employers to facilitate engagement. A significant initial challenge for the UHOVI RAPP (45W) was gaining meaningful access to employers in the face of high level competition from a range of commercial providers offering targeted short duration training packages. This was overcome through approaching businesses on a personal level with the support of local government agencies, with an offer to make provision bespoke and tailored to the company needs. While not delivering a "quick hit" it is felt that this approach will allow long term strategic opportunities to deliver the necessary critical mass of learners to achieve success.

Southampton (35SE) found a lack of understanding of the appropriate methods of effective engagement by both HEIs and businesses alike particularly amongst SMEs. It would seem most of this type of engagement for enterprise development was more about maintaining the status quo with existing partners rather than looking for new and innovative opportunities. Most of the feedback to the project from SMEs and their supporting organisations, described little contact with HE, previous unsuccessful engagements, or a lack of knowledge about what services were on offer from HEIs. This project worked to improve high level business leadership engagement with HEIs through encouraging support for the activity, promoting the activity through business interests and supply chains, and by providing feedback and comments on the perceived receipt of the resource as a whole to the business community. This experience was paralleled in the South West. The Bournemouth-led project, "Get STEM working" (37SW) confirmed the need for interaction between industry and HEIs at all levels but highlighted the communication blockages inherent within the latter that act as barriers to access.

The Anglia Ruskin project (27SE) saw academic and technical staff spend time working at Huntsman's production facility, a global manufacturer and marketer of differentiated chemicals, to enhance understanding of their business needs. This engagement ensured better relationships were built from direct communication with the business. From this visit, it was established that a series of flexible work-based accredited short courses would be beneficial.

In Gateshead College (11NE) too there has been an ambition to help staff to better understand the needs of industry. In an emerging sector for electric and low carbon vehicle manufacturing the college has benefited from the use of teacher placements in industries - going into businesses for one day a week. This knowledge transfer activity has enabled teaching staff to develop the skills and knowledge relevant to the new technology and its science and this is now informing curriculum development.

The Sunderland project (20NE) was also about understanding employer's needs and subsequently developing a responsive programme. It could not be achieved without direct contact with people working in the field. The training managers and laboratory departmental heads from the regional foundation trust hospitals formed a steering group for the project and thus directly influenced the content of the curriculum and the mode of delivery.

Working with employer and industry sector groups

These projects have found that developing places and opportunities to bring employers together with the institutions involved has been crucial in opening dialogue around business needs. For some projects an intermediary organisation could support the approach such as the NWUA but for other projects, identifying existing forums and groups that could give access to employers was an alternative several followed. There is evidence that some have followed a learning curve in developing their experience and knowledge.

The North West Legacy project (L3NW) utilised learning from the previous NWHLSP (see above) and used local FECs as brokers to access employers. The university audited the FECs to find out where strengths existed in approach and provision to make this more successful. The project found that using an experienced consultant to develop one-to-one relationships with providers has been central to success. This was replicated too by the Wales Legacy project (L6W) that has used the project manager to travel across the country to access companies directly even with the advantage of the CRM database of contacts. While the Wales project found developing a CRM database useful it demonstrated that this is only a first stage of engagement.

An efficient and effective way of gaining access to more than one employer is to use an existing forum providing it is well-managed. The South West Legacy (L5SW) project was aware that traditionally the university had relationships with larger companies for placements. When exploring the opportunities for different and local placements they aimed to work with more SMEs and conducted research with the student union. They found that existing groups of employers such as 'Silicon South West', a network over 100 companies connected to the microelectronics sector, provided the opportunity for enhanced engagement with SMEs.[18] They recognised however that students generally wanted placements with larger companies so it was more difficult preparing students for placements in

18 Silicon South West http://siliconsouthwest.co.uk/index.php/about-2/

SMEs but building reputation by utilising information through the employer network was helpful.

The experience of the South East Legacy project (L4LSE) also demonstrates the advantage of considering the supply chain to larger employers. This project worked with the large company National Power but through building relationships with this company and working with a recruitment agency supplying engineers to this employer plus other supply chain businesses the project was able to expand their understanding of where learning demand might be found.

In a similar vein, the Gateshead RAP project (11NE), assembled a working group from the motor industry and the emergency services to look at the implications of greener technology and from this the training needs were prioritised to include emergency services and recovery personnel, body repairers, public service personnel and motor vehicle service maintenance technicians. This resulted in Gateshead College developing and delivering 6 new programmes for high voltage vehicles and a bespoke programme with BTEC Edexcel for the Emergency Services.

The employer communities have been vital stakeholders for the success of the University of Sunderland project (20NE). These include the North East Strategic Health Authority (SHA), the Regional Learning Strategy Group, the Pathology network, the North East Cardiovascular Network, Regional Audiology Committee for Training Audiology Professionals. Representatives from each of these groups formed the employer steering group for the project. The steering group identified the module content, provided feedback on the structure, content, mode of delivery and gave time off to their employees so that they could go to the university and evaluate the learning material. This was an inclusive approach which engaged people at all levels of the employer organisations. As a consequence too of working collaboratively with employers and the innovative employee evaluation of the material, the university is putting together a Foundation Degree (FdSc) in healthcare science and the credit obtained by successfully passing the short course can be used to contribute to the FdSc. A particular area of added value has been that as a direct consequence of this project the university is now in discussion with Cogent, the Sector Skills Council to address the development of a FdSc Healthcare science for the sector.

For Huddersfield (12NE), it was particularly important to have the involvement of professional bodies and business support organisations. Without these partnerships, they would have struggled to engage with such a diverse range of employers and the design and recruitment process would have been significantly longer. Liaison with the pre-established Casting Technology Industrial Support Group (ISG), containing professional bodies and key employers who were involved in the design of the original curriculum led to the successful design and recruitment of an employer mentoring course. The new, industrial-driven qualification, which provides the opportunity to extend working relationships with a range of national employers, is a new dedicated module, aimed at providing employers with much more understanding of FE/HE qualifications and standards, curriculum design and assessment, together with methods for student learning support.

I am one of your students on the Project Management and Quality Module, I have just recently been offered a graduate job starting off on a part-time basis of two days a week, and then after completion of the degree this year I will be on a full-time basis. I am working as a Design Project Engineer with a strong bias to Project Management. I started last week in the role, and I just wanted to mention how what you have taught so far has really helped me. I have already started utilizing the Prince2 methodologies with support from the templates that you provided. I have found myself in a very strong position at the company only just after a week in employment. The practical approach in which you have presented the module has been significant in my present success and will be more so in my future success in Project Management.
(Student, Huddersfield University, 12NE)

Consulting with industry partners has been a key feature of the University of Wolverhampton project (48H) as noted earlier. The project was led by some major high volume engineering manufacturers in helping shape the design and content of the new undergraduate degree in Manufacturing Engineering. Working alongside the SSC SEMTA and the Engineering Employers Federation, the university has supported the group and explored opportunities for progressing young people through schools (including a local University Technical College) and apprenticeships and onto the new programme. The group has been brought together by the University at a series of formal networking events. Here up to 25 directors and/or HR managers were brought together to discuss issues in workshops before a formal dinner. The method appears to be popular with businesses and to have led to an effective collaboration between industry and the university improving partner understanding of the issues faced by both industry and the HE sector.

In a similar vein, the University of Greenwich project (29SE) reported how the project built on an existing network- BIG - the Business Innovation Group in Kent, a regional network for Technology, Engineering & Manufacturing, designed to provide mutual business growth, peer-to-peer learning, build on public sector opportunities/funding through collaborations and partnerships. The network has a focus on innovation

and growth for companies in technology, engineering and manufacturing[19]. The project expanded the focus in response to identified need by the group members to develop new HE learning provision in Biomass Handling, Feeding and Storage, Lead-free soldering for Electronics Packaging and Theory and Practices in Reliability Engineering. The project partners have included local Chambers of Commerce, Institute of Directors, Education Business Partnership, News & Media organisations, Engineering Employer Federation and professional bodies and the Local Enterprise Partnership. A significant aspect of this programme was sharing with employers how the new flexi-mode higher education provision and specialist short courses developed by the University could contribute to up-skilling the workforce with the specific aim of contributing to business innovation and growth. This reflects an understanding of the value of the proposition to employers.

The Labour Market Intelligence project led by the University of Exeter (38SW) also involved SEMTA, COGENT plus a regional Employment and Skills Partnership. The project comprised six sub-projects that were designed to address specific challenges in employer engagement experienced by STEM-related departments and/or colleges within the Universities of Bath, Exeter, Plymouth and the West of England (UWE) and the further education colleges (FEC) of Petroc and Weymouth. The Engineering Employers Federation and COGENT took an active role in discussions with partners on employer engagement and contributed to a 'Creative Learning Journey' process.

The NWUA "STEM CPD" (25 NW) project was concerned with trying to further develop the partnerships between universities and employers in the North West and forge new ones around up-skilling and the STEM agenda, which had not been a focus previously. New partners were brought to the table, embedding a process that was already underway elsewhere into new discipline areas. The NWUA acted as a broker and required stakeholders to choose their three top priorities for development. These stakeholders included professional bodies, (the Royal Society of Chemistry, the Royal Academy of Engineering, the Institute for Mathematics and its Applications, and the Institution of Physics) and Sector Skills Councils (COGENT, SEMTA, Construction Skills, SUMMIT Skills, EU Skills, Skillset, and Pro Skills). Regional cluster organisations included Chemicals NW, the NW aerospace alliance, Enviro link NW, the NW automotive and aerospace alliance, and NWTechnet. Crucially, no individual HEI took part in these engagements.

The UHOVI project (45W) was unusual but mirrored the example of the NWUA. As an arms-length organisation separate from, but working for the Universities, it was able to take on more of a brokerage and commissioning role and was not led by the existing offer. The idea of developing employer engagement around a 'sticky cluster' (see below) in terms of subject area, industry and parties with a common interest was effective.

'Academics in a STEM department in a University were keen to engage with a specific business sector. They engaged with certain larger companies over a period of months taking several meetings but failed to achieve a successful union. Sometime later as part of the UK STEM project we approached the same University STEM department with a proposition to encourage collaboration with the sector employers. The university were sceptical of success as one might imagine. However we were able to access the employers independently to better understand their specific needs. We then spoke again to the University academics, but again separately to establish a more tailored offer. Through this new intervention, negotiations have re-opened with indications of a positive result in the near future.' (Project lead, UHOVI, 45W)

Institutional collaboration for effective employer engagement

Although there are increased levels of competition and what has been described as "marketisation" in the HE sector, these projects have shown that there are ample reasons to collaborate because this simply strengthens the workforce development offer and may well exploit new and existing markets. Delivering projects as collaborative ventures has helped to develop a more integrated and holistic approach, moving away from focusing on marketing specific "products", and instead compiling a wider offer.

The Wales Legacy project (L6W) has aimed to address skills shortages across the Wales community and SMU has worked closely with Glyndŵr University to build capacity within the region to meet local employer's needs. This project has involved the piloting of a fast track, flexible progression pathway at Level 4 in mathematics and engineering science, for experienced people within or potentially within the workforce in the two universities. Each pilot was tailored to meet the needs of local markets and employer needs. Pilot programmes were delivered at both SMU and Glyndŵr. The programme at SMU started in September 2011 and recruited 6 students, disappointingly below the target of 10. This was due to difficulties experienced by employers in releasing students from work and a nervousness amongst both employers and employees about committing themselves to a programme when there was considerable uncertainty about what rate the

19 Big Kent http://www.big-kent.org.uk/

Welsh Government would set for fees in succeeding years. Discussion with colleagues at other universities revealed very similar experiences elsewhere. The SMU programme presented lectures on Friday afternoons, from 1p.m. to 7 p.m., over an extended academic year. The pilot programme at Glyndŵr started late, but eventually recruited 11 students. Collaborating on this new development has provided two comparable pilots and the learning has been shared.

The Exeter RAP project (38SW) involved a number of HEIs coordinated by the University of Exeter, Marchmont Observatory. The project developed a range of initiatives at institutional level that engaged engineering employers in HE level workforce provision more effectively and sustainably by providing detailed intelligence about employer demand, reviewing the nature and impact of existing processes of employer engagement and developing new approaches to employer engagement and embedding these within HEIs in the South West. The sub partners involved in this project were all at different stages in their thinking about employer engagement and faced different issues. The process of partnership working enabled them to identify common issues and to learn across the sub projects.

The Southampton (35SE) project which has led to the development of the Business & University Partnerships web portal (BIZZUP) involved all the HEIs in the Solent sub-region contributing details of services they can provide to businesses in the region. The portal provides a single point of contact for an enquiry, a swift and personal business focused response providing a clearly defined course of action to resolve incoming enquiries. In this case the aim is for all the collaborating partners to benefit from increased interest from employers seeking higher level learning and development.

During the Bournemouth project (37SW) six sub-projects were developed by six collaborating HEIs from across the region. The aim was to work together to explore how to improve employer engagement in the STEM under-graduate curriculum and provide contextual relevance, employability skills, and cross-disciplinary applications and working. All the partners worked well together and were able to address customer relationship management issues satisfactorily. This was in spite of a geographically scattered situation which was overcome through effective and flexible management. An informal network has been established which will continue to meet beyond the life of the project.

The "Steel Academy", the Swansea Metropolitan University (46W) project, has seen a new collaboration between that HEI and Swansea University to achieve what the project director has described as an "integrated skills escalator". This has facilitated much closer relationships with key employers, such as Tata Steel, and stronger, closer engagements have been forged.

One strand of the NWUA project (25NW) that was especially innovative was the maths partnership, bringing together three HEIs which had not worked together before. This stimulated dialogue about what maths provision means for industry and what expertise they could bring together as a complete, coherent package. There is now a standalone on-line learning resource the three universities can input their course material onto. This enhances the potential to attract STEM industries and people can access the learning without knowing which institution provides the materials. This gives a more cohesive experience and the different expertise complements the project.

The Coventry project (2M) is a collaborative project with Aston, Derby, NTU, Wolverhampton and Keele whose ambition is to collect, analyse and present information on effective practice for part-time learners in STEM. The project has produced guidance on part-time provision aimed at those wishing to enhance existing provision or create new courses. Recommendations are also made on how to increase participation in part-time study. The guidance has been based on the experience of the collaborators, on examples of effective practice within the collaborating universities and at other institutions in the Midlands and East Anglia region, on discussions with selected employers, and on the views of students expressed via an online questionnaire.

Some projects have also collaborated with other education providers to improve access and transition support for learners to new and existing HE learning. The NW Legacy (L3NW) project for example has developed collaboration with local Further Education Colleges (FEC). The aim was to improve connection with SMEs in the process industry sector where labour market research has indicated that are significant Level 3/4 skills shortages. The new partnerships have resulted in several outputs including a new franchised Foundation Degree Applied Science programme with Macclesfield and South Cheshire College and maths applications (Apps) for android and iPhones developed as tools to address the specific mathematical skills and knowledge required for entry to L3/4 courses in collaboration with Stockport FEC. The work is also opening up dialogue around the support needs for higher level apprenticeships and transition to HE for apprentices.

Similarly the University of Wolverhampton (48H) has worked closely with manufacturing engineering employers who are keen that the programme is available as a progression across the region for themselves and their supply chain businesses. The employers and the university are now collaborating with schools, colleges and training providers of apprenticeships developing progression routes. The role of the SSC and the EEF in brokering and sustaining relationships has helped in this development.

Overall the HE STEM projects have reported that the activities have increased awareness of the needs of local employers and the skills gaps that can draw employers to consider local HE provision for learning and development. The projects have provided a space for real dialogue with employers, improved the involvement of employers with the undergraduate curriculum and explored opportunities for new provision. The teacher placements have brought an enhanced understanding of the needs of industry and working with professional bodies, sector skills councils, business support and training providers, has provided improved understanding of university capabilities to meet employer need.

'Importance of network building: without the assistance of professional bodies and business support organisations, with mutual shared interest, academic projects of this nature would face large up-hill tasks' (Project lead, Huddersfield 12 NE).

Learning summary: Building employer alliances

- Undertake a variety of approaches to engage and involve employers
- The importance of network building should not be understated. Use the services of brokers and existing alliances with mutually shared interests to widen the net of engagement
- Understand and recognise the dynamics of the market and ensure to involve HE staff with business and marketing knowledge in negotiations
- Collaboration with other HE/FE providers can be mutually beneficial and working together can provide an entry point for employers such as SMEs
- Explaining different models of engagement can improve SME knowledge of a university offer

Developing models of flexible and responsive HE provision

Previous work undertaken relating to workforce development and flexible learning has confirmed that the needs and expectations of employee learners, and the organisations that they work for, can be very different to traditional undergraduate and postgraduate learners. HEIs have been engaged with developing and enhancing pedagogical approaches which are facilitative and supportive of learning in the workplace. This is essential to ensure that the student experience is optimised and that skills, knowledge and experience gained in the workplace are integrated with higher level learning.

The STEM workforce development and higher level skills projects have had a remit to develop new models of flexible provision, revisit the curriculum and involve employers in the development, design and delivery of courses. The projects demonstrated evidence of success in these endeavours although the outcome has been variable.

Flexible learning is about providing learners with choices regarding where, when, and how learning occurs. It helps to attract and meet the needs of an increasingly diverse range of students and includes making appropriate use of technology to support the learning process…..Put simply, flexible learning is about enabling choice and responsiveness in the pace, place and mode of learning.[20]

A significant element of building relationships with employers is to involve them in the early stages in the design of any new provision and this requires that priority is given to the flexibility built within the programme. Developing flexible learning for workforce development encompasses the need to consider the pace, place and mode of the learning and to be dynamic and sensitive to the preferences of learners or sponsors of the learning (e.g. the employers).

The pace of the learning may be influenced by: the partners' attitude to accrediting prior certificated or experiential learning; to the recognition of any non-accredited learning achieved in the workplace; to the speed employers expect for achieving new competences and knowledge; whether learners will study part-time or full-time. The place of the learning requires consideration that this may involve work-based learning as well as attendance at an institution but may also involve technology enhanced learning for learning across geographical boundaries. These requirements bring forward issues of accessibility, of contextual concerns around access to learner support, supervision and mentoring.

The teaching may occur 'off campus' e.g. in the workplace itself although traditional models of teaching in the classroom on campus may work for some responsive provision especially with regard to small accredited or non-accredited provision. For other programmes a blend of technology enhanced learning with classroom based lectures may be required, or distance learning using synchronous and asynchronous modes of learning. These approaches provide both opportunities and challenges in bringing innovation to the design and delivery of the learning.

Developing flexible provision can also provide opportunities for engaging employers in the design of

20 Higher Education Academy website: Flexible Learning, http://www.heacademy.ac.uk/flexible-learning

the curriculum contents and for consideration of new approaches to enhancing the dynamic between employer, learner and HEI. In developing such provision, flexibility may be required too in responding to any changes to economic and business conditions for employers, the personal and professional concerns for learners, and policy and strategic institutional changes for the providers. All these issues have taxed the projects here.

The Legacy projects based in the London and South East, North West and Wales regions have instigated change internally to develop a more responsive and flexible approach to meeting employer needs through changes in pace, place and mode.

The South East Legacy (L4LSE) project has provided access to learning for up-skilling work-based learners in a more flexible form. The approach has involved using three different resources introducing more flexibility in their provision: video tutorials, virtual experiments and dynamic questions. The accessibility to practical skills development on the internet was pivotal in getting the support of employers as employees can access the learning off-campus and at a time to suit them. The resources developed draw on the learners' experiences in the workplace building new technical and practical skills and ensuring they are fully engaged and benefit from their learning experience. There was less focus on accreditation of provision but more on non-accredited learning that supports employers looking for more effectiveness in the workplace, aligning closely to the broader skills utilisation agenda. The material has been used by both undergraduate, postgraduate and workforce engineers on the MSc in Energy and Sustainability with electrical power engineering and with the IET Power Academy students to improve their knowledge prior to summer placements. There is a growing interest in using the resources for distance learning programmes and the wider use of technology.

Learners have been positive about the flexibility of access and the ability to revisit elements of the learning material independently. They can see the direct benefit to them in helping speed up their understanding in the topics covered. Compared with reading and working on pre-set problems they have found it much quicker and more engaging. The project provides an example of learning for people already in work that draws on their experiential learning in the workplace and builds new technical and practical skills and ensures learners are fully engaged and benefit from their learning experience. (Project lead, South East Legacy, L4LSE)

The North West Legacy project (L3NW) has also benefited from developing non-accredited CPD provision with flexibility of access and mode of delivery as important elements. This provision was designed to implement potential change in programme delivery through an approach of 'applied' training that is more flexible and employer/employee focused, can be done in small chunks and might not be accredited. This shifted the notion of what university learning can be: that it can be related to specific skills development and that the packaging of the product is as important as the product itself. Although it is targeted at a particular STEM industry, the bite-sized learning for chemical and engineering skills in process industries could result in learning available to a large number of employers. The project has developed a range of flexible resources on Laboratory Skills and Health & Safety Awareness that can be tailored for bespoke use. The project has developed a commercial operational protocol (financial, legal and regulatory requirements) as part of the project and is now seen as an exemplar of good practice across the university. One crucial area that has been explored is how to share issues around costing with employers and how the extensive use of e-learning can support efficient delivery. The e-learning provision has made communication with employers easier with respect to sharing content and learning outcomes, to show how these can be modified for flexible CPD and training and can demonstrate to employers improved communication with employees. The opportunity to combine learning in the workplace, and develop small-credit employer-responsive awards, offers learners the chance to engage with higher education and enhance their competences in the workplace. This is an excellent example of a project being very clear about its value proposition in that engagement with the university provides access to new technologies being used to enhance learning and development as well as makes clear provision will be developed that is responsive to employer/employee need.

The North West project also set up a learner user group who have been testing the mobile learning Maths 'apps'; they have found this particularly useful and will embed the approach. The 'apps' also provide a novel way of learning and the development of knowledge that supports progression. The effectiveness of approach for both full-time and part-time learners will be evaluated. The learning environment is broadened as students can engage with the activities off-campus and can develop skills and knowledge in a creative and entertaining way. (Project lead, NW Legacy, L3NW)

The Wales Legacy project (L6W) has brought more flexibility to a traditional undergraduate learning programme. The Wales project offered nothing new in general in the curriculum content but what is transformational is the flexibility of the offer and the take-up by the employers as a result of a more business-oriented approach by the HEIs. Here the project has

utilised an Accreditation of Prior Learning (APEL) process to support entry into and through programme of study and delivered this programme in a more flexible mode and improve the pace of learning. The project involves development of a fast track, flexible progression pathway at Level 4 in mathematics and engineering science, for experienced people within the workforce. The new programme will be delivered outside of normal university teaching time. Part-time formal learning and assessment is offered over 42 weeks, totalling 250 face-to-face hours of tuition. The 120 credit programme includes 60 credits achieved through formal assessed learning in mathematics and engineering science and 60 via APEL recognising existing work-related skills and knowledge. The progression pathway will enable students with the appropriate qualifications to fast track to Level 5 studies in engineering either part-time or full-time. Developing a flexible learning programme that also recognised prior experiential learning so work-based learners could fast-track through the programme has proved attractive to businesses as a more cost efficient approach and also for adult learners keen to achieve HE level qualifications. The flexibility of delivery challenged the HEIs but the business case and value proposition within the approach reflected seriousness by the HEIs in responding to employer needs.

The University of Wolverhampton project (48H) has developed a new B.Eng. Manufacturing two year degree for industry which they hope to deliver from January 2013. The innovation in this programme is in the nature of the accelerated delivery of the programme and the relationship with employers to ensure success. The plan for the degree is for a three semester programme involving the learners undertaking three days of study in work and two days in the university over a two year period. The employers will provide sponsorship for the students to undertake the learning and work-based projects will include projects that have relevance to the business. The project has drawn on existing experiences and that of Swansea Metropolitan University in designing a programme of accelerated learning that meets the needs of industry. The HE STEM funding has also provided seed corn funding for the development of new bridging modules designed to link with apprenticeships programmes approved by SEMTA to support progression into HE.

Leeds Metropolitan University, Sunderland University, Gateshead College and UHOVI have all been involved in discussions around STEM Foundation Degree developments. Each has attempted to develop new programmes to meet employer requirements and have met some challenges. In all cases projects have reviewed their approach and developed alternative forms of provision or seen the RAP project as an opportunity for the first stages of development. Flexibility here also relates to flexibility in approach and the importance of not progressing with a fixed agenda. Projects have required discussions with employers about the implications of the timeframes required to complete the institutional processes and procedure for finalising a quality product and institutions have had to learn about the business imperatives influencing the pace, place and mode of learning. Here the projects have introduced proposals for the use of blended and e-learning with the consequent issues of managing the learning and learning platforms for the learners and the academics.

At a strategic level, the UHOVI (45W) project had the aim to develop longer-term relationships with employers with jointly developed provision that responded to employer need. The mission of the project was to actively engage employers as co-producers in defining the curricula offer and to support academics in working through the requirements for reaching this stage. Early steps have been made in identifying requirements for short term courses in areas such as digital computer skills focussed around utilisation of Office software, web construction and social networking skills which are of immediate value for the companies. In the longer term more flexible provision with tailored appropriate content, level and credit value will be developed in a way that helps UHOVI to negotiate learner centred provision drawn from the existing curriculum base at all levels and newly validated bite-size and FD provision. The UHOVI project has been extended to grow a number of clusters across a range of sectors e.g. Pharmaceuticals, Food, and Automotive in line with Assembly Government priorities. A challenge remains however in bridging the gap between '*academic elitism*' and '*rampant vocationalism*' and securing institutional buy-in to the value to be derived from integrated learning.

The Sunderland project (20NE) was driven by two influential pedagogical elements: interpreting the employer needs into pedagogically sound university-approved curriculum content so that both the university and the employers are satisfied; developing flexible learning and ensuring good practice in e-learning so that the employees/students are best supported at a distance. The approach taken has involved negotiation and discussion. Although originally a Foundation Degree was planned to provide learning for NHS laboratory assistants/associates, dialogue between partners has brought about a pragmatic solution with a stronger focus on bite-sized learning at HE level which will provide greater transition support to a diverse group of learners and give flexibility for employers concerned about protected time off for study. Four modules have been developed as flexible learning opportunities and formally approved as a 40 credit short course (Chemistry for Biology, Basic statistics and data handling, Microbiology, Immunology). These modules will be delivered entirely by the university's virtual learning environment (VLE) using an open learning format. Here the project has addressed employer/employee

constraints and the course began in May 2012 with 16 students all of whom are local hospital employees.

Mathematics was at the centre of the RAP project developed at the University of Bradford (10NE) also in response to health service employers. The project reported that the motivation for the development was NHS employer concerns about the mathematical skills of nurses already working in the National Health Service (NHS). Initial scoping activity carried out with five NHS Foundation Trusts identified the need for contextualised learning materials which could be used to develop the mathematical knowledge of staff delivering patient care. The project which involved collaboration with Teesside University, Bradford College and several NHS Trusts forming a steering group, identified the need and type of mathematical support required for healthcare professionals. Here the learning is outside of existing HE programmes but offers a flexible opportunity for work-based learners to update and upskill for effective practice.

The Leeds Metropolitan RAP project (15NE) faced a similar challenge in changing direction from an original plan to develop a Sector Skills Council approved Foundation Degree in new technologies for local employers, to creating a learning package that is more likely to be accessed by employers looking for flexible learning in a time of economic constraint. The project had been focussed on creating units that fit in with industry needs in respect of new technologies and the result following consultation with employers has been the development of a programme of short blended learning courses in line and with approval from the Sector Skills Council. The project also involved partnership teaching with another institution and although there were industry concerns around this the different institutions involved considered that there were benefits to be gained by the students. The advantage for all in the dual HEI approach may be an increase in the number of employers who would look at the programme and therefore help its sustainability.

At Gateshead (11NE) the intention was to develop and deliver a Foundation Degree for employees working in motor industry partnership with Nissan and Smith Electric Vehicles (SEV). Communications had identified a skills gap for engineers working in the production of low carbon and electric cars. Currently courses at only Level 2 & Level 7 are available in the region and the aim is to develop qualifications and training which will provide the employers and employees with the current and future skills required to access growth opportunities in the rapidly expanding Low Carbon Economy. The programme has a strong maths and science content and applications that underpin Low Carbon Vehicle Technology. A blended learning approach is being taken to the design. The early stages of discussion involved the University of Sunderland as a validating institution but local HEI changes in strategy have influenced progress with this and now a new HNC/D may be validated as an alternate approach. The programme will be delivered as a 'long and thin' series of modules to help with development – delivered two nights a week and each week there will be one hour of maths. This is in response to requirements from local HEIs for better preparation to support progression to full degrees. Pedagogic approaches will have relevance to the students and their employers: using more e-learning; using more group/team exercises and drawing on experience of students in the workplace. The aim is to develop content for learners to draw on their workplace activities with opportunities for assessed projects to be designed around the workplace. The aim is to also develop a range of short courses to meet employer needs.

Coventry University's project, (2M) was an exploration of best practice in the delivery of STEM provision on a part time basis to the engineering sector. Participating in this flexible, work-related learning aroused mixed feeling among learners. The project surveyed students who provided some interesting responses: The institutions participating all approach things differently when they are infilling part-time students in full time provision-mixing both full and part-time together for group work for example – some keep the part-timers together others mix groups up. The survey revealed that part-timers already in work had strong feelings of resentment for this approach, they felt they were having to share their knowledge but not gaining much back for themselves. Although they saw that it gave them experience in 'supervising' junior staff and developing leadership skills and team work some still resented it. As a result project collaborators are reviewing their practice with respect to group work. They do want to make the most of more experienced students but also need to ensure that they these learners are not seeing the activities as too one-sided. Academic staff are certainly prepared to manage the risk but they understand balance has to be struck because of the overall benefits to group work.

As a result of the involvement of the academics as outlined earlier, the Anglia Ruskin project (27 SE) developed accredited, bite sized learning to upskill chemical industry employees. The core of this project has been to work closely with the employer partner Huntsman, to undertake a comprehensive revival of their training programmes and skills need and build a course that addresses these specific requirements. This course is particularly designed for production workers in chemical industry and helps them give context to their day-to-day operational work as well as an academic underpinning to their extensive experience.

Also in response to employer requirements in the chemical industries the University of Reading RAP project (33SE) has piloted a flexible distance learning course for employees in pharmaceutical, forensics, agrochemical and analytical services industries. The

programme is aimed at Level 4 learners who are working in the industries but have no formal HE qualifications involving fundamental analytical chemistry and the project trialled the learning with a small group of employees working in partnership with CEMAS an analytical services company. The aim was to discover whether there was a need for this type of material, what type of companies and employees would be interested and how useful the material would be and whether employees in industry with limited chemistry could succeed. The online distance learning course consists of 18 sub chapters each dealing with a specific aspect of analytical chemistry relevant to the modern chemical industry. The chapters are associated with self-study questions and formal quizzes to check understanding along the way. Where appropriate they are illustrated with video links and animations to assist comprehension. It is planned that students will spend around six months working through the 20 credit programme. The course is assessed by a portfolio approach and draws on work placed learning experiences.

Teesside University have utilised the HE STEM funding to further expand their existing Open Learning in Engineering programme (TUOLE) by introducing new flexible learning opportunities that meet local employer needs. The Teesside RAP project (21NE) reported it has developed an open learning module in Engineering Design, and provides a flexible pathway for employers to meet an identified need for professional three-dimensional computational engineering design learning. The project targeted process engineering companies, including petroleum, chemical, oil and gas, offshore marine, renewable energy and those in associated industries. The '3D CAD for Plant Engineering' 15 credit Level 4 module has been presented to a range of employers and learners and modified as a result of employer involvement and after addressing some software licensing issues. The module now provides learning within a plant design engineering context and is based around typical project engineering considerations for 3D CAD implementation, within a multi-disciplinary context. The project has cemented a successful relationship with AVEVA Solutions, a major and global plant engineering solutions provider and an AVEVA training facility based at Teesside University Darlington campus has been formerly approved, and will become the premier AVEVA training centre for the North East region.

The model of distance/open learning is one also followed by the University of Plymouth RAP project (39SW). The project reports that the university responded to an international company Fugro, which is the largest integrated supplier of geosciences, survey and geotechnical related services and the Royal Navy. Fugro's requirements were to facilitate engagement for their workforce with the HE sector to help individuals to gain accreditation by the International Hydrographic Organisation (IHO) at both Category A and Category B levels of professional practice. Many of the staff currently working in the offshore sector are experienced, but may lack formal qualifications, and there are relatively few with the Cat A and Cat B certification. More significant is that the offshore Hydrographic survey industry workforce is deployed frequently for extended periods in remote locations, often at sea aboard ships. There is very little opportunity for individuals to access the internet and time off for study is expensive to both employers and employees. As a result of the project development a new 10 credit Level 4 module was developed and trialled with a group of 12 students. The learning materials were packaged on an 8GB USB memory stick and mailed to the students allowing them to access learning when working offshore. The new programme has received positive feedback from the student trial, the industrial partner and the academic institution demonstrating that taking a creative approach to distance learning can meet the bespoke needs of a variety of employers.

Learning Summary: Curriculum and pedagogic approaches that support employee learning

- Developing full programmes with employers requires discussion and negotiation and may be more effective taking a commercial approach
- Flexible provision may require taking a 'building block' or 'bite-size' approach for employers and employees to have the time/flex needed
- Meeting employer needs is not the same as meeting the needs of adult work-based learners so engagement should be based on career and business benefits
- Transition support and access requirements need full consideration to support learner achievements
- More staff-employer interaction/exchange in a workplace can enhance understanding and support knowledge transfer that enhances curriculum content and the learner experience
- Providing incentives through reward and recognition for those involved in workforce development activity can bring better results and can support an institutional culture for this work


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Part Five: The Graduate Skills projects

The requirement for improved graduate skills was highlighted in the Wilson Review of University-Business Collaborations. The Review suggested that there are three interconnected themes relating to the development of graduate skills:

- relevance of programmes to the world of employment
- skills development and awareness
- the importance of work experience[21]

The HE STEM Legacy and Regional Action Plan projects aimed to address these themes in different ways. They contribute to the evidence of progress within HEIs in developing relationships with employers in support of graduate skills development. This section identifies how the projects considered these issues.

The programme directed projects to explore ways for employers to contribute to undergraduate teaching, learning and project work and involve them in course design and delivery. The projects could provide opportunities for students to develop wider skills as part of their programmes of study including through the development of experiential/work-related learning. Projects were also encouraged to consider involving professional bodies in recognising their wider range of skills. Three Legacy projects and twenty-five RAPPs had a specific focus on graduate skills although six projects also influenced both strands of work.

An initial step taken by several projects was to seek out further information about the issues and concerns of employers relating to their discipline area or regional employment concerns. They have used the project to gather evidence about what employers really want from graduates and how their requirements can be developed in undergraduate programmes. Several projects have reviewed their approach to work-related learning and considered new ways to enhance the curriculum introducing new modules, involving employers in designing the curriculum, and introducing new co-curriculum offers to raise student awareness of employability and career management issues. For some projects this has meant a focus on improving placement options or creating opportunities for students to make direct contact with businesses.

21 BIS (2012) A Review of Business–University Collaboration, Professor Sir Tim Wilson DL, February 2012, P44

Our structured questioning of the project leaders asked them to comment on the different motivators for developing these projects, and the emergent themes have been arranged as follows:

- Ensuring the relevance of HE programmes to the world of employment
- Developing placements and work experience
- Improved Career Advice and Management
- Student engagement with graduate skills development

Key drivers for developing these projects

One of the main drivers for developing these projects was to review curriculum provision in the light of the challenging economic climate regionally, nationally and globally. In particular, individual projects wanted to introduce new approaches in order to manage student expectations and support employment prospects. There is also a continuing requirement to respond to the accumulation of evidence on the mismatch between the supply and demand of STEM graduates. For some projects there was a need to be more responsive to changing patterns of employment within a region. For example this involves preparing students for the shift from public to private sector provision and the need to refocus attention to SMEs and other organisations when larger companies have withdrawn from an area.

The Legacy projects intended to influence institutional culture and attitudes for involving employers in graduate skills developments. Three projects (L1M&EA, L2NE, L5W) responded to employers' requirements in STEM-related employment sectors but the North East project (L2NE) in particular built on existing institutional approaches to enhancing employer involvement in the university provision and for improving the university approach to 'greening' the STEM curriculum. The project ambitions encompassed infrastructure matters, evaluation and learning at a strategic institutional level and for sustainability beyond the life of the project. The project extended two previous Strategic Development Fund projects, Escalate and Ecoversity[22].

Some employers and employer groups have articulated the need to review graduate training schemes that are unsustainable in a challenging economic time (Lincoln, 5M). For some projects, the awareness that the job market is changing and the requirement for flexible workers was a stimulus to review approaches to the guidance given to students about employment prospects (Nottingham Trent, 6M).

22 HEFCE website, Workforce Development Projects, http://www.hefce.ac.uk/whatwedo/kes/ee/workforcedevelopmentprojects/escalatebradford/ University of Bradford website: Ecoversity, http://www.brad.ac.uk/ecoversity/

The imperatives to prepare graduates for this changing employment market and for the world of work in general, were central concerns driving several projects. Some wanted to address specific issues for a target group of students, for example those from particular disciplines (Leeds 14NE, Leicester 4M, Reading 34SE) or female (UCL 36SE) or Black and Minority Ethnic students (Greenwich, 30SE, Reading, 34SE). The projects built on knowledge they had of their alumni experiences in struggling to articulate the skills they had. A scrutiny of destination data revealed their graduates were not entering graduate level jobs or were not working in identified STEM sectors. (Leicester, 3M, Northumbria, 17 NE, Sheffield Hallam, 19NE) These were issues that have been identified by previous reports and through the work of other funded activity such as by Lifelong Learning Networks, previous Higher Level Skills Pathfinder (HLSP) projects or professional body research.

For some projects the motivation has been to understand the specific issues relating to graduate skills development and explore how and where opportunities for developing skills can be addressed during their undergraduate experience. Developing better relationships with employers was a central facet of this work and was a key driver for how the project was planned and developed. (Sheffield, 18 NE, Leicester 3M)

The requirements for graduates to have desirable work experience was also the motivator for some RAP projects which aimed to review approaches to placements and the opportunities for work-related learning and experiences in their programmes. (Brighton, 28SE, Reading, 32SE) Bridging the skills gap between what employers say they require and what universities can provide in supporting graduate skills was a driver for several of the projects here (Leeds, 14NE, Reading, 34SE) and for Cardiff University (43W) responding to the demand for more enterprising students, particularly those from STEM disciplines, was a challenge that motivated the project.

A review of project reports and the specific explorations with project leaders led to the identification of some more specific themes within which to examine and assess good practice and success. This section now addresses these.

Ensuring the relevance of HE programmes to the world of employment

A number of the projects set out to understand what employers seek in STEM graduates and aimed to enhance their relationships with employers through developing this understanding. The main aspect was to understand how to develop the skills and qualities employers wish to see demonstrated at the recruitment stage and this could be improved by having better communication with employers.

The University of Leeds RAP project (14NE) set itself a challenge to develop a better understanding of the skills a range of employers want from Mathematics graduates, to develop an employer-defined skills set for Mathematicians and develop learning activities and resources that can be used to embed these skills into the core curriculum. It established a School Employability Advisory Board consisting of employers and other stakeholders. The aim was to form stronger alliances with employers for the benefit of Leeds's graduates across a range of disciplines. Contacting employers was a successful way to gauge their willingness to be involved with the project and has led to the development of a number of work-related project activities in a team project module. Similarly another Mathematics project, the Birmingham RAPP (1M) reported that it learned from industry partners that rather than discipline specific topics being missing from the curriculum, team work and confidence in addressing problems were two areas where it was felt improvements can be made. The Imperial/Cogent project (47H) focused on developing graduates to make them not just good engineers, but "nuclear literate" and the presence of the Sector Skills Council ensured that the right employers were making the right contribution, with marketing and communication of the initiative having a prominent role.

The University of Leicester (3M) has considered why some engineering graduates become unemployed or employed in non-graduate jobs when there is evidence of demand for their skills. This was a collaborative project with Aston, Birmingham, Loughborough and Coventry universities who each used their HESA data to understand the issues. The project interviewed 19 employers (large and small) and the findings reiterated that there are skills gaps among engineering graduates. Chiefly the employers expressed expectations about transferable skills and the importance of work experience in an engineering context and to be able to apply technical skills and knowledge within a business workplace context. They also valued high academic qualifications (preferring a MEng. above a BEng).

Aston University RAPP (1(ii) M) reported they have also researched into what engineering employers were looking for from graduates. Using the responses from informal interviews with 20 employers, the research has informed the development of toolkits for both staff and students. The 'Graduate Employability Toolkit' was put together to help students make the most of the generic skills and competencies developed whilst studying Engineering, Maths, Applied Science and Design. The Toolkit comprises an eclectic mix of models, tasks and questions and is suitable for students at all levels of study. It brings together employer, academic, graduate and student perspectives to provide useful tools that students may adapt and utilise for their own purposes. The toolkit draws attention to key employability skills expected of engineering graduates:

Global Citizenship; Communication Skills; Interpersonal & Team-Working Skills; Self-Management; Ability to Think 'Out of the Box' ; Ability to Reason in the Technical Domain; Enthusiasm - Inspirational & Motivational Attitudes; Problem-Solving & Critical Thinking Abilities; Leadership Abilities and Presentation Skills.

The University of Sheffield (18NE) decided on a more personalised approach by developing an employer forum to enhance communications and explore issues about graduate skills with both academics and employers. The project was designed to establish a faculty-level dialogue between employers and the department, to articulate a model for establishing an Employer Liaison Group, to find ways to maintain the group efficiently, and ensure its sustainability.

The University of Huddersfield RAPP (12NE) aimed to build on established relationships and to extend the support mechanisms available to undergraduates, to enhance their transition between academia and the workplace. The project had a broad remit but it brought together employers, other HEIs, sector representatives and professional bodies to explore the issues in a collaborative way. The approach to having several HE providers and employers together has also worked for the Northumbria University project (17NE). A regional employer forum, the North East of England Process Industry Cluster (NEPIC), appeared to be more comfortable with this model of an open forum rather than with an individual university. A mixture of Chemical, Petrochemical, Polymer, Specialty Chemical, Fine Chemical, Pharmaceutical, Biotechnology, Composites, Bioresources, Biofuels and Renewable Materials and Energy companies all based in North East are involved in NEPIC. They were familiar with each university's strengths, have knowledge of the programmes and understand what graduates from the different universities will have to offer. The group has provided a forum for identifying an 'Employability Skill Set' to support other aspects of the project. Some commercial sensitivity has influenced the effectiveness of this group and this is a challenge that HE partners have to manage. However the group has provided improved links with employers including additional benefits such as opening dialogue for research and KTP.

The University College London project (36SE) had a specific focus on supporting female undergraduates into STEM careers. It gathered evidence about the recruitment of women into engineering-related employment in order to understand the gender differences for engineering undergraduates' transition into STEM related jobs. The aim was to develop the curriculum to bring modern leadership and team models into the HE environment to improve the confidence of women and men to meet employers' needs and expectations more appropriately. The project engaged key employers in an industry survey on the recruitment process for graduates, through one to one interviews and round-table discussions with academics and employers and HR people. Subsequently the project has developed work-related leadership model projects with employers using resources, videos, group activities, discussion topics and coursework for undergraduates. Personal intentional learning plans for students have been designed to help them map their journey into leadership.

We found the importance of speaking to people to build a dialogue is vital. It seems that email may have had its day as people get so many. And we seem so surprised when we pick up the phone and find the right person. (Project lead, UCL 36SE),

Learning Summary: Developing curriculum for relevance to the world of work

- Difficulties in developing curriculum with employers can be overcome and employers are prepared to offer guidance and participate in activities to help graduate employability
- Employers recognise there is a mutual benefit in working with a university to gain access to the graduate market
- A good starting point is to understand directly what employers want from graduates
- Direct approaches to employers can help gauge their interest in being involved with a HEI and can lead to the development of work-related learning projects
- Providing a forum or group for employers and academics to freely explore issues about employability can prove mutually beneficial
- Engage learners early with plans for changes to curriculum or co-curriculum to ensure implementation is well received

Curriculum enhancement for work-related skills development

Several of the HE STEM RAP projects addressed curriculum development for enhancing graduate skills, acknowledging that for providers of STEM programmes, existing requirements for laboratory practical work in a loaded timetable can present challenges when attempting to add to the curriculum. A common element has been to incorporate more employer input either by sharing the delivery of work-related learning, using contributions for projects and activities or by engineering opportunities for students to visit business premises/sites to gain a realistic understanding of the needs of business and workplace requirements. Some projects have introduced work-related modules that

fit within the existing curriculum or provided support 'workshops' that have relevance to the overall course.

Employers involved in delivering the curriculum

Projects have been innovative in using the services of employers to help develop and deliver elements of their programmes. The Midlands and East Anglia Legacy Project (L1M&EA) led by the University of Birmingham aimed to bring together local employers and STEM students through the development of a four-week "internships" programme delivered at the university but with input from employers. The content of the programme provided Level 6 students with the opportunity of working on 'real-world' projects in mixed teams. The activity was supported by sessions on team building, problem solving and communication skills, skills assessment and logging, peer assessment and reflection, an alternative approach to placements as these are not always accessible/ available for all students and this programme was designed to offer an alternate. Multi-disciplinary working, which has always been a struggle during term time because of timetabling constraints, was included.

Employers were involved in the design and delivery to ensure that the programme had relevance for businesses and address some of the skills deficits. The employer involvement happened over a short space of time but was both extensive and intensive. Employers contributed a 'challenge' to groups of students signed up to the programme. The employers introduced the challenge to the students themselves and assessed the outcome. The opportunity to have a funded project was attractive to employers coupled with the chance to "test out big ideas with 30-40 good brains who were also potential future employees". This was quite a heavily resourced input by the employers but it represented a very good public relations activity for them being associated with a prestigious university and they were having a private preview of up-and-coming talent. In 2011 the Challenge involved four teams of eight enthusiastic third and fourth year students from the Schools of Mathematics, Physics, Chemistry, Chemical Engineering, Mechanical Engineering, Electrical Electronic and Computer Engineering and Civil Engineering. In 2012 they had six teams of eight and it included materials and metallurgy students this time. It was oversubscribed and encompassed all of the STEM academic disciplines.

Another approach was to target STEM alumni to invite them to deliver a workshop as a representative of their company. While remuneration was not offered for this, it was marketed as an opportunity to meet with some of the brightest graduates. It was also seen as a rewarding form of engagement for alumni which can only reinforce relationships and cross-sectoral links. The project leaders have used social media, particularly Twitter and LinkedIn to engage employers with the project and now other universities are joining in.

The South West Legacy project (L5SW) at the University of Bath intended to provide more on-course support for developing graduate skills. It also aimed to influence the on-going institutional strategy for employability by encouraging and enabling more employers to provide 'real world' experiential learning for STEM students through placements and employer-defined collaborative projects. This approach extends and embeds existing good practice in the university in relation to employer engagement within STEM departments and within the undergraduate curriculum.

The University of Greenwich project (30SE) built on their understanding that mathematics graduates are viewed by employers as typically well-equipped with technical skills but weaker on communication and teamwork. DELHE data also identified employment for black and minority ethnic (BME) students as problematic and this gave the incentive for a more focussed and structured approach. The maths department had established links with the ADAB Trust (an organization dedicated to increasing graduate level employment outcomes for students from Black, Asian and Minority Ethnic – BAME- backgrounds) and the HE STEM funding helped to develop this work. This project used the services of the Trust personnel to deliver elements of the programme to final year students and the Trust also set up master-classes provided by employers from a number of companies. The emphasis was on providing inspirational speakers with good practical advice using BAME role models, to enhance awareness of their employability, build confidence, and improve their career opportunities.

The University of Lincoln (5M) has recently established a new School of Engineering and set a priority objective to deliver 'industry ready graduates' i.e. graduates who are ready and fully prepared to make a contribution to their future employers from day one. The RAP project provided additional funding to build on the innovative approach the university was taking to establishing a partnership with Siemens but also with other local employers. The project aimed to find more about employer requirements, and involve them with undergraduate teaching in an attempt to bridge the gap between university and industry. The project used an interesting and innovative approach using the idea of customer relationship 'touch points', led by employer colleagues at Siemens. The process was for academics and employers to jointly identify professional skills, and for the academics to review the syllabus for where the industry based engineers could deliver a teaching and learning opportunity to help develop skills. Industry based colleagues delivered elements of the course ranging from discrete day long activities to a whole module throughout the academic year. The operation and progress of the 'touch point' was monitored primarily through student feedback

via a range of mechanisms from focus groups to evaluation questionnaires. A final year project has now been extended from 30 to 45 credits to allow students to deliver useful outputs that have real value to the company and gain credits for this. Industry involvement has begun to permeate the whole degree syllabus and is not just limited to isolated project-based modules.

We have developed deeper and more open relationships with industry and have a better understanding of what employers mean by employability as opposed to what academics think it means. (Project lead, Lincoln 5M).

The Nottingham Trent University project (6M) worked closely with employers to introduce new approaches to practical work, develop an evidence-based skills portfolio for graduates to articulate evidence of their practical/professional skills, and included context based/problem based learning activities into modules in chemistry, physics and forensics using professional/industrial contexts/case studies. The project has worked with Biocity[23] in Nottingham and set up workshop and events where lab managers and employers of STEM graduates could review the skills sets devised and feedback on issues. The changes are becoming a significant part of a whole curriculum review. In a similar vein the Birmingham RAPP (1M) project aims to embed Enquiry Based Learning (EBL), graduate skills and career awareness into the curriculum. These changes also form part of a wider planned curriculum review, including introducing a first year EBL module, the establishment of an Industrial Advisory Board and a module 'Mathematics in Industry' involving presentations and assessment tasks given by partners from industry.

Learning Summary: Involving employers in curriculum delivery

- There are benefits to be gained from involving employers in activity to improve the practical application of theory
- There are some risks for involving employers in delivery to support employability but these can be outweighed by the benefits gained
- Dialogue and exploration of the concerns and capabilities for delivering learning is important
- Students and employers should be involved in giving feedback on their experiences of employer input into the curriculum to be used for programme/module review

23 BioCity Nottingham provides business support, finance, labs & offices to bioscience, pharmaceutical, med-tech & healthcare companies http://www.biocity.co.uk/

New modules within the curriculum

A number of the projects developed work-related modules that can be delivered as part of a core programme but are more commonly available as an optional module. The aim has been to have an element of the curriculum designed to specifically support skills and to raise student awareness of the relevance of the skills for future employment. The credit size of the modules and how the content has been delivered has varied but the emphasis has been on students participating in activities and providing a space for reflection on personal achievements.

The North East Legacy Project (L2NE) involved a large number of students across all disciplines and has made some significant changes in the chemistry, engineering and technology areas and created a test-bed for several areas for development. The intention here has been to improve the skills of graduates to respond to employers in the low carbon and green technology fields through significant programme developments, curriculum change and a cross-institutional approach to low carbon issues. New modules in Human Power Vehicle Design and Build and curriculum changes in Software Engineering and Low-carbon Computing that address the relationship between sustainable development and computing, involve active group learning between students and staff and helps students to feel fully engaged with their learning experience. For example, the automotive engineering module is a multidisciplinary, practical curriculum project located in a high impact, substantial core module. Student engagement with the module/curriculum gives them the opportunity to work collectively to build a 'green vehicle' in order that a national green racing competition can be launched. In Computing, web-based resources have been created that encourage students to think about and address the relationship between computing and sustainable development. A number of new green chemistry practicals have been introduced into the existing curriculum. This multi-faceted and inclusive project has delegated the development of modules to individual academics with a brief that they enthuse and inspire. The genesis is to do things that are worthwhile and this enthusiasm is influencing the student learning experience in the different STEM disciplines.

Some projects were discipline specific. The University of Leeds RAPP (13NE) had a focus on mathematical modelling and problem solving. The driver was to respond to employer requests for more graduates with knowledge of Newtonian mechanics and its application in the workplace. The project introduced modelling appropriate for engineering, mathematics and physics students in new module or units of study. The future aim is to involve existing and new local employers and introduce more examples of 'live' problems for students to solve. The module

contents will possibly be embedded in other learning in the future as the whole curriculum is reviewed.

A second University of Leeds project (14NE) has introduced a work-related module as a result of the employer survey with emphasis on specific skills that are transferable to a workplace. A year two (Level 5)10 credit module "Maths at Work" was trialled by the project with 35 students and has now been developed as an optional module in 2012/13 for all year 2 students. The learning outcomes for the module test a range of skills and the assessment reflects this. The module incorporates career development activities with employer input and the major component is a team project with topics being mostly developed in collaboration with industry. The employers gave the project authenticity and have helped to strengthen links between the school and key industries. The model for the module development is to be replicated for other STEM disciplines.

The project has provided a mechanism to open up dialogue with industry with a real purpose, Initially it was challenging to work out the best way to work together but as the project progressed and we could define a specific requirement, employers were very helpful'. (Project lead, Leeds 14 NE).

A similar project in the University of Leicester (4M) also had a focus on the skills of Maths graduates and developed a new work-related module taken by 20 final year students. The project involved a number of employers who contributed examples of 'real-world' projects. Students took part in a business simulation game run by an external consultant and the students attended an employability workshop, run by the Bizbuilder, the commercial part of the Leicester Chamber of Commerce (CoC). All the student projects had an external client from a variety of business sectors e.g. an engineering firm, a police force, imaging software company, credit unions, an incubator company for green technologies as well as the university's own Estates department. Companies took part in the judging of final presentations and also 'speed-dated' with the students which resulted in an offer of an internship and a job. The CoC was a good broker in accessing employers for the department.

The University of Cardiff project (43W) has aimed to specifically develop the enterprise skills of STEM students. The focus has been to develop an enterprise and commercialisation module by contextualising academic learning in terms of its potential professional and commercial application. The 'Commercialising Innovation' module was piloted in Electrical Engineering undergraduate programme to be further implemented in Mechanical Engineering and Bioscience. The module framework was implemented as a 10 credit 3rd year undergraduate standalone option but elements of the programme can be adapted across a programme. The aim was to develop activity which centred upon a company/innovation development scenario using experiential learning. The programme develops student skills in problem solving, enquiry and task based learning, group work, professional skills and self-awareness. The design and delivery of the learning has involved external stakeholders (employers and experienced professionals) and has been innovative in that it has attempted to implement a multidisciplinary approach across the STEM disciplines. The project also involved Cardiff University Student Enterprise and discipline specific academics.

The description of the module was to develop commercial awareness of engineering innovation and the module did exactly this, I now possess a better understanding of the process of commercialising an idea and have developed an understanding of Intellectual Property, marketing techniques as well as general business practices. I also have a more thorough understanding of the type of companies that operate within the UK and can appreciate how the size of the business can affect the structure of it. Whilst obtaining commercial skills during the module, it has also improved some of the softer skills that are needed in industry such as self-confidence and communication skills. (Student, Cardiff University, 43W)

The Bangor project (42W), Enterprise by Design, was used to develop and test a novel approach to embedding multidisciplinary Design and Enterprise within the curriculum of 5 collaborating schools (Engineering, Business, Product Design, Creative Studies and Media, and Psychology). The project mixed students from different disciplines to foster the understanding of the relative value of each contribution, encouraging them to think about where and how value is added. The project leader noted that "students are crying out for relevance and they are right".

The Bangor "UPSKILL" project (41W) had unintended spin offs for curriculum development. The project's main aim was to develop a technique of teaching photonics to industry in a way that encouraged learners to harness their imagination, develop new skills and explore solutions and opportunities which proved to be engaging and successful with a wide range of participants. It was therefore brought into the university to be used in final year projects. A follow-on programme has secured EU funding to extend it throughout Wales.

The Imperial/Cogent project, "Building the Nuclear Island" (47H) involved the "nuclearisation" of traditional engineering disciplines. Because this involved developing a set of behaviours and attitudes rather than specific skills it necessitated curriculum development and pedagogic transpositions. This was a new approach to studying mainstream engineering

rather than the development of a new sub-discipline. The undergraduate curriculum reflects this, and the post-graduate experience has changed. The new curriculum is available as an open resource and learners from the first cohort have emphasised the value of being able to make mistakes and learn from experience on the nuclear island prior to entering the real world of work.

Learning Summary: Graduate Skills development

- There are a range of approaches to supporting graduate skills development
- Developing a graduate 'skills set' jointly with employers can lead to further contributions for how to develop skills in programmes
- Co-curricular and extra-curricular approaches both bring challenges for academics and students but these can be overcome especially when students are actively engaged with their development
- Introducing enterprise learning that is STEM discipline related is possible using projects and experiential learning approaches

Developing placements and work experience

The Wilson Review asserted that *"placements, internships and other work experience are extremely valuable to students, both in terms of their academic performance and their employability skills"*[24] There is an increasing imperative on HEIs to explore with students the opportunities for gaining relevant work experience to assist their career planning. STEM disciplines have a tradition of offering long placements to their students but there are limits on how many of these can be made available to students. The alternative of shorter placements may be considered part of the work experience 'offer' but the quality and effectiveness of different experiences vary and it is unclear how useful they are to the learners, or the employers or how some of the challenges in developing them and making them fit with the curriculum can be overcome by the HEIs.

It was important for the South West Legacy project (L5SW) that the initiative responded to the demand from employers for graduates who have greater awareness of issues that drive business and that can be achieved through effective employer engagement such as work-placements. The aim was to review existing placements, get to know the key employers more and further develop the quality of the placement experience.

The ambition of the placements review was to build upon and extend good practice and to improve the co-ordination of information and intelligence in relation to employer engagement. Encouraging students to view their placement in a different way and to be reflective of their achievements and build relationships with employers is important to the university and graduate outcomes. Equally having clear learning outcomes gives employers the chance to make the most of the placement too for the benefit of the businesses. The review also intended to increase equality of access for students to these experiential learning opportunities.

The University of Northumbria (17NE) reviewed options for chemistry students and they have developed a package of alternative approaches that are now working to support employability development. They had identified the skills set that employers say they require and knew these could be achieved through work experience but their current sandwich course did not meet all student needs. An alternative approach was to have shorter placements but employers showed a lack of interest in the model as 2-3 months was not considered sufficient time for an employer to recoup investment from the training/workplace integration required for any new employee. An alternative and additional approach has been to develop agreements for students to undertake on-site visits to employers. The project team has used alumni at the site visit where possible to correlate their own HE experience and the work they are doing in the company, to the undergraduate. The project has also developed a series of supportive workshops as a co-curricular programme, 'Job Ready', which comprises a series of voluntary attendance lectures, events and supporting materials designed to raise student's awareness of their own skills and those that are valued by an employer.

As the Northumbria project demonstrated plans for shorter work-placements may not be popular with employers. However the recent national internship schemes have demonstrated that shorter, often summer placements can be effective in giving students insights into working practices and the concerns of business.[25] Other HE STEM RAP projects have also addressed the issue of understanding what works for students and employers with regard to work experiences and an exploration of the different models work experience can take. Two projects by the University of Brighton (28SE) and the University of Reading (32SE) have undertaken research to establish some of the issues around placements.

24 BIS (2012) A Review of Business–University Collaboration, Professor Sir Tim Wilson DL, February 2012, P44

25 Oakleigh Consulting/CRAC (2011) Evaluating the 2010 HEFCE-subsidised placement and internship schemes: Legacy and lessons learnt http://www.hefce.ac.uk/pubs/rereports/year/2011/highqualheworkexp/

The Brighton research involved surveying over 400 students and the project gained substantial insight into and information about the current undergraduate placement scheme across STEM disciplines within the Faculty of Science and Engineering at the University of Brighton. This project evaluated the impact of different placement formats on the development of second year mathematics students' employability skills and reviewed assessment processes in preparation for the introduction of a university-wide accredited placement scheme.

The Reading (32SE) research was designed to identify work placement formats that could be tested against the employability skills they might provide. A literature review provided a broad understanding of what 'work experience' is and an audit of existing schemes within HEIs and a review of guidance and research related to learning outcomes and assessment methods were carried out. Reading also surveyed students and the results showed that they see the value of placements but lack understanding of employability skills. Year-long placements were considered the most beneficial format for skills development and showed increased motivation and understanding of the relevance of studies to the workplace. One-day site visits and work shadowing were shown to influence career choice, appealed to students concerned about workload and engaged those who did not want placements. All formats were perceived as valuable when combined with pre-placement support, opportunities for self-reflection and skills awareness.

The activities undertaken by these two projects have identified that students need better information about placements and how they can gain the best from placement experiences. Each of these project have stimulated discussions internally to review their placement offers and going forward a range of different models are being taken up by departments. Reading (32SE), like the South West Legacy project, has produced a Toolkit for academics providing a guide in how to make the best use of placement opportunities and Brighton has put forward proposals internally for a variation of accredited placement offerings consisting of summer internships, shorter placement options, flexible placement models including a series of shorter placements to fulfil a year-long placement in addition to the existing 12 month placement option. In addition they have proposed timetabled slots for their Placement Office to begin working with students from the first year towards placement preparation and skills identification.

The requirement for better student information and preparation for placement is something another University of Reading (34SE) project took as the focus for their project. This project was specifically designed to support HE graduates wanting to enter the biopharmaceutical industries. A previous ECIF project to support graduate internships in the biopharmaceutical industries had shown that graduates were not familiar enough with the industry environment. The RAP project aimed to address the gap for students and the industry. This was a collaborative project led by Reading with other HEIs who network around the biopharma industry across the region[26]. The project has developed a website for housing resources, developed with the Royal Society of Chemistry, to help students better prepare for placements, stimulate students to research about the industry and provide information and careers advice using audio material utilising industry representatives describing their work.

The University of Wolverhampton project (48H) has taken the idea of work placements one step further in developing their provision. Here students will be provided with a sponsored placement (they will be paid and university fees paid) and will gain the workplace experiences that employers say they need. This project is working with large employers but also including SMEs that may be the employers that graduates currently do not consider and not approach for employment. The project will open up opportunities for graduates especially those who may progress through the apprenticeship route into HE.

Improved Career Advice and Management

All the activities described above have been designed to enhance student understanding of employability, employment opportunities in the STEM sectors and to improve advice for how to manage their future careers. Some of projects have indicated that students have been reluctant at first to be involved with activities or new modules/workshops and sometimes action plans have had to be revised. But once engaged students have been enlightened in their new understanding about employability through activities such as the site visits, the real-world projects and the modelling and problem-based projects identified above. Students have also begun to use the careers information and advice on offer.

For some of the projects, information may have been developed initially within a faculty or department but most have shared their findings/experiences with their careers services. The Legacy projects in the Midlands (L1M&EA) and the South West (L5SW) have involved graduate skills developments that include developing an alternate to placements or work experiences but support student reflection and experiences of skills and competences required in the workplace. The Midlands project gave students group work activities addressing problems that employers have experienced in reality and that requires them to think through the needs of business. There is little evidence in the HE sector of the effectiveness of this type of approach other than enhancing students understanding of complex working

26 Biopharma website; http://www.bsc-biopharma.org.uk/

practices but nevertheless they are an alternative when work placements are not always available to all students.

Another approach that is becoming popular with HEIs is to link students with business-based mentors to explore together the employer requirements of graduates and to network directly with people based in industry. The Huddersfield project outlined earlier (12N) has not only linked students with industrial mentors but has also developed an internal mentoring programme designed to enhance the skills and understanding of the mentors undertaking the activity. Similarly the RAP project at Sheffield Hallam University (19NE) had a specific focus on developing relationships with employers as career mentors for engineering students. The Career Mentoring Scheme aimed to enhance the employability of maths and engineering students by introducing mentoring partnerships between a student and an 'employer' i.e. a professional from industry in a job role/organisation that was of interest to the student. The scheme was designed to support those students deemed to have potential problems obtaining employment due to ethnicity or gender. Individual students were given the opportunity to gain support in career planning by creating a network of contacts, developing an enhanced understanding of job roles, explore how their studies relate to the workplace as well as develop interpersonal skills and confidence. The project found it was important to highlight the scheme in relation to the engineering programme: students needed to understand how and when it could fit within the programme. The project provided clarity around the student journey in partnership with students and academics delivering the engineering programmes. There was also a focus on improving communication skills specifically in relation to manufacturing engineering. Participants in the scheme acknowledged that career mentoring provided valuable experience and contributed to employability development initiatives for engineering and maths students. There were some challenges in setting up this scheme not least raising student awareness and identifying appropriate mentors but the pilot has proved effective especially with participating students who have identified improved understanding about employability and career management and with mentors who have recognised the advantage in having a better understanding of the students. The project has become an embedded part of the university strategy for employability and has extended links with a new Women's Engineering Network, the Institute for Mechanical Engineering (IMechE) and is being supported by staff in the Careers Services in the university and the faculty.

The Liverpool John Moores project (23NW) was a large project involving all HEIs in the North West that have STEM programmes and their careers services. The project reported it was designed to find out in more detail some of the key influences on career progression for STEM graduates from HEIs in the region. The project had three phases and research was conducted with careers service personnel, students and STEM graduates and SMEs and larger employers. The research report outlines that STEM graduates often do not participate in careers activities because of timetabling pressures, academics in departments generally are reluctant to engage with the activity and the lack of placements and internships mean students are not interested. Much of the careers information available for STEM students comes from the professional bodies rather than directly from the companies themselves. A significant issue appeared to be that students do not understand the opportunities for working with SMEs. Career progression and the geographical location of employers were important but significantly, most STEM students want to work in a STEM related job. Students are drawn to employers offering specific graduate training schemes but STEM employers are less likely to offer internships to STEM students.

An interesting conclusion to this section is provided by the Nottingham Trent project (7M), which reported that for placement learners and recent graduates, workplace culture had been a surprise, although often different aspects were mentioned; working late, socialising with colleagues both caused some to question their position and whether they were behaving appropriately. Consultation with recent graduates and current students has unveiled a surprising lack of awareness of important knowledge regarding employment. Two striking aspects of this have been the lack of understanding of the application process and the mistaken assumptions about their future role in the workplace. The student guide created to enhance the employment prospects of graduates has addressed these issues in an accessible and straightforward manner.

Learning Summary: Work experience and Careers information

- Developing work experiences in parallel with an undergraduate programme may require a variety of options to meet all student needs
- There is a need to explore with employers and students alternative options other than full sandwich years
- Developing guidance for employers, students and academics to make the best of a variety of models of work experience can be beneficial
- Careers guidance needs introducing early into a programme and using PDP for personal reflection and recording achievements gives added support to career management
- Encouraging learners to access guidance on career planning and skills for successful application and recruitment for employment is crucial.

Student engagement with graduate skills development

The Legacy and RAP projects have brought more attention to employability for their STEM undergraduates and the activities described above have included reflection and change in pedagogic approaches to work related learning. Previous work by the University of Glasgow and partners can be drawn on to examine how these STEM projects have made efforts to introduce relevant and effective pedagogic approaches for work-related learning.

Work Related Learning (WRL) encompasses the higher order attributes, skills and understandings students gain throughout the course of their degree, from a broad range of activities in, or related to, the world of work, which will enhance their learning, progress into, adaptability for, and success in, their chosen careers[27]

The Aiming University Learning @ Work Project, a collaborative project led by the University of Glasgow concluded that effective WRL is that which is:

- Compatible with, and complementary to, the learning and development needs of the student, the academic integrity of the programme of study, and the goals of other principal stakeholders
- Supported and Structured
- Open and Accessible to all stakeholders
- Recognised and Rewarded
- Embedded in the curriculum, and
- Endorsed as an integral element of the student's learning.[28]

The Glasgow team developed a set of principles for guiding institutions in developing WRL and some of the HE STEM activities mentioned earlier reflect these principles.

WRL should provide students with learning opportunities to integrate theory and practice.

This is seen particularly in the Cardiff project (43W) with its emphasis on experiential learning, drawing on existing learning in the curriculum. Other projects have also introduced problem based learning into their programmes with a strong emphasis on group/team projects including the Midlands Legacy project at the University of Birmingham, Lincoln (5M), Leeds (13NE, 14 NE), UCL (36SE), developing student awareness of skills that employers frequently complain about.

WRL should achieve learning outcomes that state what the students will be able to do in the workplace.

The projects in Lincoln (5M) and Leicester (4M) have made efforts to integrate work-related learning in the curriculum with associated learning outcomes for students. On the whole however these short modules have been developed by projects as optional learning related to the core programme. Projects have expressed that they are looking to embed these learning outcomes into the core programme placing less pressure on student time and timetabling concerns.

WRL should encourage and support students' interest in a wide variety of careers.

The Leeds (14NE) and UCL (36SE) projects have made efforts to enhance student understanding of the broad range of careers open to graduates and inspire students in their career ambitions and the Reading project (34SE) is providing resources online for students to access information about the biopharma industries.

WRL require students to take on an active rather than a passive role in the learning process.[29]

The Midlands Legacy project (L1M&EA) has introduced activities that have been contributed by employers. The Level 6 students from all STEM disciplines work on these activities in groups over a 4 week period. The overall aim of the module is to present students and recent graduates with an open-ended, undefined real-world issue, for which they would propose solutions. The intensive programme includes three full-day workshops in week one. On day four the challenge is issued and discussed and the following day the learners plan the project and submit a project plan the next week. In the second and third weeks they work on the project for four days and Friday is for reflection and synthesis. Additional sessions support skills development. In week four, students submit a 1000 word reflection about where they want to progress to and skills and experiences they need to develop further. The teams present their ideas on solving the challenge to a panel of academic colleagues and industrial supporters of Grand Challenge. The programme has been adopted and adapted by Nottingham Trent and Aston Universities and they have both targeted Level 5 students who have not been in a position to take up a year's industrial placements.

27 Aiming University Learning @ Work Project (2009) Benchmark Statement on Work Related Learning www.gla.ac.uk/services/aulw/

28 Education AUL@W Team, University of Glasgow; http://www.gla.ac.uk/media/media_178983_en.pdf

29 McKinnon S. (2010) Work-related learning – a matter of principles? Employability in the Curriculum: Beyond the Bolt-on Conference at University of Central Lancashire, Preston

In the South West Legacy (L5SW) project there has been considerable effort to involve students in the project through on-going monitoring, evaluation and feedback from participants. The project has learnt from students when participation and involvement in developed co-curriculum activities has been low and reviewed the programme taking account of student feedback. Utilising a student working party has been very instrumental in the development of the sessions. Guidelines for employers running similar sessions have also been produced taking into account student working party feedback on what students have found useful. The project has promoted the use of an automated e-mail to the student's University e-mail account to improve communications, and 'Mahara' has been rolled out to students, with groups set up and news feeds added. Student's interaction with this e-portfolio tool has been monitored. 'Turning Point' has been used within each development session, and has been largely successful in gathering student feedback. A number of placement visits has been summarised and the learning from the visits used to inform guidance on the benefits of placements for students and employers. Students were asked for their comments during the visits and this has informed the guidance. From student's own feedback it is recognised that a quality placement must be at a level considered to be "varied, interesting and a little challenging" for undergraduate students and employers can benefit from the contribution of the student in the workplace.

These elements of the project illustrate how involving students with new provision can sometimes be challenging especially when they do not see the benefits of engagement, but with continual monitoring, opening out the discussion to invited student membership, responding to their feedback, and using online resources to give individual feedback the learning experience can improve and the benefits increase to students and stakeholders. (Project lead, SW Legacy, L5SW)

The STAND OUT STEM project at UCLAN (26NW) included the formation of the "robot club". Second year undergraduates were invited to join this and have since taken over its running, with no prompts from academic staff. They have gone into schools, presented at a conference and recently put in a bid for funding from British Aerospace. The students are now in the final year and have extended the club to all cohorts. They meet informally every Wednesday and their future is eminently sustainable. Their activities have been an exemplar in including students in outreach and public engagement and have contributed to how the university is redefining its understanding of and commitment to public engagement.

The Lincoln (5M) and the Nottingham Trent (6M) projects have demonstrated that involving students in active learning about issues related to future employment can provide them with a greater understanding of how their studies and skills can be transferable to a workplace. Students have felt engaged and, when invited to communicate with employers, have addressed the issues and solved problems they may face out in the workplace. Most of the other STEM projects report they have discussed the project aims and objective with the students and have asked for their involvement in the developments. Those surveying employers have also involved students and alumni and are changing practice as a result of student responses e.g. Leicester (3M), UCL (36SE) and the Midlands Legacy project (L1M&EA).

At Warwick, the SME project (9M) reported the involvement of a team of four undergraduate researchers who investigated interactions between HEIs and SMEs and explored the mechanisms through which mutual understanding can be improved and how more opportunities for graduates can be created.

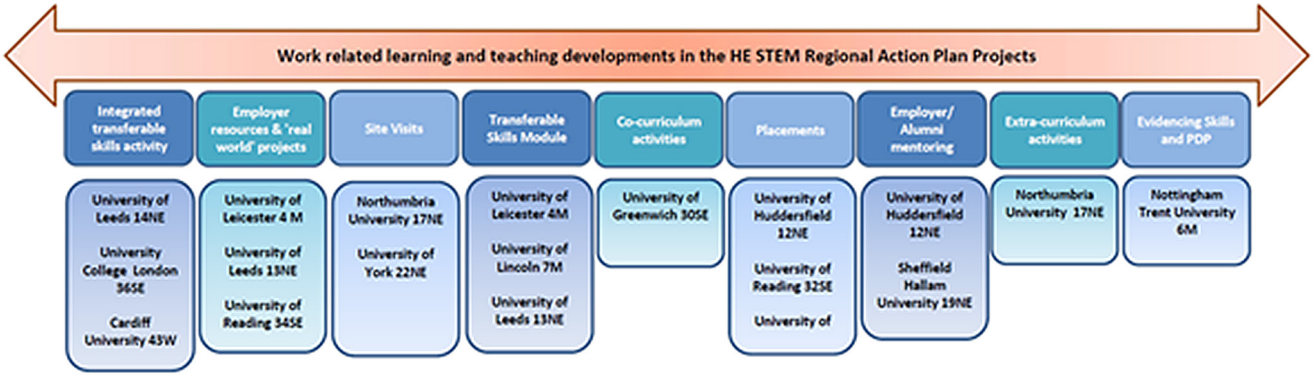
WRL should accommodate cultural diversity[30]

The Leicester (3M), Greenwich (30SE), UCL (36SE) and Northumbria (17NE) projects have made efforts to ensure they are more inclusive in their approach and that the needs of different student groups are considered in the models and approaches available for enhancing their employability. The Sheffield Hallam University project (19NE) now sees the mentoring approach as part of the university access agreement and targets students who may face disadvantage in their transition to employment. The Leeds project (14NE) is exploring options for international placements as a result of the work of the project. An interesting outcome of the research with employers by the Aston project (1(ii) M) was the requirement for graduates to have of an understanding of global citizenship reflecting the requirement for graduates to be prepared to work globally and with businesses that have a global outlook.

The diagram overleaf summarises the spectrum of work-related learning and identifies the STEM RAPP projects that have developed WRL:

In general projects have reported that engaging students with the project outcomes has been a positive experience. Student feedback has been good with take-up and response to new developments well received. Projects report that tutor-student interaction has been enhanced when they have been working together on activities with students being open and honest. The activities have provided an opportunity for more targeted support and understanding of how and when learners want to receive resources. Overall there was

30 Bell, I. Berrie M, Naven L. (2010) Models of Recognition for Work Related Learning in Higher



a sense that students had an improved awareness of careers and jobs in STEM sectors, CV requirements, and application and recruitment procedures.

'Many learner reflections have revealed a strong awareness of the practical value of the skills and experiences gained from participation in the module and it has been viewed as a valuable complement to the predominant engineering elements…' (Project lead, Cardiff 43W).

Part Six: Challenges and Sustaining developments

Challenges

The projects identified some common challenges while progressing these STEM developments, particularly in embedding the work within the institution, getting students on board with extra and co-curricular activities, and in managing relationships with employers.

With regard to the latter, most projects made headway in engaging employers but some have struggled to establish meaningful access and finding common ground with them. Some projects reported that understanding issues around flexible learning, what is possible and how it can be delivered required careful negotiation. Developments were not always easy when professional bodies were involved, and during the lifetime of the project stakeholders had to accept that original, possibly too ambitious, plans had to be reined in. The projects looking for more flexible placement schemes were particularly disappointed that employers could not meet their needs.

'A significant challenge initially was gaining meaningful access to employers in the face of high level competition from a range of commercial providers offering targeted short duration training packages. We have overcome this through approaching businesses with the support of …local brokers… with offers of bespoke provision' (Project lead, UHOVI 45W).

Overall, projects have had some success in developing WRL and involving students with new approaches but this has not been without challenges. Student attendance and involvement has been sporadic for some HEIs. Projects have reported that influencing some of the pre-conceived ideas of students has been time-consuming, as has timetabling events and activity that meet student, employer and academic needs.

Reflecting the experiences of the previous HEFCE funded employer engagement activities, some of the most obstinate barriers projects have faced have been regarding institutional processes and procedures. Although projects have made progress in addressing some of these issues they have nevertheless had to face challenges that reduce the likelihood of make sustaining developments. The concerns projects have raised include:

- Institutional regulatory structures with regard to non-accredited new provision
- Systems and process issues for work-based learners including enrolment and accessing resources
- Creating a new approach for part-time learners
- Integrating a new course with university programme
- Maintaining commitment to the project objectives
- Constraints on academics in providing support for implementing new modules
- Impact of funding on FD developments
- The nature of STEM skills: there are some challenges associated with STEM subjects around the acquisition and development of practical skills that do not exist in non-STEM disciplines. Innovative approaches to making these accessible to employees needs to be embedded. These practical skills are resource intensive and rely on skill sets among support staff which might not always be forthcoming
- There are practical issues relating to incorporating employability development into existing curricula, creatively and sustainably

Influencing the ability of projects to address these issues internally has generally come down to the lack of time to make significant change. Projects commented on:

- Timing of the project funding period
- Time for resourcing/setting up the project
- Time for developing popular activities/resources
- Time for reviewing achievements and outputs

The HE STEM programme requirements for all developments as Open Educational Resources (OER) has also taxed projects in some HEIs.

'Resilience plays an enormous part in a multi stakeholder project with so many facets and diverse deliverables. It's just impossible not to meet barriers and unexpected blockages that can derail timescales, so being flexible and resilient is key' (Project lead, UCL, 36SE)

Sustaining what has been achieved

A prime ambition for funded projects of this nature is to embed new practices as much as possible and to disseminate any resources and materials so they are used by colleagues and other stakeholders beyond the life of the funding period. Sustainability has been central to the development of these Legacy and RAP Projects and project leaders were asked to comment on elements they hope to see in existence in the future and any opportunities to develop them further after the project has ended, how, and by whom, in order to get the best value from the work that has been funded.

Many of the projects generated tangible outputs: these included tools, models, guidelines, methods, case studies, programmes of study or recommendations that can be taken up by the wider STEM community.

Evaluating and reviewing progress

The projects have in many cases provided pilots for new approaches to engaging employers, to changing curriculum or initiating new approaches in their discipline communities. They have generally not reached the stage of evaluating outcomes for students or measuring the effectiveness in enhancing the student learning experience. However projects have indicated they will continue with the developments beyond the funding period.

The Wales Legacy project can see that there is an on-going need in the local region for the developments they have started. The project lead reported that this demand for engineers will affect the demand for the programme to address skills shortages:

"In 2017 we will need half a million engineers just to be able to compete economically on a global scale. Companies are finding it hard to recruit so universities need to be more commercial in demonstrating their offer and this project has shown that no employers turn away approaches from an HEI. They are curious, they might not need what is on offer now but they do not rule it out for the future. Give the chicken a bite of corn and it will follow the trail and one thing often leads to another: one employer sponsored one student, and then bought a whole 6 week course on the strength of that engagement. (Project lead, Wales Legacy LW6)

An important lesson is that this kind of activity cannot be delegated to a university's marketing department. Employers want meaningful engagement with the people who are designing and delivering the programme - the academics themselves. This kind of engagement must extend beyond the inception of the project to become an on-going relationship with regular review and communication. This can be demanding on busy academics, but is essential if projects of this nature are to succeed and become sustainable.

For the North West Legacy (L3NW) the project lead indicated that ***"the model developed is one of organic growth, it has indicated that it is financially viable and can generate income so the developments are sustainable."*** The model of working relies on an understanding of the user community and how people learn so the distinctive products will be responsive to the user community. Any future user groups will have the links with FECs already established so CPD for staff will be readily facilitated. The intention is therefore to review how the model fits with internal developments but build on the progress made.

The Lincoln RAPP (5M) intends to carry out an evaluation of the progress made and the programmes developed and Huddersfield (12NE) is undertaking a more longitudinal study of the learners and employers engaged in the project, to assess the wider impact and evaluation of the developments. For Brighton (28SE) the evidence provided by this project has formed the basis of proposals to be made to the Faculty Board regarding placement model offerings going forward.

The learning from this project has enabled us to identify that student confidence and fear of rejection are two of the key factors which disengage them with the placement process; subsequently we are looking at innovative methods of working with student and employer mentors to build confidence in our students and empower them in their placement search; we have already begun liaising with the Chief Executive of Wired Sussex (a Brighton based networking organisation for Digital Media SME's in the East Sussex area) to look at potential mentorship models. (Project lead, Brighton, 28SE)

Embedding curriculum change/ pedagogic initiatives

The projects have learnt from trialling new approaches but also now the initial stages are complete practitioners can begin to embed the new curriculum content or teaching and learning initiatives.

The London and South East legacy (L4LSE) is that employers see value of what has been developed for online learning (more significant for international developments) with increased buy-in and understanding that the flexible approach to delivering content is very useful. The department will seek funding in order to develop additional modules with the employer Mott Macdonald. The staff too have begun to see the benefits of the new approaches and the developments are being embedded into the curriculum.

The tutorials are being produced by suitable trained front line staff, and the HEI is experimenting with this happening for the virtual experiments and the dynamic questions. Some of the previous work in this area has relied on enthusiasts that do it all themselves but is not taken up by others easily or on a larger scale. These developments begin to address this concern. (Project lead, SE Legacy, L4SE)

The North East Legacy project considers that a lot of scaffolding is in place to support the sustainability of

the project objectives for enhancing graduate skills. All the modules will be delivered and reviewed, the international design competition will happen…

…..you should be able to walk into classes with engineering students looking at building performance, chemists doing new experiments in energy efficient, safe, thermally comfortable labs. (Project lead, NE Legacy, (L2NE)

For the South West Legacy graduate skills project (L5SW), the guidance produced for staff and employers to encourage more effective placements will benefit students in the longer term. The employability skills sessions have been reviewed and new ways to fit these around the curriculum will be further developed to make them credit-bearing.

The project has made an impact on the on-going internal strategies for employability with initiatives developed through the project continuing beyond the life of the project and influencing other STEM departments. (Project Lead, SW Legacy, L5SW)

The Midlands Legacy (L1EA) initiative can be embedded as part of a rolling programme to enhance students' learning opportunities. (Permanent staff have been deployed to the programme at Aston and it will be embedded into modules at NTU.) It will be an alternative to a placement. It will be collaborative, local and put STEM on the agenda.

Because the host university has a system of five colleges, each with a semi-autonomous school, it was a huge challenge to operate within the existing structures. These structures, and the associated regulatory framework, presented challenges in terms both of assigning staff to the project and accounting for their input, and negotiating credit weighting. A respondent compared a university to a super tanker that cannot change course quickly and this is a useful metaphor. However this project reflected that a short, focused initiative generated "tremendous" academic learning that can only be enhanced through a cross-cutting approach. So breaking down departmental barriers on a small scale can reap tangible benefits….. This course will still be running in 10 years either as a 20 credit module or part of a personal skills award. Other universities are joining in. A hope is that Birmingham City Council will join and will set the challenge; it will be collaborative, local and put STEM on the agenda. (Project lead, Midlands Legacy, L1M&EA)

In Nottingham Trent (6M) all the academic staff who have contributed a change to existing programmes will be ***"carrying it on and rolling it out to other modules or year groups. It was seen as the start of a project and it will spread".*** For Northumbria (16NE), there is on-going development from the project as students become engaged and enrol for the programme. There is also evidence of wider impact on university processes, from both sharing knowledge at learning and teaching enhancement workshop, to more structural changes, the most significant of which is gaining recognition for 'bite-size' credit bearing modules in a context where previously no awards existed below 60 credits.

The Northumbria RAPP (17NE) has led to additional work on enterprise developments for students and further work is planned relating to post-graduate opportunities. There is an intention to involve more academics by exploring opportunities for assessment and embedding of elements of the project relating to enterprise, within the existing curriculum. Students have fed back that they want the programme to be part of their personalized timetable. This is being arranged.

Students have fed back that they want the programme to be part of their personalized timetable. This hadn't happened before so students had missed out – resulting in poor turnout. We will now explore how the programme can be fitted into personalized timetable. (Project lead Northumbria RAPP, 17NE)

The Cardiff RAPP (43W) has directly influenced next stage sustainability with regards to further developing enterprise education within the STEM disciplines and beyond. The Commercialisation module which has been available for Electrical Engineering pathways will also be made available to Mechanical Engineering students in September 2012. It is intended that the interventions carried out within Chemistry and Mathematics will be further iterated. In addition the module and its intrinsic pedagogies will be adapted and implemented within the Level 3 Bioscience curriculum. A multi-disciplinary application of the module is a longer term possibility which is still being actively pursued.

The project has also contributed to the institution's employability and enterprise strategy and also been successful in bidding for further funding from the HEFCW 'Driving Enterprise and Innovation in the Cardiff City-region' project. The HEFCW funding will enable the creation of two enterprise curriculum development posts with the intention of embedding enterprise learning within the curricula of thirteen academic schools by 2014. (Project lead, Cardiff RAPP, 43W)

The focus on enterprise learning within STEM schools instigated by the HESTEM project in Cardiff will remain but will be complemented by curriculum developments in Arts based disciplines. Preliminary liaison has already begun with Schools of Journalism, Social Science and History and Religion with a view to developing curricula embedded learning using variants of the core enterprise learning established during the STEM module development.

The maths modelling project originally delivered by the mathematics department at the University of Leeds (13NE) and successfully included in the Practice Transfer Adoption funding call has had a fundamental impact on curriculum as the methods deployed have now been taken up by other STEM departments at the University. Without the development funds provided by the National HE STEM Programme this sharing of ideas, methods and activity would have been unlikely. However the project has attracted institutional interest in the project, gathering support and recognition for the work which in turn will increase the likelihood of continuation and support from senior management for this kind of work and delivery.

The Liverpool John Moores Project (23NW) report that the findings of the student and employer research showed there are a number of dichotomous views on a wide range of issues relating to the STEM graduate employment process. There is continuing work identifying useful feedback that may inform future careers support for STEM graduates with the purpose of increasing the efficiency of careers advice and guidance and to create links between the outcomes of the Big Question project and other initiatives promoting STEM skills and recruitment.

The good news is that not only is there overwhelming commitment to progressing into STEM employment by graduates, this is reciprocated by the goodwill and enthusiasm of the employers to work with HEIs to ensure the system improves. The next stage is to methodically identify the key areas of disjunction between graduate and employers and to propose methodologies to overcome these barriers and miss-understandings. (Project report, LJMU RAPP, 23NW)

Disseminating across and beyond the HEI

Several of the RAPP projects have been working in isolation in one school or department in an institution. However many have taken active measure to involve other groups and departments from across the Faculty or the university either through a steering group or by sharing the learning at staff development sessions. Projects are also disseminating their experiences at workshops and seminars for STEM activity.

The Coventry project (2M) for example has formalised the sharing of information with departmental and other colleagues in order to share their learning and influence approaches to part-time learners. This is seen to be a good stimulus for further development of the approach taken in the project. The Leeds project (14NE) has also been very well received in the science faculties and they will roll out the development to other disciplines and it will be more widely disseminated both internally and externally, including via the HEA Employability Developers Network.

The introduction of team based projects is new to the faculty (with an exception in Food Science). Whilst this is not new universally, it is a new teaching style for Maths, Chemistry (and Physics) and the project funding has enabled us to develop a rigorous methodology which has given confidence to the execution of the module design. Whilst there are pockets of the University that are actively engaged with employers, this is new, and so the way we have built the relationships with employers will provide useful advice (and supporting documentation) for others. (Project lead, Leeds RPP, 14NE)

As part of the Leeds project, the School has now established an External Advisory Board (EAB) comprising of members from industry, professional bodies and other universities. The EAB considers both teaching and research activities of the school, and how industry might be more involved in such activities. Members have also provided valuable advice on aspects of curriculum development, particularly those associated with this project, and wider skills development. For future meetings, the intention is to link the meetings to another activity, such as research seminars and student networking sessions.

The University is recommending that all Schools/Faculties establish an Industrial/ External Advisory Board, and this project has enabled the Faculty to be "ahead of the curve" in this respect. (Project lead, Leeds RPP, 14NE)

While the Sheffield project (18NE) is largely complete and personnel have moved on, it is felt that the initiative itself will continue because it is embedded within the faculty structures and longer-term links with employers have been established.

Hopefully employers, university staff and students will all benefit. Students have been exposed to comments from employers about how to make a successful application, from the broad issue of being determined and persistent to the specifics of researching what the employer does, and being interested in that activity. A specific example is the need for

graduates to be able to make presentations quickly, frequently and effectively. Because the Employers Liaison Group (ELG) is embedded within the faculty structure and longer-term links with employers have been established. Its sustainability is guaranteed. (Project lead, Sheffield RAPP, 18NE)

The Lincoln project (5M) is taking this further by preparing journal publications with colleagues and will use this opportunity to properly disseminate the findings of this work. This project has gained national recognition for being innovative in its relations with employers. The programme became a larger initiative than was initially envisaged. It was initially intended to include only a series of discrete touch-points with a single employer during semester one, but part of the evidence of the success of this project is the number of additional employers who became involved (an increase from 1 to 6) and the number of touch-points (4 to 20) and the duration of the programme, which ultimately ran through the entire academic year.

The touch points programme will be a permanent feature in undergraduate programmes, and our ultimate goal would be to include a touch point within every module. (Project lead, Lincoln RAP, 5M)

Some projects have been extensively 'adopted' by other HEIs such as the Leeds project (13NE) on mathematical modelling. There is continuing learning from experiences to be gathered from the roll out of this model.

This HE STEM project has clearly demonstrated that it is possible to introduce teaching initiatives into HE to achieve changes in practice that have a national impact and the potential for sustainability with modest units of funding. (Project report, Leeds RAPP, 13NE)

The Gateshead College (11NE) programme has attracted interest from other colleges and HEIs. The Brighton project (28SE) has taken active measure to embed new practices, with the support colleagues from Placement Offices within the Business School and the Faculty of Arts and Media, to share the learning and developments of the project, and will continue to share the placement models developed across other UK HEI's through the Placenet network.

On a long term basis this project has enabled us to understand the importance of gaining student and employer feedback on our placement offerings and support, and as a sustainable development following the project we will be looking to gain feedback from students and employers at the end of each placement cycle, the findings of which will be used to continually update and develop our placement offerings in line with changing student and employer needs. (Project lead, Brighton RAPP, 28SE)

The Swansea Metropolitan project (46W) has had two practice adopter bids from English FE Colleges. While Materials/metals has been most popular with employers in Wales, Yeovil College is having a Polymers route way for the degree validated in January, which will introduce provision in South West England to service the aerospace industry.

Part Seven: Reflections

This section provides a summary of the achievements and challenges that Legacy and RAPP projects have highlighted. There are common reflections from many of the projects and a significant one is the positive experiences people have had in developing more open and dynamic communications with employers. Projects leaders have expressed surprise at how far they have come in a short period of time simply by giving this area of work more attention. The outcomes of collaborations with employers, brokers and other institutions have also been rewarding. Projects highlighted as well the positive benefits of stimulating more interest in graduate skills development with students and observing their engagement and enthusiasm when undertaking work-related activities.

In this final section we highlight and comment on elements of the Programme that exemplify the progress that has been made to meet the HE STEM programme objectives. Significant features stand out, namely the regional focus of the developments and innovative approaches that have been adopted. These both have the potential to further influence the STEM community.

The regional focus

We wanted to explore with the project directors the extent to which their initiatives had been driven by local circumstances and the need to respond accordingly. Each of the regions had projects that worked in collaboration with other HEIs or employers to respond to a local requirement. These projects also indicate the importance of building on transferable practices developed by previous projects.

The North East

In the North East three projects provide examples of how working with brokers and/or existing employer groups can provide a good opportunity for HEI-industry collaborations around workforce development in STEM-related sectors.

The Gateshead College (11NE) project was responding to the regional economic context in which it operates. The North East has been designated the UK's first Low Carbon Economic Area specialising in ultra-low carbon vehicles and low carbon technology, thisis an area that offers the greatest hope of sustainable employment. This is a priority requirement as Gateshead, South Tyneside and Sunderland are among the 20 per cent most deprived districts in England according to all six summary measures in the Index of Multiple Deprivation 2007. The project was designed to addresses these issues with activity aiming to fill a skills gap for engineers working in the production of low carbon and electric cars. The project has strengthened on-going relationships with employers in the locality and the focus on electric vehicle technology is now broadening out to attract interest from other stakeholders.

At Huddersfield (12NE) the primary aim of the project team was also to build on existing collaborations and networks with a remit to address regional economic growth. This project built on the work of the West Yorkshire Lifelong Learning Network, employer engagement activity (and past Customer First surveys) that indicated a demand for support and development for employees and industrial mentors to successfully manage, support and bridge the transition between academia and the workplace, whether through work-based projects, student placements, collaborative curriculum development or employment opportunities. The project led a range of activities that responded to dialogue with regional employer partners and although the work was aligned to institutional strategies the focus here was on the needs of regional employers and their employees rather than internal directives.

"Working with the HE-STEM project, the WYLLN and Bradford College has been instrumental in developing new curriculum and support networks for the nationally important subject of Casting. This support has helped generate a critical mass and ensuring a sustainable partnership to be established". (Employer: Dr P. Murrell, ICME, referring to Huddersfield 12 NE).)

Local employer communities have been vital stakeholders for the success of the Sunderland project (20NE). These included the North East Strategic Health Authority (SHA), the Regional Learning Strategy Group, the Pathology network, the North East Cardiovascular Network, Regional Audiology Committee for Training Audiology Professionals. Representatives from each of these groups formed the employer steering group for the project. Here partners have been brought together to address a regional issue but the context was also driven nationally by the Department of Health. The project is a good example of how a development led by a HEI (for a FdSc. in Healthcare Science) that has had coordinated contributions from a mix of employers can be influential on the development of a national approach.

The North West

The Liverpool John Moores Project (23NW) has collaborated with several other career services in HE providers across the region. The information collated by the project has the potential to benefit the employability of graduates for all the participating HEIs and the recruiting employers in the region.

The NWUA project (25NW) provides an example of how a project that has the regional context at its centre can also provide the starting point for further developments with individual collaborators. The project was designed to fill the skills gap around STEM subjects with a specific slant on technical up-skilling to capture the interface between Level 3 and Level 4. This work built on the North West HLSP research and started with an analysis of the higher level skills needs of the STEM Industries using Labour Market Information (LMI) published by STEM Sector Skills Councils (SSCs), Regional Cluster Organisations (RCOs) and Professional Bodies (PBs). The information was collated identifying regional sector specific and more generic skills needs. A review of the current STEM CPD provision offered by NW HEIs was undertaken and a gap analysis performed between the needs and the current offer. The suite of CPD modules produced has resulted. The success of this project has been attributable to the strong partnership working between NWUA, SSCs, Professional Bodies, Regional Cluster Organisations, Employers and HEIs. This project demonstrates the effectiveness of a regional focused brokerage service for HE. The NWUA reported that modules will be further developed because of the discussions that have started with the employers. For example partnerships involving Liverpool Hope University and also the University of Salford will continue further development of CPD provision despite the demise of the NWUA itself.

The output from the NWUA "STEMBUG" (24NW) is an online resource tool to help businesses build relationships with Universities in the Northwest, with the aim of training and developing its workforce (http://www.stembug.co.uk). This pulls together the essential pieces of information about HEIs, that STEM businesses would want to get, in a user friendly way, building up on the HLSPs HE database. It brings together provision at Level 4 and above, offered by all institutions in the NW, including the FECs and private providers. This is a very powerful database.

The South West

In the South West, understanding LMI to benefit HEI engagement with employers was at the heart of the objectives of the Exeter project (38SW) too. The project worked collaboratively with several HEIs to gain a greater understanding of the extent and nature of the LMI being used to inform employer engagement in the partner institutions. A report of the research, LMI and Employer Engagement, was produced together with a Labour Market Handbook, which provides guidance to staff in institutions wishing to access and understand LMI. Ultimately the aim is to improve employer engagement across the South West region and sharing information has proved beneficial. For instance many of the projects did not have CRM systems but wanted to work towards them. The fact that one FEC already had a well-developed system and was willing to share its knowledge was a great asset to the project. The project focused on the engineering sector but the findings and approaches are applicable to STEM disciplines across the board.

'The CRM is an important tool that improves effectiveness for users; acts as a conduit for knowledge transfer; enables staff to be more informed and prepared for communicating with employers and schools; enables staff to be aware of the current relationship; shows partners that we do communicate within the organisation and can assist them with the flow of communication' (14-16 Coordinator & Learning Support, Directorate for Quality & Performance, Petroc College, Exeter RAPP, 38SW)

Wales

The employer engagement projects in Wales funded through the RAP and the Legacy strands have each been designed to respond to regional requirements for up-skilling local people and supporting businesses through this challenging economic period. The Wales Legacy project (L6W) and the Steel Academy RAPP (46W) are both aiming to be responsive to the local manufacturing engineering sectors and the UHOVI project (45W) has also been providing a 'brokerage service' across the region in a similar way to NWUA as detailed earlier. The key issue here to note is how developing an understanding of the regional provision around STEM and creating links between HEIs and employers can prove beneficial to all stakeholders, firstly in bringing new business into the HEI and secondly in responding to employers and the national policy for up-skilling the workforce.

The ENGAGE project at Cardiff Metropolitan University (44W) has also played a similar role in responding to the regional agenda in Wales. This project has been a good example of how researchers in the university have come together to share their expertise for the benefit of SMEs in the STEM sectors. The project has supported regional government policy for building stronger innovation in Wales. The project was led by the National Centre for Product Design and Research (PDR) in Cardiff, a consultancy and research centre and for this HE STEM project PDR identified a gap in the skills and competences of employees in SMEs in STEM sectors in using design to bring new products to market and have developed new provision to fill this gap. Working with the support of an existing service innovation group involving employers and regional government representatives, the project has designed a series of modules for employees in STEM businesses to provide hands-on understanding and learning of how design can transform research and development into new products. The project has funded the development of five modules that explore the issues for business and design including: the competitive advantage of

design, managing design in SMEs, the technology, end users and external design expertise. The project has accessed further funding geared to support regional developments and will be able to deliver the workshops again for a further three years including for further developing sectors in Wales such as the food industry.

The Bangor photonics project (41W) engaged such a wide spectrum of stakeholders,and staff involved expressed pleasure in reaching out to such a range of ages (from 16-17 year olds to grandparents) at different levels of study. A project that began as a response to a gap in the market for specific skills updating in the photonics industry has led to a pan-Wales collaboration, not necessarily for teaching, but to consider how HEIs present their work to gain support from industry.

London and the South East

In the South East, several projects have shared developments with other HEIs in the region both for the successful outcome of the project but also, as with the Leeds project (13NE) to see the ideas further developed by institutions that have adopted and adapted these within the STEM community.

The projects in Southampton (35SE) and Reading (34SE) have also responded to regional issues. Southampton's development, providing an online information service for SMEs across the sub-region, is meeting local employer needs and the Reading project, building on an earlier Economic Challenge Funding initiative (ECIF) has developed resources that can be utilised by several HEIs in the South East to benefit biopharma companies in the region.

"We planned and have delivered a fully functional automated website under full control of each of the partner institutions. This website requires minimal input depending on the level of input available from the partner institutions. We have developed a service that is fully scalable so it could be taken on by other regions with the potential for further development for a national rollout." (Project lead, Southampton, 35SE)

Anglia Ruskin (27SE) intends to roll out its new programme, or a variation of it, to a wider group of chemical companies such as BASF and Johnson Matthey. It is also approaching the Royal Society of Chemistry for accreditation and UCL (36SE) have seen interest in their leadership resources grow.

"Through the pilot we hope to run with UCL and other universities, we aim to explore take up of the resources and improve them. Loughborough will definitely be using them. Cardiff, Kingston and the Open University also expressed intent to take them further forward. UCL will hold a leadership in engineering forum to explore progress and developments" (Project lead UCL 36SE)

The Midlands

In the Midlands region, cross-institutional collaboration was central to the outcome of the Coventry project (2M). The improved understanding of where part-time provision is delivered within the region has the potential to be helpful in developing STEM programmes that are demanded locally, and in understanding how part-time work-based learning can be delivered in a responsive way to meet learner and employer need. The Lincoln project (5M) is also having repercussions within the sub-region as employers associated with the main partner in the engineering programme, Siemens, show increasing interest in the collaboration and are approaching the university to further their own interests. Many of these employers are based in the local region and ultimately their involvement in Lincoln's programmes will benefit the employability of local graduates.

Evidence of innovative interventions

A number of innovative practices and developments do stand out from the plethora of project activities. Generally these relate to workforce developments and show innovation in the approach taken to responding to STEM employers. The examples below vary from providing services and information that are mutually beneficial, to developing employee learning that fits with business needs and/or uses new technologies. The Huddersfield project is highlighted because it has demonstrated innovation in developing activity that not only responds to employer needs but also has used access to employers to further support graduate skills.

Northumbria University's project (16NE) on the accreditation of in-house training and flexible/ responsive models focussed on the progression of the engineering workforce to higher level skills and appears to demonstrate an effective workforce development Large employers such as Siemens provide between 12-20 daily training events for their employees including apprentices and others requiring up-skilling. This programme recognises this training. Employers involved reported that the role of technicians in the workplace has improved and that there is better compliance around issues such as health and safety. The model can be replicated by other HEIs working with large manufacturing companies in STEM-related industries who often have in-house training that when accredited by HE can provide more competent employees for the workplace and improve business performance.

The University of Exeter's project (38SW) has reinforced the importance of university-employer collaborations by developing a shared understanding about employers within a region, what their requirements are and how

HEIs can respond to them. Seminars were held at all the partner institutions that highlighted the role of the HE STEM projects in supporting this agenda. The project provided the opportunity to explore local business leaders' perceptions of HE and in particular, how HE could support their enterprise. The project has researched HE providers' understanding and used this market intelligence to develop and test systems and processes that would help their staff to discuss higher level training needs and provision more effectively with employers. This project approach and outputs has the potential to be replicated within all regions to respond to the demands for STEM graduates and up-skilling of the workforce in STEM related businesses.

For the UHOVI project (45W) the 'Sticky Cluster' has developed as a concept from its work, a cluster of companies prepared to work together and with the team, energised and with a positive effect, which then attracts other companies, usually from the same sector, to join the group. This same stickiness can be applied to a critical mass of learners and to collaboration between academic providers achieving significant benefits thus attracting others to participate. This approach relies on the STEM community building alliances with stakeholders and brokers across STEM industries and reviewing local HE offers in collaboration with universities and colleges.

The Huddersfield project (12NE) has aimed to respond to employer requirements for up-skilling the workforce. They have further developed and expanded local networks with employers using existing employer groups and the services of other stakeholders such as SSCs. They have also looked to further develop these contacts to benefit all learners on undergraduate programmes. Although it took time to get the concept of an 'Industrial Mentors' course off the ground, the team have been surprised by the level of positive feedback received. This has come from both employers and other academics who would be interested in offering the module to enhance their own partnerships and course committees. The delivery of the module has taken place largely at revolving employer premises and this has also assisted learners, who have had the opportunity to undertake wider employer site visits at the same time. The mentoring model developed here can be replicated both for supporting a workforce development agenda and for graduate skills development. For the STEM academic community looking for flexible approaches to providing work experience for their students this model could prove of interest.

Targeting work-based learners provides an opportunity for innovation around the use of technology enhanced learning, new social media and social platforms for interacting with learners. The Open University project (31SE) has trialled the use of a mobile phone App to encourage learner interaction with nuclear energy. The ambition was to use an open access online learning platform, OpenLearn, with an e-Book version of the online course created for the OU store on iTunes which they have trialled with young people. How learning is assessed and the effectiveness of the model still requires further development and evaluation. The potential for this approach to 'distance' learning is only just being explored. Along with the North West Legacy, HE STEM developments around Maths Apps developments, this type of approach could be shared within the STEM community.

Project Vignette: Graduate skills development

Developing graduates' employability skills through industry led touch points, University of Lincoln (5M)

The Touch-points project was one of the factors that led Siemens and the School of Engineering to win the prestigious Lord Stafford Award for Open Collaboration in November 2011. The Awards recognise, showcase and reward the best in collaboration between businesses and universities. Lord Stafford, Patron of the Awards, said "This is an example of a superb link-up between a major employer and the Higher Education provider in a city to create a facility which is beneficial to both parties. Not only does the involvement of a major company like Siemens make the offer of the University of Lincoln more attractive to engineering students but the graduates produced benefit Siemens. This is collaboration at its very best and really shows what the Lord Stafford Awards is all about."

The level of engagement between Siemens and the School of Engineering was identified as 'unprecedented' and that the collaborative nature of the School means that graduates are 'industry-ready' and able to immediately contribute when they enter the workplace – whether with Siemens' manufacturing centre in the city, or other engineering companies. It was noted that our students benefit from real-world, practical experience of industry alongside the delivery of the underpinning theory in an academic environment. The partnership also provides opportunities to extend student's learning from beyond the lecture room or lab and into a real professional environment.

Steve Middlesbrough, Director of Engineering at Siemens in Lincoln, said: *"Our collaboration with the University of Lincoln, to establish the UK's first engineering school for 20 years is ground-breaking in many ways. It represents a new model of industry/educational collaboration."*

This early success and citation of the touch points programme received significant media attention via the Lord Stafford Awards website, 'The Engineer', the IET's 'E&T Education Magazine', the Lincolnshire Echo and a number of Siemens publications including 'Venture Magazine '.

Unplanned for achievements and spin-off activities

Projects have identified how participating in these activities has led to additional developments particularly when activity has involved employers. Several of the projects have indicated the project has unfolded in a way that had not been originally envisaged due to the reception and positive outcomes of developments with employers, staff or students. Significant spins offs have included the following:

- Knowledge transfer from working with employers
- Offers of bursaries as well as internships
- Increasing number of employers who have joined projects that have led to new curriculum developments
- Other STEM courses within a university are taking up the developments with employers
- Feedback to students and student satisfaction rates have improved
- Internal funding to set up initiatives across Faculty/other discipline areas
- Links with professional bodies has been very beneficial in terms of sharing findings and resources
- Improved careers information leading to further development with schools
- Students have become involved as STEM ambassadors involved in outreach activity
- Coordinating learning with other STEM projects
- Links between employers with regard to potential research and for staff, academic papers
- Proposals for developing further Foundation Degrees and short courses
- Sharing information collated on a regional database with other HEIs and major employers to expand the regional scope of a project

There were unexpected curriculum spin-offs from the original project. Participants on the training courses used their knowledge to write new procedures for the emergency services with regards to the hazards that an electric vehicle presents in a road traffic accident situation. The project team are currently in dialogue to develop training scenarios as simulation for the Fire Service College plus there's an increasing interest from the retail motor industry (the mechanical shops and body repair centres) in raising awareness of this emergent technology. (Project lead, Gateshead, 11NE)

Through working with employers, several projects have also become involved in activities to support learner access and transition into undergraduate programmes. For example the Gateshead project (11NE) has been engaged in developments regarding apprenticeships progression as well as enhancing the content of apprenticeship programmes for the low carbon vehicle industry and this is a potential area for growth. This project has also shared knowledge of developments with schools; making presentations to Year 8 children to help them make informed choices about identify what GCSEs to study. Taking an electric car into the classroom raises interest and will hopefully address the demand for future technicians and need for STEM students. The Plymouth RAPP (40SW) created 24 video case studies of adults who returned to higher education in science, technology and engineering via different routes such as foundation years, access to HE diplomas and Open University units. These resources have been made widely available via a range of websites. The Plymouth case studies will be maintained on-line and they will seek funding to update and add to these over the next few years. DVD versions have also been produced for use at open days, outreach events and preview days.

The University of Wolverhampton project (48H) working with the local University Technical College has mapped the content of a BTEC programme with the new degree to support progression for learners from Level 3 to Level 4. As a result the University has developed a model for a National Skills Factory which has received funding from UKCES through the Growth Innovation Fund Skills development programme in partnership with the Black Country Local Enterprise Partnership (LEP) aiming to provide higher level skills development for the high volume manufacturing sector. The focus on skills will have an impact on the content of all the undergraduate programmes in the School.

Developing employer responsive provision can lead to new business opportunities either from the primary groups involved or from others who can see the benefits to engagement for themselves. The project developments have given pause for thought in some of the institutions on how to build on the initiatives and make further investment in some of the ideas.

Where does STEM meet the Arts and the Social Sciences?

One of the notable spin-offs of the project has been where boundaries between STEM and other disciplines have been made more fluid, or even broken down. At a basic level, the Warwick project (8M), Real World STEM, delivered a voice and status workshop led by a facilitator who is a theatre practitioner. The project reports, that by using a performance specialist, the session developed the students' understanding of how

to use their voices and demonstrated how body language and posture were integral to effective presenting.

The Bangor Enterprise by Design project (42W) provided a "problem" that all the participating disciplines could contribute to and learn how to talk about the constraints from their own perspective. An aspirational initiative, with an emphasis on inclusive engagements across academic disciplines, it opened up the conceptualisation of creativity to beyond a particular set of courses and has enabled participants to appreciate the value of each other's remit. The project was based explicitly on social constructionism and adopted a conversational approach to learning in groups. This was beyond the experience of many STEM academics but the methods, informed by the psychology department's research on the learning application of blogging, was particularly effective. Post-graduate students facilitated this project and supported their learning groups by blogging (using WordPress as the platform). One blogger adapted poetry to reinforce the learning:

No converging without love, no diverging without dreams of love
Be mad or chill obsessed with angels or machines,
The final wish is love"
"Yes, yes, that's what I wanted,
I always wanted,
to help refine and divine,
to facilitate not debilitate enterprise by design."

The University of York Project, Connect to Science (22NE) focused on the transition to higher level science learning for people who had poor experiences previously. This project used the soft tool of creative writing to consolidate the principles of science. Students were required to produce a piece of creative writing relating to the work they had been doing and then an accurate, journalistic style formal piece. Two tutors, one a scientist and one from creative working, came together to deliver a project that proved to be empowering. (One learner reported that her children has said "mummy you actually know something" when she was explaining a scientific principle.) What astonished the tutors was that the learners were consolidating internally the scientific learning when they were using it to be creative. When they came to read out their work they were empowered by the force of their knowledge. This was a powerful learning tool. ***It gave science some emotion.*** (Project lead, 22NE).

Motion
According to Newton:
Action equals reaction.
Speed depends on force and weight
And gravity makes a difference
But not in space
The splash was heard,
We surfaced.
It was April 18th, 2012
Beverley Cole[31]

So science and the arts and humanities are different. But they are complementary and the barriers we often see do not need to be there.

Managing projects in a time of change

Some say that change is a constant in the world of higher education and certainly over the last few decades HEIs have had to respond to many different policy agendas to meet contemporary requirements for delivery of world-class higher education. The STEM projects aimed to influence the nature of provision in institutions but over the lifetime of these projects the more influential policy change around funding HE, in response to changing political requirements and national economic challenges, has tended to dominate and in some cases has influenced project outcomes and direction of travel. Maintaining a profile for the projects at a time of institutional change has sometimes been challenging for keeping momentum and for achieving and embedding outcomes.

For all projects there have been economic challenges to overcome in sustaining the initiatives. Institutions may have to be creative and patient in making decisions about the next stage. For Leeds Metropolitan University (15NE) for example, much of the further development depends initially on the uptake of the programme by employers and the financial climate of the industry. It is considered however that in the next few years the programme will have been amended to encompass technology changes.

Some projects were affected by other external factors. The Imperial/Cogent project (47H) found it difficult to engage with civil engineering contractors as major government contracts relating to the nuclear industry had not been finalised, and such contractors simply did not have the money to participate. The tsunami of 2004 set back all developments in nuclear power several years which meant that the parameters were more limited than they could have been.

Buy-in and active support from academics, Vice-Chancellors and senior executives is crucial to sustaining workforce development activity. As such, HEIs should ensure appropriate evidence is gathered to

31 [31]Motion by Beverley Cole in Connect to Science, an anthology, edited by Alex Brown and Elizabeth Linklater, 2012, University of York

demonstrate the value of the activity internally and to make a robust business case for continued investment. This could include key metrics on income generated, the number and variety of employer relationships developed and positive impact on other external facing activities such as, knowledge transfer partnerships, continuing professional development and internship placements, to demonstrate an overall return on investment of this activity. Clarity on what "success" looks like will be measured from the senior executive's perspective and is critically important in this respect.

Concluding comments

Overall the HE STEM programme for workforce development, higher level and graduate skills has demonstrated a range of approaches across the STEM community for improving the student learning experience. The projects have developed change within HEIs at an individual course, department or faculty level. They have taken active measures to share project objectives and outcomes in collaboration with other HEIs and have also worked in partnership with other stakeholders to benefit employers and employer groups within a region. They have demonstrated new approaches to workforce development with an individual discipline focus or a whole STEM approach and have undertaken activities that are transferable to other HEIs in other regions. The tactic taken by most of the workforce development projects was to build on existing practices and experiences. Their achievements can add to the current knowledge around employer engagement in the HE sector as a whole.

For the STEM community the projects have demonstrated that there are opportunities to work closely with employers for workforce development and the most effective approach seems to be to collaborate with other HEIs and with networks of employers. These developments can have a specific discipline focus but there is often a requirement to involve colleagues from across the STEM disciplines as together they can bring a fuller picture on skills and capability requirements for effective collaboration.

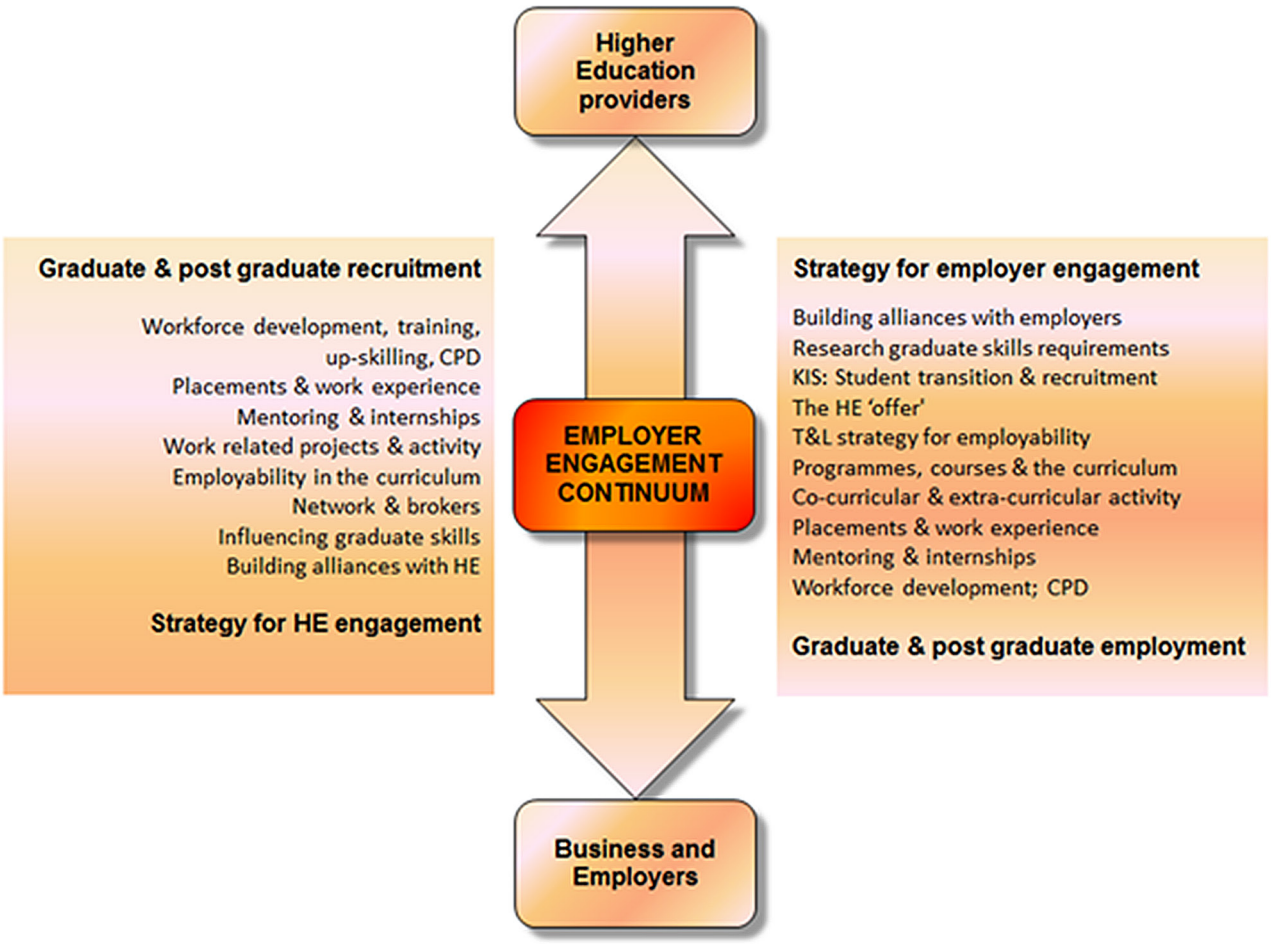
The projects have provided examples of employability development in non-vocational programmes and this has taxed academics in several HEIs but the projects have shown that it is possible to adapt existing discipline specific learning for employability and they are taking active measures to embed the developments further. The importance of raising student awareness of employability within these programmes has been highlighted. The projects show that engagement with students is crucial when introducing these new approaches whether they are developed as part of the curriculum or as extra-curricular activities. In either case, students need information early about the issues of employment, work experience and career management. The issue of work experience and finding a model that works for STEM students still needs more development in partnership with employers, their representatives and professional bodies.

Projects have told us that they have learnt more about the process of employer engagement as a result of their activities and have ideas for further development, especially to share their learning internally for the benefit of the university, department, and faculty or student service.

Although projects have set out a vision for sustainability their ambitions will be influenced by the direction of the institution as this responds to the changing dynamic in higher education. The STEM disciplines remain high on the policy agenda particularly following the recent House of Lords report and the Wilson Review, but individual HEIs will favour different elements of this type of activity with employability and graduate skills development possibly more favoured than employer responsive provision.

The HE STEM programme initially established the themes of higher level skills, workforce development and graduate skills as separate areas of concern, but for many of the projects outlined here there has been an improved understanding that these issues are mutually dependent. We would argue therefore that these HE STEM projects show that any strategy for building alliances with employers for workforce development belongs on the same continuum for improving graduate skills. Institutions cannot have a robust strategy for employability without the significant involvement of employers. Equally engagement with employers to support workforce development cannot be effective without a clear understanding of the skills and capabilities demanded of graduates and others in the workplace and how these requirements are articulated by employers.

The Projects have demonstrated that developing employer responsive provision and curriculum change to enhance graduate skills can take many forms; there is no set way of approaching this endeavour. Building alliances with employers can remove the urgency of just wanting to attract short term income. Successful employer engagement takes time and commitment with an clear understanding of how it can best occur and is only the first stage for developing longer-term more meaningful relationship with employers that can bring mutual benefits to institutions, to student and graduates and to the employers. These projects have demonstrated that a specific initiative can lead to broader, mutually beneficial business alliances.


Higher Education providers
Graduate & post graduate recruitment
Workforce development, training, up-skilling, CPD
Placements & work experience
Mentoring & internships
Work related projects & activity
Employability in the curriculum
Network & brokers
Influencing graduate skills
Building alliances with HE
Strategy for HE engagement
EMPLOYER ENGAGEMENT CONTINUUM
Strategy for employer engagement
Building alliances with employers
Research graduate skills requirements
KIS: Student transition & recruitment
The HE 'offer'
T&L strategy for employability
Programmes, courses & the curriculum
Co-curricular & extra-curricular activity
Placements & work experience
Mentoring & internships
Workforce development; CPD
Graduate & post graduate employment
Business and Employers

Appendix

List of Acronyms

BTEC	BTECs are work-related qualifications
CoC	Chamber of Commerce
COGENT	Sector Skills Council for chemical, pharmaceutical, nuclear, petroleum, polymers and life sciences business
CPD	Continuing Professional Development
CRM	Customer Relationship Management
DH	Department of Health
ECIF	Economic Challenge Innovations Fund
EEF	Employers Engineering Federation
EU Skills	The sector skills council for the gas, power, waste management and water industries
Fd/FdSC	Foundation Degree (in Science)
FEC	Further Education College
FE	Further Education
HE STEM	National Higher Education Science Technology Engineering Maths Programme
HE	Higher Education
HEFCE	Higher Education Funding Council for England
HEFCW	Higher Education Funding Council for Wales
HEI	Higher Education Institution
HEIF	Higher Education Innovation Fund
HLSP	Higher Level Skills Pathfinder
HNC/HND	Higher National Certificate/Diploma
HR	Human Resource
IMA	Institute of Mathematics and its Applications
IoP	Institute of Physics
ISG	Industrial Support Group
JC	Jay Consulting
LMI	Labour Market Information
LP	Legacy Project
LEP	Local Enterprise Partnership
NWUA	North West Universities Association
OER	Open Educational Resources
OU	The Open University
PB	Professional Bodies
PROSKILLS	Process and Manufacturing Sector Skills Council
RAPP or RAP	Regional Action Plan Project
REF	Research Evaluation Framework
RCO	Regional Cluster Organisations
RAE	Royal Academy of Engineering
RSC	Royal Society of Chemistry
SEMTA	Sector Skills Council for the Advanced Manufacturing and Engineering sectors
SHA	Strategic Health Authority
SIG	Special Interest Group
SKILLSET	Creative Skillset is the SSC for the creative industries
SME	Small-Medium size Enterprises
SSC	Sector Skills Council
STEM	Science Technology Engineering Maths
SUMMIT SKILLS	The sector skills council for the building services engineering (BSE) sector
UCLAN	University of Central Lancaster
UHOVI	Universities Heads of the Valleys Institute
UTC	University Technical College

The National HE STEM Programme

The National Higher Education Science, Technology, Engineering and Mathematics (HE STEM) Programme was a three-year initiative funded by the Higher Education Funding Councils for England and Wales through an activity grant to the University of Birmingham in August 2009. The Programme co-ordinated its activities through six geographical regions represented by the Universities of Bath, Birmingham, Bradford Manchester Metropolitan, Southampton and Swansea, and by working in collaboration with four Professional Body Partners: The Institute of Mathematics and its Applications, The Institute of Physics, The Royal Academy of Engineering, and the Royal Society of Chemistry.

Working across the higher education sector in England and Wales, with a particular focus upon the disciplines of Chemistry, Engineering, Mathematics and Physics, the Programme supported higher education institutions in encouraging the exploration of new approaches to recruiting students and delivering programmes of study. It enabled the transfer of best practice across the higher education STEM sector, facilitated its wider adoption, and encouraged innovation. Through collaboration and shared working, the Programme focused upon sustainable activities to achieve longer-term impact within the higher education sector.

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