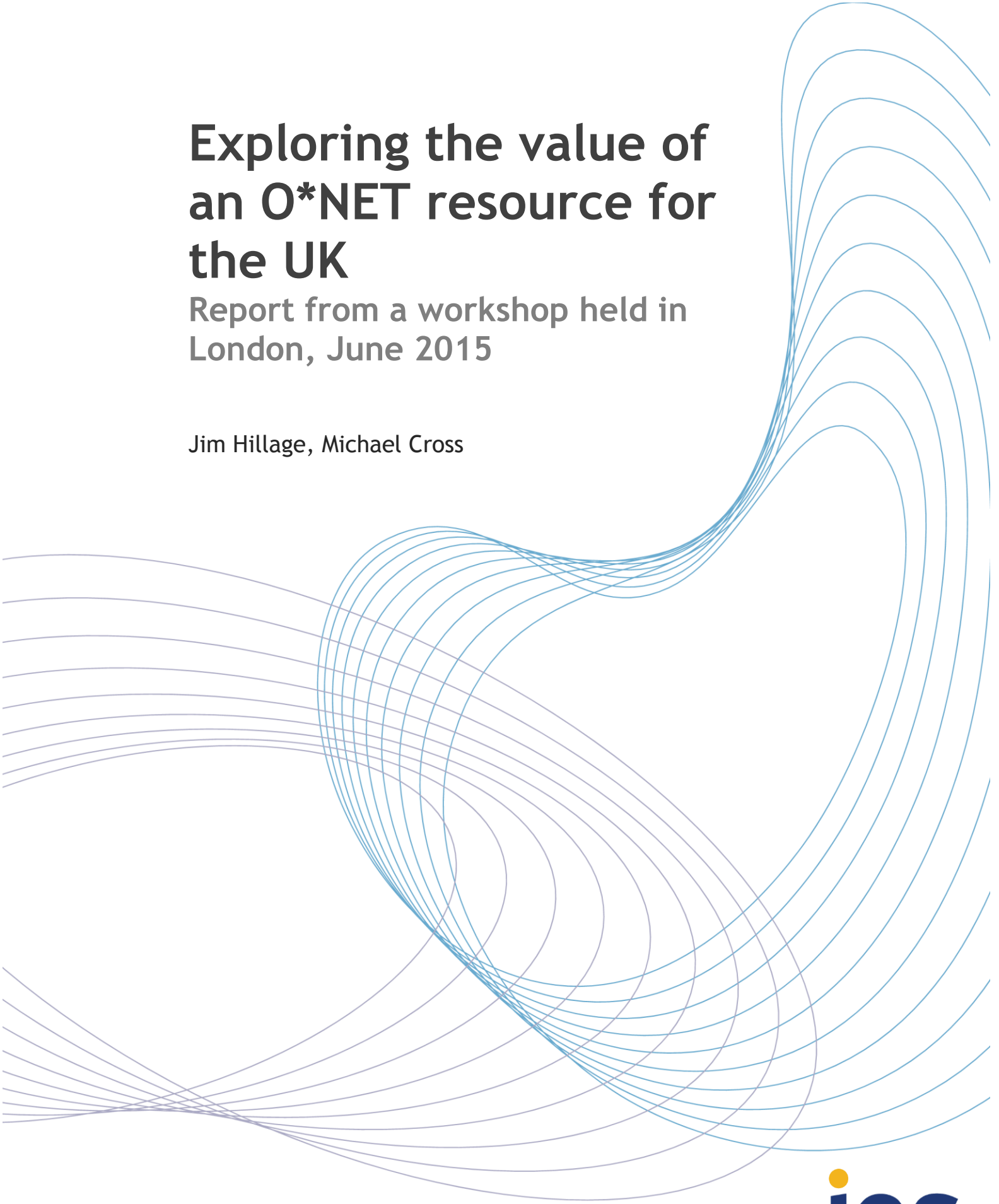
Exploring the value of an O*NET resource for the UK

Report from a workshop held in London, June 2015

Jim Hillage, Michael Cross



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The workshop

On 11 June 2015, the Gatsby Foundation hosted a workshop to examine the potential of an occupational database such as the O*NET resource in the United States of America to help research and address UK occupational and skill challenges.

Specifically the workshop aimed to:

- Examine whether and how the O*NET occupational database could provide relevant information the detail to explore UK skills trends and issues.
- Understand what current research is being conducted or planned using O*NET.
- Identify future priorities for research about use of the O*NET database and whether sector(s) could be identified for testing out potential developments.

The workshop was attended by representatives from relevant policy bodies including The Department for Business Innovation and Skills (BIS) and the UK Commission for Employment and Skills (UKCES), plus interested academics and researchers. For a full list of attendees and the agenda for the workshop see Appendix 1.

This report briefly reviews the background to O*NET and describes the work done to investigate the feasibility of mapping US O*NET to the UK, presented to the workshop by Prof Andy Dickerson. It then notes the points made at the workshop about the potential value of the US O*NET to the UK and how best to take such a concept forward.

The key points from the workshop are that:

- A UK O*NET would be of significant value and help fill important gaps in **identifying and researching skill demand** and **linking skill demand to productivity** at macro and micro level. It could also support **better careers information** for labour market entrants and job changers and **more efficient job design** in the workplace.
- **Developing a UK O*NET from scratch is not feasible** given the huge investment in resources required.
- There is considerable scope for **exploiting the US O*NET** database for UK purposes.
- Researchers and funders should adopt a **collaborative approach** to developing a data resources based on the US O*NET which can be exploited in the UK.

- Such a resource should have **open access** to maximise its utility.
- Immediate next steps include **further validation and development work**, identifying ways in which a UK O*NET could be efficiently updated and establish potential funding sources.
- **Key medium-term research themes identified include:**
  - exploring how a UK O*NET can contribute to understanding productivity changes due to skills;
  - using UK-O*NET data to evaluate the success of UK skills policy;
  - supporting careers advice and information provision;
  - developing a national UK occupational database and explore the potential for use in key sectors and occupations (eg within Industrial Partnerships and for developing apprentice trailblazers). At the same time, this development work would result in a widely available database and also further examine skills trends across the UK labour market;
  - developing local UK occupational databases to serve the needs of the 39 Local Enterprise Partnerships in England.

O*NET background

The US O*NET programme is a comprehensive system for collecting and disseminating information on occupational and worker requirements[1]. The O*NET data superseded the US Department of Labor's *Dictionary of Occupational Titles* (DOT) in 2001 and provides additional occupational requirements not available in the DOT.

The O*NET programme uses a data structure, the Content Model (Figure 1), to organise occupational information and to provide a common language of standardised and defined occupation descriptors and measures for use by all audiences. The O*NET Content Model is the result of extensive research. It comprises worker-oriented and job-oriented characteristics at both an occupation-specific level and across occupations.

[1] O*NET Data Collection Program. Office of Management and Budget, Clearance Package Supporting Statement Part A: Justification. April 10th 2012. 82 pages.

Figure 1: O*NET Content Model

<table>
<tr><td colspan="5">Worker Oriented</td></tr>
<tr><td rowspan="2">Cross Occupation</td><td>Worker Characteristics
Abilities
Occupational interests
Work values
Work styles</td><td>Worker Requirements
Skills
Knowledge
Education</td><td>Experience Requirements
Experience & training
Skills
Entry requirements
Licensing</td><td rowspan="2">Occupation Specific</td></tr>
<tr><td>Occupational Requirements
Generalised work activities
Detailed work activities
Organisational context
Work context</td><td>Workforce Characteristics
Labour market information
Occupational outlook</td><td>Occupation-Specific Information
Tasks
Tools & technology</td></tr>
<tr><td colspan="5">Job Oriented</td></tr>
</table>

*Source: O*NET Data Collection Program*

Each of the six domains of the Content Model groups information hierarchically. For example, the Worker Characteristics domain contains four types of information: abilities, occupational interests, work values, and work styles. From these four, the abilities domain, in turn, contains four types of abilities: cognitive, psychomotor, physical and sensory. Each of these types of abilities contains further levels of detail. For example, the psychomotor type includes fine manipulative, control movement, and reaction time and speed. Finally, fine manipulative contains three specific descriptors: arm-hand steadiness, manual dexterity and finger dexterity. Hierarchies both organise the information and allow for different levels of specificity. By organising occupational information hierarchically, the O*NET taxonomies of information and Standard Occupational Classification (SOC)-based occupations facilitate the use of a common language to describe the world of work.

Figure 2: O*NET Data Collection Programme Questionnaires

O*NET Data Collection Programme Questionnaire	Number of Descriptors	Number of Scales per Descriptor	Total Number of Scales	Data Sources
Skills	35	2	70	Analysts
Knowledge	33	2	66	Job incumbents
Work styles[a]	16	1	16	Job incumbents
Education & training	5	1	5	Job incumbents
Generalised work activities	41	2	82	Job incumbents
Work context	57	1	57	Job incumbents
Abilities	52	2	104	Analysts
Tasks[b]	Varies	2	Varies	Job incumbents
Total (not including tasks)	239	NA	400	NA

Notes: Occupation experts use the same questionnaire as job incumbents for those occupations whose data collection is by the occupation expert method.

(a) The knowledge questionnaire package also contains the work style questionnaire and the education and training questionnaire

(b) All job incumbents are asked to complete a task questionnaire in addition to the domain questionnaire

*Source: O*NET Data Collection Program*

The O*NET programme takes the best knowledge about both content and methodology from the last 70 years of research, since the first DOT (in 1938). The descriptors and rating scales for O*NET data were developed through extensive research, drawing primarily from job analysis in industrial/organisational psychology and human resource management[2]. The descriptors in the O*NET programme are meant to be exhaustive. The primary sources of data are job incumbents and occupation experts. The SOC system is used as the basis for classifying occupations. The use of questionnaires and rating scales reflects the most currently accepted approach to job analysis. The scales used for the O*NET ratings are: importance, level and frequency. Each descriptor in the O*NET questionnaire may use one or more scales. For example, the O*NET skills descriptor 'co-ordination' is rated both on a five-point importance scale and a seven-point level scale. The number of descriptors and scales is set out in Figure 2.

[2] Development of Prototype Occupational Information Network (O*NET) Content Model. Peterson, NG; Mumford, MD; Borman, WC; Jeanneret, PR and Fleishmann, EA. Utah Department of Workforce Services, Salt Lake City through a contract with the American Institute of Research. 1995. Also see: 'Understanding work using the Occupational Information Network (O*NET): Implications for practice and research' by Peterson, NG et al, Personnel Psychology, Vol 54, 2001, 451-492.

Data collection for the O*NET Data Collection Programme began in June 2001 and has been in continuous operation since then. Figure 3 shows the cumulative response rate experience as at December 2011. The comparable response rate for the occupational experts is 79.8 per cent.

Figure 3: Establishment Method of Data Collection Results

Sampled establishments	203,266
Eligible establishments	163,834
Participating establishments	124,598
Establishment response rate	*76.1%*
Eligible employees	248,507
Participating employees	161,505
Employee response rate	*65.0%*

*Source: O*NET Data Collection Program*

Approximately 100 occupations are updated each year and recent updates of O*NET includes identification of and information about 'green' and new emerging occupations. The whole O*NET system had a budget of six million dollars in 2012.

O*NET is widely used as measured by visits to the O*NET site (1.1 million per month) with a further 305,000 visits per month to the O*NET Resource Centre. Bridges, the private provider of careers information and which uses O*NET data in the USA, is used by one million graduating high school students in the US and Canada. While 'IntoCareers' is used by 10,000 schools and state agencies in the US[3].

O*NET: proof of concept in the UK

A recent UKCES project investigated the feasibility of developing a mapping between the US SOC and UK SOC taxonomies in order to exploit the information that is already collected for the O*NET system[4]. The project proceeded in four main stages.

In the **first stage** the researchers matched the occupational taxonomy in O*NET to that of the UK SOC. This was accomplished by using CASCOT (Computer Assisted Structured Coding Tool) which was used to match almost 57,000 US job titles to around 28,000 UK job titles. CASCOT produced a systematic mapping between US job titles and UK job titles, with scores between 0 and 100 which reflect the quality of the match.

[3] *O*NET Products at Work*. National Centre for O*NET Development. Spring 2011. 112 pages.

[4] *Developing Occupational Skills Profiles for the UK: A Feasibility Study*. Andy Dickerson, Rob Wilson, Genna Kik, and Debra Dhillon. UK Commission for Employment and Skills. Evidence Report 44. February 2012. 93 pages.

Each job belongs to a specific SOC, and hence the job-to-job matching was aggregated to produce a corresponding O*NET SOC-to-UK SOC matrix of matching scores.

In the **second stage** of the project, these scores were used together with the relative employment in the O*NET occupation to produce a matrix of weights which enabled O*NET occupations to be matched to 4-digit UK occupations.

In the **third stage**, a range of dimensions or descriptors of job skills, abilities and the other occupational characteristics on the O*NET system were selected, and the weights were used to assign these measures to each 4-digit UK occupation. The methodology can be illustrated with two examples. The first is the classic 'data', 'people' and 'things' classification of skills as used by Autor et al[5] amongst others, which is constructed from the 35 skills descriptors in O*NET using factor analysis. The three categories of data (cognitive skills), people (interpersonal skills) and things (physical job tasks) reflect the quite different sets of skills that individuals may use in their jobs. The second example is a measure of STEM (science, technology, engineering and mathematics) skills which are generated by simple averaging of eight relevant descriptors selected from the abilities and skills domains. These include: deductive reasoning, information ordering, mathematical reasoning, and number facility (from the abilities domain) and mathematics, science, technology design and programming (from the skills domain).

The **final stage** of the project assessed the quality and robustness of the resulting occupational skills profiles.

The findings suggest that it is indeed possible to map between US and UK occupational taxonomies, and thus to be able to assign the job tasks, skills and other content of the O*NET system to matched UK occupations (at 4-digit SOC level). As there are more occupations on the O*NET database than in the UK SOC, some UK occupations are mapped to more than one equivalent US occupation, although in some cases there are direct single matches. This mapping appears to be quite robust. When used to generate occupational skills profiles for data-people-things and for STEM at the -digit (unit group) level of SOC 2010, the resulting occupational profiles appear to be sensible and reasonable and conform to the researchers' prior expectations. Moreover, when the mapping was used to derive measures of required qualifications and training time and these were compared with similar measures taken from the 2006 Skill Survey[6], the correspondence between the two different sources was very high – at least

[5] 'The skills content of recent technological change: an empirical investigation', Autor, DH; Levy, F; and Murnane RJ, *Quarterly Journal of Economics*, 118 (4), 2003, 1279-1333

[6] Skills at Work 1986-2006. Felstead, A; Gallie, D; Green F and Zhou Y, ESRC Centre for Skills, Knowledge and Organisational Performance, Universities of Cardiff and Oxford. 2007. 209 pages

at the SOC Major Group level – giving further confidence in the validity and robustness of the methodology used.

Exploiting the mapping demonstrated in this project between O*NET SOC and UK SOC enables the multi-dimensional O*NET system to be used to generate a comprehensive database of occupational skills profiles for the UK, providing a much more detailed depiction of skills utilisation, and changes in skill utilisation, than is currently available for the UK.

UKCES has also through its LMI for All portal made use of O*NET. This has involved a new mapping from the UK SOC 4 digit categories to one or more US O*NET occupational categories. O*NET information for the latter was therefore linked to queries made through the LMI for All portal about any UK 4 digit SOC category.

The O*NET information was identified as useful by a number of the entrants to a recent NESTA competition (with the Open Data Institute) to support the development of IAG tools and information for new labour market entrants[7].

Building on the initial UKCES project, further work on O*NET is planned to be undertaken by the new Centre for Vocational and Education Research (CVER) to explore skill change among intermediate jobs.

Potential value of O*NET to the UK

There was unanimous agreement among the workshop participants that making full use of O*NET and mapping it across to UK occupations was a priority given the richness of the data available and the very low likelihood of a similar system being developed for the UK from scratch.

A number of needs were identified for such data in the workshop at both a macro and micro-level. These included:

- **Establishing trends in the demand for skills in the UK and the link to productivity**. There is a growing policy need to identify how skill development can support productivity growth. However there are very few sources of reliable data on UK skill demand and none that are comprehensive. An O*NET-style UK database has the potential to fill this gap and allow the investigation of national skill trends.

[7] http://www.lmiforall.org.uk/

- **Examining skill trends at spatial and sectoral level.** This could be of use to industrial partnerships in growth sectors and Local Enterprise Boards and other regional skills bodies to identify local skill change.
- **Improving careers and job information**. Data generated from O*NET could be used to enhance available information on new jobs and careers and thus be of use to organisations such as the new Careers and Enterprise Company in England.
- **Mapping qualifications to skill demand.** This could help training and further education providers ensure they are offering qualifications and courses, including apprenticeship that employers and employees will need.
- **Providing better information to help manage migration**– UK O*NET – type data would potentially be of value to the Migration Advisory Committee on the measurement of skills, and on the specific skills that are in shortage.
- **Improving job design tools** – for employers and trade unions involved in organisational change. It could also help map out the development of new apprenticeship frameworks (trailblazers).
- **Help with skill definition** and the language used to discuss skill issues.

Moving forward

The workshop discussed the ways in which the development of an UK-adapted O*NET database could be taken forward. These covered four areas:

- the general principles that should be adopted;
- short-term validation, technical and contextual issues that would be valuable to address;
- more substantive research themes and issues that could be pursued;
- potential funding sources.

Principles for making progress

A number of general principles were identified which should underpin the development of the UK-type O*NET database:

- **Co-operation**: the overall task of maximising the benefits of using O*NET should be pooling expertise and co-operating in order speed-up the use of O*NET and to remove duplication.

- **Open access**: the 'translated O*NET database' should be open access and so maximise the return on the initial effort.

- **Maximise utility**: given the value of O*NET, its use should be maximised wherever possible to add deeper understanding to key skills issues.

Short-term priorities

The more immediate requirements that need addressing include:

- Further validation of the UKCES feasibility project by the development of a more robust indexation and weighting system(s), building on the developments implemented for LMI for All.

- Further validation of the UKCES feasibility project at the occupation level by making detailed comparisons of several specific occupations between the UK and the USA. There is also value in making a US-UK-Germany comparison based on the potential commonality of the basis of both the US and German occupation information systems. This could be undertaken with the support and involvement of SSCs and their Industrial Partnerships and focus on STEM occupations. This might also have the additional benefit of introducing O*NET to employers.

- International comparisons and understanding – investigating what use is made of O*NET elsewhere. Questions include: what international evidence is there for the benefit of O*NET and, similar O*NET systems and where does ESCO (European Skills/Competences, Qualifications and Occupations) contribute to this understanding?[8]

- Identifying ways in which a UK O*NET could be efficiently updated. One example could be to use data crowd funding and sourcing – learn from experience in Singapore and possibly engage with the members of the Recruitment & Employment Confederation (REC) to look for ways to harvest skills usage, needs and preferences through engagement with both current and future employees and employers.

[8] See O*NET Products at Work pp30-33 which lists the wide international use of O*NET with web visits recorded coming from 192 countries and with specific projects being undertaken in Canada, Oman, Ireland, India, South Africa, Philippines, Sweden, South Korea, Mexico, Australia and reference is made to the widespread use of O*NET across Europe and Central America. The German Berufenet system which includes 3200 current job descriptions with 60 information fields for each one across 16 professional fields. For Singapore see www.mom.gov.sg and www.skillsfuture.org

Substantive research themes and other research issues

A number of research themes and other ideas were suggested, largely reflecting the gaps in the UK knowledge base identified above as set out below. Participants were asked to identify their priority themes. Not all responded, but the list reflects the priority order of those who did.

- Productivity – exploring how O*NET can contribute to understanding productivity changes and differences within the UK due to skills, and between the UK and other economies[9].

- Skills policy evaluation – use the UK derived database based on O*NET data to evaluate the success of UK skills policy.

- Supporting careers advice and information provision to help support the new Careers and Enterprise Company, and also to support the mapping of progression routes based on their existing skills. This theme could be extended by mapping individual preferences (possibly around career anchors) and capabilities, and matching them to the opportunities in the current and future labour market.

- Developing a national UK occupational database – for wider research and policy development use, and for the evaluation of skills policy – by ensuring the weightings used to date are more effective and exploring the potential for use with the current Industrial Partnerships. At the same time, this development work would result in a widely available database and also further examine skills trends across the UK labour market.

- Developing local UK occupational databases– to provide a skills rich database by adding a spatial component to serve the needs of the 39 Local Enterprise Partnerships in England. Examining the spatial dimensions to O*NET and seek to explore 'skills ecosystems' and their relationship to employment and economic growth[10].

[9] See, for example, 'The UK Productivity Puzzle, 2008-2012: Evidence using Plant Level Estimates of Total Factor Productivity' presentation by Richard Harris at the NIESR-LLAKES Productivity and Firm Growth Workshop. November 2014. Plus see: 'Regional Economic Indicators with a focus on the relationship between skills and productivity' by Sebnew Guz and Jonathan Knight in Economic and Labour Market Review (ONS), February 2011, 133-164

[10] See: Cities, Tasks and Skills by Suzanne Kok and Bas ter Weel (2014) who used O*NET (task level) to measure and interpret changes in the employment structure of the 168 largest US cities in the period 1990-2009. CPB Netherlands Bureau for Economic Policy Analysis. Discussion Paper 269. 50 pages.

- Awareness raising and communication of the value and the potential of O*NET amongst employers as a resource to be used when creating the content for the current apprenticeship trailblazers and also seek to provide a better occupational context for the trailblazers.
- Mapping of qualifications to skills in use and in demand – allows the better alignment of the output of education and training systems with skills demanded at the workplace.
- Skills utilisation (under and over) – provides a means to examine skills usage at work and the use of acquired skills and where real skill gaps exist.
- Providing an in-depth view of skills demand – matching skills supply and viewing the changing structure of skills as used at work, and understanding the whole skills economy. This can also be used to provide estimates of future skills demand (rather than simply providing estimates of future patterns in employment by sector and occupation) by linking to *Working Futures* projections.
- Valuation of skills in employment – examine the value of skills at work and view differences between different genders, racial minority groups, the disabled etc.
- Migration information provision – extend the information available to the Migration Advisory Committee on the measurement of skills, and on the specific skills that are in shortage.
- Make a comparison of the role of the technician (in a specific sector, say, aerospace or car manufacturing) between the UK and Germany in order to examine how the variances explain effectiveness and productivity differences[11].
- Make the link between skills demand and skill supply by mapping qualifications to the skills in use at work by using O*NET to help to define the skills at the job and occupation levels.

[11] This work could build on: 'Some practical aspects of human capital investments: training standards in five occupations in Britain and Germany', S.J. Prais and K. Wagner, National Institute Economic Review, Vol 105, No 1, August 1983, 46-65. The five occupations covered are: mechanical fitter, electrician, construction worker, office worker and retailing. Also see: The Engineering Profession. A comparison between the operation of the engineering profession in the UK and other countries. James Hamilton. Engineering Council, London. 2000. 84 pages. In particular see: 'The Technician Problem' pp25-28 and the UK (pp45-48) and Germany (pp54-56) And, International Comparisons of Qualifications: Skills Audit Update. H Steedman, S McIntosh and A Green. Department for Trade and Industry and Department for Education and Skills. Research Report RR548. 2004. 64 pages

Funding sources

No specific funding sources were identified. However it was suggested that:

- Validation and basic research to further develop a core UK O*NET methodology may be best funded by a number of sources.
- Specific funders may be interested in specific topics eg STEM skill developments.
- Employer and recruitment agencies may be potential sources (see above).
- Sectors Skills Councils and/or industrial partnerships may fund particular O*NET research to examine key occupations in their sector(s).

Appendix

O*NET workshop Agenda

Introductions – Jim Hillage, IES

The background and aims of the workshop – Michael Cross & Jim Hillage, IES

Previous work on O*NET – Andy Dickerson, University of Sheffield

General Discussion

- Should the development of a UK-style O*NET be seen as a priority?
- Potential improvements to existing work on mapping UK Standard Occupational Classifications to O*NET classifications?
- Would a pilot application to a sector/set of occupations be of value?
- What are the labour market questions that a "UK O*NET" resource could address?
- What is the potential for an O*NET-type of resource to enhance human resource management among employees?

Summary & Where Next?

Participants (attending)

- Daniel Sandford Smith, Gatsby Foundation
- Beth Jones, Gatsby Foundation
- Andrew Dickerson, Department of Economics, University of Sheffield
- Peter Glover, Senior Research Manager, UK Commission for Employment and Skills
- Duncan Brown, Economist and Policy Researcher, UK Commission for Employment and Skills

- Frank Bowley, Deputy Director of Skills Policy Analysis, Department for Business, Innovation & Skills
- Adrian Jones, Head of FE Data and Statistics Unit, Department for Business, Innovation & Skills
- Rob Wilson, Institute for Employment Research, University of Warwick
- Iain Murray, Senior Policy Officer, Unionlearn TUC
- Annette Cox, Associate Director, Institute for Employment Studies
- Becci Newton, Principal Research Fellow, Institute for Employment Studies
- Jim Hillage, Director of Research, Institute for Employment Studies
- Michael Cross, Principal Associate, Institute for Employment Studies

Dan Jones, Director, Innovation Lab, NESTA was interviewed after the event