

CApability Matrix for Photonics Up-Skilling (CAMPUS)

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ABSTRACT

This paper describes work undertaken to define the photonics up-skilling capability of higher education (HE) and further education (FE) institutions in Wales. The expertise was compiled in matrix form and included specification of the Training, Research, Equipment and Expertise (TREE) of the relevant institutions. The information contained in the CAMPUS TREES is designed for use by industry and commerce.

Keywords: Photonics, training, education, upskilling

1. INTRODUCTION

This paper details work undertaken within a project funded by the HE-STEM initiative to define a “ CApability Matrix for Photonics UpSkilling “ of higher education institutions (HEIs) and further education institutions (FEIs) in Wales, UK. CAMPUS was part of a wider project concerned with enhancing opportunities in Science, Technology, Engineering and Mathematics (STEM). The HE-STEM project was funded by the Higher Education Funding Councils of England and Wales – HEFCE and HEFCW respectively.

The requirement for CAMPUS was identified in the context of efforts by the Welsh Optoelectronics Forum (WOF) via the Photonics Academy for Wales to support growth of the photonics industry by ensuring the availability of suitably trained personnel. A particular stimulus for CAMPUS was provided by work on the parallel HE-STEM project UPSKILL project within which Bangor and Aberystwyth Universities have developed level 4 photonics education, training and up-skilling (ETU).

Photonics is a high-tech industry and product development and manufacture creates much added value. The utilisation of know-how which characterises photonics manufacturing activity ensures that the industry is robust to challenges from low-cost manufacturing areas. Sustaining such creativity requires continuous up-dating of relevant skills so that the introduction of innovatory products and novel processes can be effected in a cost-effective manner. Although several HEIs and a few FEIs in Wales have capabilities in photonics ETU no extant summary of those capabilities was available. Moreover the existing disparate descriptions of such capabilities was typically presented in terms suitable for education rather than for industry. The key insight for CAMPUS was to assemble, in an industry-friendly format, a complete compendium of photonic ETU available within HEIs and FEIs in Wales.

2. OBJECTIVES

The objectives identified for CAMPUS were to

- 1) Define the opto-electronics education and training capabilities within HE and relevant FE institutions in Wales ;
- 2) Map the capabilities into categories which are meaningful to industrial users ;
- 3) Assess the strengths of the capabilities ;
- 4) Capture the capabilities within an easily-accessible matrix format – the capability matrix ;

- 5) Communicate the capability matrix to an industrial audience ;
- 6) Assess the potential for delivery of the capability to industrial partners.

The project has delivered against all those objectives. CAMPUS has thereby assembled in compact form a representation of available photonics education, training and up-skilling (ETU) in Wales.

The process of executing the translation of defined capabilities in photonics ETU into a form suitable for use by industry led to the identification of critical areas for further activity. Specifically, interactions with SMEs and micro-enterprises have revealed the pressing need for an easily negotiated interface between such companies and photonics ETUs providers. CAMPUS work has thus led to a proposal for the establishment of a Photonics Skills Brokerage (PSB) service. It is conjectured that analogous services would be of value in other STEM-based technologies.

3. IMPLEMENTATION

As outlined above, the strong focus of CAMPUS is the presentation of photonics *Education, Training and Up-skilling* (ETUs) opportunities in a format which is readily accessible to industry. In order to ensure the viability of the approach, CAMPUS engaged the direct support of the Welsh Optoelectronics Forum (WOF) – the de facto trade association for the photonics industry in Wales. The key tasks undertaken within CAMPUS were performed by the WOF administrator Susan Sheridan (SS) and by David Rimmer (DR) of Drem Ventures. Both bringing a clear industrial perspective to the project. The PI (KAS) provided the required academic perspective. It is noted *en passant* that CAMPUS was implemented in the later stages of the HE-STEM project and ran to a very tight schedule. The inputs of the industrially-focussed participants (SS/DR) were invaluable for achieving delivery against objectives

3.1 Methodology

The principal tasks undertaken within CAMPUS are indicated here (with participants indicated in parentheses)

1. Definition of HE/FE Capabilities : utilise publicly available information as a baseline for capability ; obtain direct information from HEIs or FECs on detailed aspects of provision ; make preliminary estimate of the strength of the capability ; (SS/KAS)
2. Define initial categories for capabilities (KAS); gain an initial industrial view of the defined categories(DR) ; obtain indications from industry of desirable additional categories(DR) ;
3. Make an initial mapping of defined capabilities into defined categories thereby defining an initial capability matrix (SS/KAS);
4. Share the initial mapping with partner HEIs and FECs to elicit modifications as required (SS);
5. Share the modified mapping with industrial partners (SS/DR);
6. Modify the capability matrix in the light of comments from industrial partners (SS/KAS);
7. Iterate to academic partners as appropriate to obtain a final capability matrix (SS) ;
8. Disseminate the capability matrix via a presentation event aimed at an industrial audience (SS/KAS/DR);
9. Seek feedback from industry of the specific elements of the matrix which could be delivered to them (DR);

The implementation of the Capability Matrix required two components: the definition of key topics in photonics and the identification of industrial sectors into which those activities could be mapped. It was decided to adopt the photonics subject areas defined in the recently-updated OSA-Sponsored **Handbook of Photonics [McGraw Hill, 2010]** to meet the former requirement.

It was considered appropriate to use the European Technology Platform Photonics²¹ [www.photonics21.org] Value Chain headings with sub-headings to reflect activities within the Welsh photonics sector to satisfy the latter requirement

3.2 Collation/Translation/Dissemination

The core task of CAMPUS was to determine into which photonic subject areas ETUS activity at participating institutions could be classified and thence to translate that into a capability for industry. It was appreciated that industrially-useful capability could exist outside the formally validated ETUs provision of the institutions. Specifically it was noted that there would be opportunities to exploit research experience, equipment resources and general expertise available within the participating institutions in support of industry.

On this basis HEIs and FEIs were asked to complete a pro-forma which sought to capture for CAMPUS the **T**raini**n**g, **R**esearch, **E**quipment and **E**xpertise (TREE) of the participating institutions.

The compilation of the CAMPUS TREEs required some iterations between the project staff and the partner HEIs. Inevitably there was some variation in the balance between TREE components at the various institutions. Moreover accessibility to relevant data (e.g. specification of ETU opportunities) differed amongst the partners. Such variability underlined the value of the CAMPUS project in offering a single-stop collation of a broad spectrum of activity.

Having assembled the relevant ETU data the compilation of the capability matrix – or more precisely matrices - was effected.

The representation of the HEIs capabilities was executed in two forms in terms of (i) photonics technologies and (ii) industrial sectors. For ease of usage, the capabilities in both forms were captured in a single page matrix. More detailed information including photonics specialities and industrial sectors was also presented. The relevant documents have been published and disseminated.

The key aim of CAMPUS was to provide key information of utility to industry. Two dissemination events were organised in order to both broadcast the availability of the capability matrix and also to gauge industrial response to the project outputs. The first dissemination event was held on 11 July 2012 at OptIC, St Asaph, North Wales; the second event was held at the Millennium Centre, Cardiff, Wales on 19 July 2012. It is observed that rather short lead times were available in which to publicise these events but nevertheless a satisfactory attendance was achieved with about 25 attendees at OptIC and 20 in Cardiff.

In addition to the formal dissemination effected via these events, use was made of the industry network provided by the Welsh Optoelectronics Forum to gain additional feedback on the capability matrix. Overall the response to the activity has been positive.

In order to provide a semi-permanent location for the CAMPUS outcomes discussions were held with the Welsh Government with a view to incorporating the CAMPUS data on the ‘ Expertise Wales ‘ website [<https://www.expertisewales.com>].

A preliminary version of the material had been mounted on the web-site in time for the CAMPUS dissemination events. Work will continue beyond the present project to realise this outcome.

Having gained the cooperation of the HEIs to assemble the core data for CAMPUS it was possible to offer the partners an opportunity to promote their activities using a single-page two-sided ‘flyer ‘.Such material is also planned for inclusion on the ‘ Expertise Wales ‘ website.

As a final means of both enhancing and perpetuating the impact of the activity, CAMPUS representatives (DR and KAS) attended a EU Photonics²¹ meeting focussed on education and training at the Institute of Physics in London on 13 July 2012. It is intended to use the work on CAMPUS to contribute to future Photonics²¹ activities and thereby effect a Europe-wide dissemination of CAMPUS outputs.

4. EVALUATION

As indicated above, CAMPUS proceeded against a well-defined set of discrete tasks. The evaluation of CAMPUS activity was made, in the most part, on the objective basis of the completeness with which those tasks were performed. In these terms it is appropriate to indicate, on the basis of the physical outputs from CAMPUS that tasks 1 through 7 were fully completed. Task 8 and 9 included crucial interactions with industry.

Informal meetings and telephone discussions have been held with a number of individuals from organisations within the photonics sector. The purpose has been to seek views on the usefulness of the “matrix” produced through the CAMPUS project.

Overall feedback has been very positive with most contacts finding the material “easily understood” and presented in a clear format. It will not be possible to measure impact of the material until companies begin to use it in anger. However, comments received to date include suggestions for additional data which suggests that the potential benefits are being readily recognised.

The following is an abbreviated selection of some of the specific comments. Some of these have been received in slightly different forms more than once:

“My immediate reaction is that this will be very useful”;

“I like the format, it’s well presented and easy to understand”;

“We don’t have any immediate plans but see that this could be very useful document”;

“I really like the approach. It’s different from anything I’ve seen. I much prefer the way the topics are laid out to the usual approach. It’s a credit to Wales to see so much photonics material in one place”;

“This is really useful. Are there any plans for extending the information provided? It would be good to see the specific grant titles of RCUK and EU funded research. Also existing collaborations and the partners involved in these”;

“I think this is very helpful and suggests a practical slant. I don’t think people realise how much of an investment training and development is for industry. There are many hidden costs and we need to get it right. Training providers must understand that what they deliver needs to make money for us”;

“I hope lessons have been learned (re access to facilities) about the difficulties of access and time allocation. It’s all very well having great equipment but you need to have people to operate it properly when it is needed”;

“This provides a very clear and potentially useful guide to what is available. I think it will be very helpful, certainly for access to courses. However, knowing that there is expertise there doesn’t always help. There doesn’t seem to be any easy mechanisms to buy short term consultancy from universities”.

“This is a good top level view. I’m not sure yet about the detail. Will there be a way of seeing what financial help might be available to access the right material – or will we have to look elsewhere for that”;

“This looks like a fresh approach and I look forward to finding out more. The matrix clarifies which universities are specialising in certain aspects of photonics. This isn’t always easy to see”.

It is noted that the published CAMPUS Matrix exceeded the original brief of the project by capturing data on the ‘Training Research, Expertise and Equipment’ (TREE) available at the participating HEIs. As a further additional outcome, all participating HEIs were given the opportunity to produce flyers summarising their TREE capabilities. Such flyers will offer one means for widening the impact of CAMPUS beyond the shelf-life of the project. Wider impact of the work is also expected by utilisation of the material generated within CAMPUS via the Expertise Wales website.

The litmus test of the efficacy of the CAMPUS project will be the dialogue which is subsequently maintained between the HEI partners which have contributed to CAMPUS and the targeted principal beneficiaries – industry. Given the timeframe in which CAMPUS was executed it is not possible to adduce evidence of that impact. However it is shown below how avenues are opening through which a positive legacy for the work of CAMPUS can be expected to be evidenced. Such legacy impact is anticipated at a regional level via the Welsh Optoelectronic Forum as well as through the Science and Innovation policies of the Welsh Government. Sights are also set on engaging deeply on a European scale and specifically via Photonics²¹ activities.

5. FURTHER DEVELOPMENT AND SUSTAINABILITY

Several dimensions for further development of CAMPUS activity have been identified

The process of executing the translation of defined capabilities in photonics ETUs into a form suitable for use by industry has led to the identification of a number of critical areas for further activity. Specifically, interactions with SMEs and micro-enterprises have revealed the pressing need for an easily negotiated interface between such companies and photonics ETUs providers. CAMPUS work has thus led to a proposal for the establishment of a *Photonics Skills Brokerage* (PSB) service. It is aimed to progress consideration of such a service under the auspices of the Welsh Optoelectronics Forum. It is underlined that there would be an opportunity for a commercial activity in this respect.

It is strongly conjectured that analogous services would be of value in other STEM-based technologies.

Having collaborated to construct CAMPUS, the partner HEIs have indicated a readiness to undertake further collaboration in the area of photonics work-force up-skilling. A specific vehicle for such continued activity has been identified within an ERDF programme on Work-Based Learning (WBL) supported by the Welsh European Funding Office (WEFO). That project, “Optics and Photonics Up-Skilling (OPUS) – for Industry” - which aims to provide companies in Wales with opportunities for photonics up-skilling – is described in an accompanying paper.

The CAMPUS dissemination events included presentations on the ‘Photonics Enabled Innovation Strategy for Wales’ which was recently-developed by the Welsh Optoelectronics Forum (WOF). Having a highly trained work-force is a key requirement for realising the ambitions articulated within the WOF strategy. Continued collaboration between HEIs in Wales and WOF will be key to implementation of that strategy. The work of CAMPUS provides a framework within such collaboration can prosper.

It is observed that almost contemporaneously with the development of the WOF Innovation Strategy, the Welsh Government held a consultation on an Innovation Strategy for Wales. A response to the Welsh Government consultation has been made including indications of the contributions which the work on CAMPUS can make to innovation in photonics.

It is anticipated that innovation in photonics will play a significant role in the wider innovation context defined by the Welsh Government. Ipso facto it is expected that the platform for collaboration created by CAMPUS will feature in the implementation of the Welsh Government Innovation Strategy.

A further dimension for the utilisation of the work undertaken within CAMPUS is offered by the Science Policy for Wales published by the Welsh Government. That policy is accompanied by substantial funding including support for attracting high-profile research leaders.

CAMPUS was executed in a specific academic-industrial context and its detailed outcomes are of particular utility in that context. However it is expected that the methodology which underpins CAMPUS can be applied in other contexts and notably to other technologies.