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# Global Software Innovators Strengthening the Software Innovation Capacity of Europe and Korea

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# Global Software Innovators

## Strengthening the Software Innovation Capacity of Europe and Korea

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### Abstract

*Global entrepreneurial talent management is a key challenge for the software sector internationally where competition for high-end skills is intense. SMEs are at a significant disadvantage when competing with major multinationals to access these skills. The Information and Communications Technology sector accounts for 5% of all employment in the EU and there are 900,000 vacancies in this sector in 2017 [1], however over 50% of senior ICT managers believe graduates lack the necessary combination of technical, business and interpersonal skills [2]. In addition, only 4 in 1000 women work in the ICT sector [3].*

*To address these challenges, HubLinked, an EU-funded Knowledge Alliance partnership of 11 industry and HE partners in the EU and Korea, is developing an integrated curriculum for industry-oriented, internationalised, innovation focused and interdisciplinary Computer Science degrees ("CS<sup>I</sup>"). CS<sup>I</sup> features Global Labs, where teams of students work across timezones to prototype software, an internationalization-at-home experience which mimics working in a global ICT company.*

### 1. Introduction

The goal of HubLinked is to strengthen Europe's software innovation capacity by learning from regions of proven ICT strength and sharing that knowledge with all regions. HubLinked will (i) improve the effectiveness University-Industry (U-I) linkages between computer science faculty and all companies (ii) develop global software innovators that can work in any sector (iii) increase the participation of females in the ICT sector and (iv) upskill academic and industry staff to engage in U-I linkages for software innovation. The specific needs addressed are outlined here.

### 2. Background and Rationale

HubLinked adopts a strategic approach of connecting the major European ICT-intensive regions by connecting some of the largest Faculties of CS in Europe and Korea, an approach which has critical mass on an international scale. In an already crowded curriculum, in a discipline that is ever-widening and ever-changing, 'doubling up' of skills development with technical proficiencies is essential.

The ICT sector accounts for 5% of employment in the EU and there will be 900,000 vacancies in the Digital sector by 2017 [1], representing a clear need to increase the quantity of graduates with these skills. However over 50% of senior ICT managers also report that CS graduates lack the necessary combination of technical, business and interpersonal skills [2]. The ICT sector is also one of the most R&D intensive sectors and there are projections of one million new research jobs by 2020 in the EU [19]. Therefore, there is a need to enhance the research and innovation skills of graduates at bachelors, masters and doctoral level.

Only 29 of every 1000 women hold an ICT degree (as compared to 95 men) and only 4 in 1000 women work in the ICT sector [3]. Efforts to address the digital skills shortage are accessing only half of the population. Perception of careers in the ICT sector [20] and the nature of the CS curricula on offer are major factors. Therefore, there is a need to make CS curricula more attractive to females. This will not only boost numbers in this heavily male-dominated sectors, but will also address help female underrepresentation in entrepreneurship. More men than women start and run new businesses - fewer women still run mature businesses.

Industrial sectors differ considerably in the dynamics U-I linkages [21]. The ICT sector creates more new firms that survive longer and achieve higher growth [22], innovation happens in a variety of firms (not just MNCs and startups) and innovation is inherently global [23]. Software innovation includes advances in products, processes or services [24]. Patterns of innovation in the software sub-sector are science-based but are distinctive [24]. Disruptive technologies such as mobile, cloud computing and web 2.0 have transformed the software sector in recent years making previous research obsolete. Therefore, there is a need to better understand the dynamics of U-I linkages in the software sector. Effective knowledge flow between centres of software innovation expertise and the companies that need this expertise is critical for the EU's economic success.

ICT-enabled innovation represents up to 25% of total innovative output in the EU [25]. OECD research from 18 countries showed that young SMEs are primarily responsible up to 42% of total job creation over the last decade [26]. Given that SMEs represent 90% of all businesses in the EU1, there is a need to ensure that SME's have access to software innovation [26].

### 3. The HubLinked Knowledge Alliance

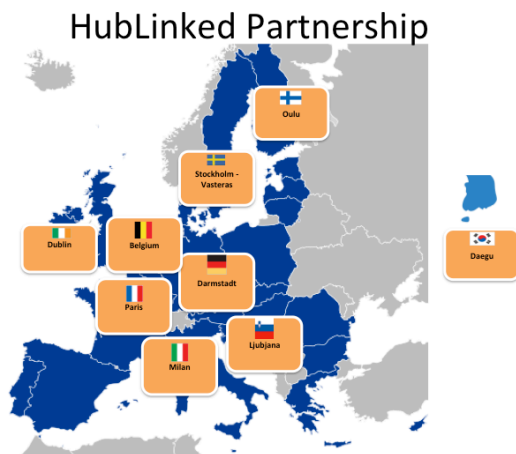
By creating a sustainable strategic network of major European and Korean ICT hubs, the goal of HubLinked is to strengthen Europe's software innovation capacity by learning from regions of proven ICT strength and sharing that knowledge will all regions. HubLinked will (i) improve the effectiveness University-Industry (U-I) linkages between computer science faculty and different types of companies (ii) develop global software innovator graduates that can work in any sector and (iii) upskill academic and industry staff to engage in U-I linkages for software innovation.

Although the ICT sector is a major economic sector in Europe, HubLinked also includes SMEs in the non-software sector to provide a 'low-cost low-commitment' mechanism to prototype software innovations. An established partnership of large, industry-focused computer science faculties have come together with a representative mix of industry partners (large multinationals, SMEs in both the

software and other sectors and start-up companies). HubLinked Partners include:

- Dublin Institute of Technology (Ireland)
- University of Applied Sciences Darmstadt (Germany)
- Telecom Sud-Paris (France)
- University of Applied Sciences Oulu (Finland)
- Mälardalen University (Sweden)
- University of Ljubljana (Slovenia)
- SAP SSC (Ireland)
- Irish Small and Medium Enterprises Association (Ireland)
- Eurocrea Merchant (Italy)
- European Business Network (Belgium)
- Kyungpook University (Korea)

Figure 1 HubLinked Partnership



HubLinked partnership can directly reach over 3,000 companies, 12,000 students and 400 staff during the lifetime of the project. HubLinked will create a network of European and Korean ICT professionals that will increase the innovation capacity and competitiveness of European software hubs and help underpin education, research, innovation, trade and economic development for years to come.

HubLinked began in January 2017 and will run for three years. HubLinked extends the State-of-the-Art in this domain in a number of ways. The strategic *approach* of connecting the major European EIPER regions, at Faculty level and across all levels from bachelors to doctorate, has critical mass on an international scale and it aligns the strategic development of some of the largest Faculties of industry-oriented CS in Europe. Innovative *results*, which will make major contribution to third level CS

<sup>1</sup> European Commission. Growth, Internal Market, Industry, Entrepreneurship and SMEs. [http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/index\\_en.htm](http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/index_en.htm)

education internationally, include Practical Guidelines for U-I linkages, the CSI<sup>4</sup> Curriculum Framework, Global Labs, the HubLinked Mobility Network and the Staff Development programme.

#### 4. Effective University-Industry Linkages for Software Innovation

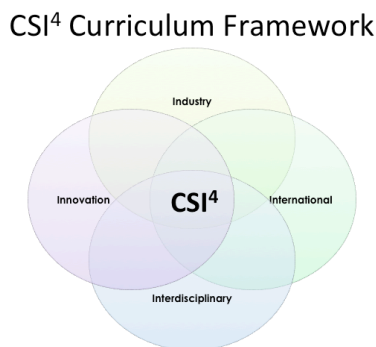
The co-creation between academia and industry of Practical Guidelines for effective U-I Linkages for Software Innovation which consider the organisational structures within HE institutions and different types of companies is innovative [5]. Few studies empirically examine the role of HE in innovation by discipline or by industry [6,7] although the disciplines and the environment in which knowledge is produced are known to be important factors in knowledge transfer [8,9] and innovation [10]. Related projects in other disciplines include projects that strengthen the knowledge triangle between universities, SMEs and innovation support organisations include social innovation university-community models [11,12] and frameworks for innovation competencies and assessment in U-I linkages [13].

Extensive research will be undertaken with HE and companies in all sectors to determine what works best when higher education institutions work with industry on software innovation. The range of potential mechanisms to for U-I Linkages is extensive - collaborative projects, student projects, contract research, scientific publications, patents, spin-off companies, technology licences, incubation space, sponsorship of postgraduates, resource sharing, staff exchanges, joint positions, training and consultancy, employing graduates, internships, hiring of HE staff by industry, technology transfer offices, personal contacts, membership of professional organisations and graduate networks, participation in conferences and other networking events. Some are more effective than others however and we need to determine which activities work best for in U-I linkages for software innovation. The result is a report entitled “Practical Guidelines for U-I Linkages for Software Innovation” which will identify (i) the best ways for different types of companies to engage with CS faculty and (ii) how engagement with companies from all sectors can be mainstreamed into the activities of a CS Faculty. This research enables a better understanding of the dynamics of U-I linkages in software innovation and ensures SMEs in all sectors can access software innovation expertise in a cost-effective way.

#### 5. Curriculum Reform

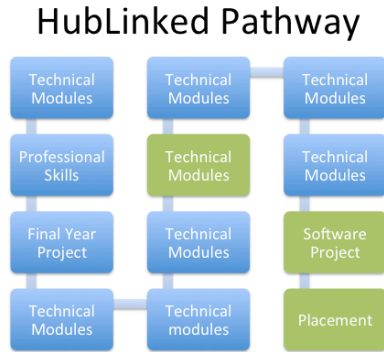
While industry-oriented CS programmes are common place at all levels and the main international CS standards bodies have well specified competencies for industry and professional skills [14,15] (ACM, IEEE, BCS, e-Competence Framework), the integration of the four I’s of industry, international, interdisciplinary and innovation in a “CSI<sup>4</sup> Curriculum Framework” is innovative. While there are many promotional initiatives to attract females to ICT careers at international [16], European [17,18] and national level there are few examples of fundamental CS curriculum reform to make CS degrees more attractive to females. CS degrees that offer interdisciplinary approaches, real world or international experiences have been shown to be more popular with females [4].

Figure 2 CSI<sup>4</sup> Curriculum Framework



Informed by the U-I linkages research, and building on the experiences of the GlobalWorkIT project and partner’s track records in CS education, HubLinked will develop the CSI<sup>4</sup> curriculum framework for industry-oriented, internationalised, innovation-focused and interdisciplinary CS degrees at Bachelors, Masters, LLL and Doctorate levels. HubLinked will focus on identifying a pathway of ‘high impact curriculum components’ which are feasible to implement in partner curricula. CSI<sup>4</sup> will take into account supports available on Erasmus+ and other programmes. In an already crowded curriculum, in a discipline that is ever-widening and ever-changing, ‘doubling up’ of skills development with technical proficiencies is essential. This will increase the supply of CS graduates with global innovation skills. help address gender imbalance and include ‘innovation skills.

**Figure 3 HubLinked Pathway**



## 6. Global Labs

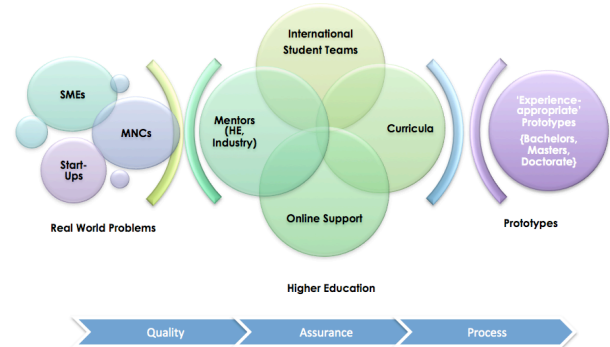
The Global Lab model which provides companies in any sector, particularly SMEs, with a low-cost and low-commitment mechanism to engage with CS faculties is innovative. Global Labs incorporate the four I's of industry, internationalisation, interdisciplinary and innovation skills development, providing an international experience which can be achieved without physical mobility.

Global Labs are one example of an effective U-I Linkage which have shown significant potential in involving industry, particularly non-Software SMEs, in the curriculum. Global Labs will provide a low-cost low-commitment mechanism for SMEs in the non-software sector to prototype software ideas. Informed by the U-I Linkages research, building on the experiences of GlobalWorkIT, Oamk's Demola and TSP's Destine projects, four Global Lab modules will be designed, delivered and evaluated at Bachelors, Masters, LLL and Doctorate level. These accredited modules form part of the CSI<sup>4</sup> curriculum. Teams of international students work together across timezones, supervised by industry mentors, to turn real-world problems from any sector into 'experience-appropriate' prototypes. On completion of the prototype, its value to the company can then be assessed. If further research is required, research groups within the HE can investigate it. If there is potential for commercialisation, technology transfer offices can be engaged. A co-created quality assurance process for managing global labs with industry partners will also be developed.

Global Labs build the innovation skills of students, provide an accessible 'internationalisation at home'

experience on a much wider scale than current Erasmus+ mobility participation.

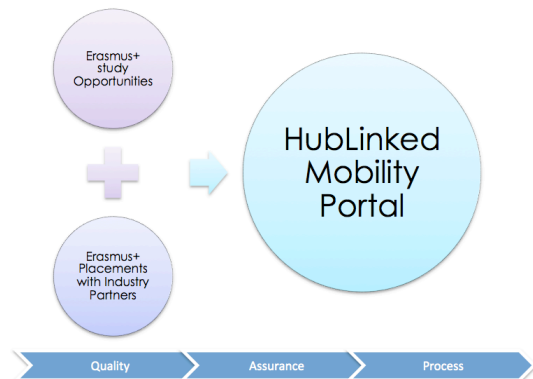
**Figure 4 Global Labs**



## 7. Strategic Mobility Network

While there are several EU initiatives promoting internships (e.g. Eurasmus.com), the strategic approach of developing a mobility network between major international ICT hubs is innovative. Each HubLinked placement will ensure that students gain experience of at least two major ICT hubs and gain global software innovation skills by (i) in-company placement or (ii) a study placement undertaking the HubLinked pathway in the HE partner. A quality assured placement management process will be designed, tailored to the needs of different types of companies, informed by the research on effective U-I Linkages and the EUEN project.

**Figure 5 HubLinked Mobility Portal**



Offering placement opportunities closely linked to professional career paths in major software hubs will help address the underrepresentation of CS students

in the Erasmus+ programme. This addresses the need to produce CS graduates with intercultural and linguistic skills and make CS programmes more attractive for females.

## 8. Staff Development

The Staff Development programme is innovative as it also adopts the integrated 4 I's approach (industry, international, innovation, interdisciplinary) and is delivered online using the Global Labs model. Staff development in the CS discipline tends to focus on technical upskilling and/or pedagogical skills training.

Informed by the U-I Linkages research, and building on professional development activities in the partners the online professional development for academic and industry staff will provide staff with the skills needed to engage effectively in U-I linkages for software innovation. It will also assist in building relationships between CS Faculty and companies, upskill HE staff to deliver the CSI4 curriculum, develop the innovation skills of staff and share experiences between regions. The Global Software Innovation module (5 ECTS) will cover models for U-I linkages, software innovation management and legal aspects (e.g. Intellectual Property, Confidentiality and Non-disclosure Agreements). Participants will work on a Team Project (5 ECTS) on a common challenge (technical or non-technical) (e.g. topics might include developing international competencies, new technologies and new curriculum content.). HE staff (in a variety of roles such as teaching, researcher, technicians, in support offices etc.) will have the option of incorporating an Erasmus+ staff exchange so that in addition to their teaching duties, staff can help progress HubLinked objectives as part of their exchange and further develop Communities of Practice.

## 9. Conclusion

Although at an early stage, HubLinked builds on best practice in this domain and offers significant potential for global entrepreneurial talent management in the software sector. In addition to the four major industry partners, each higher education partner has an extensive network of industry partners and campus incubation units. We estimate the HubLinked partnership can directly reach over 3,000 companies, 12,000 students and 400 staff during the lifetime of the project. HubLinked will create a network of European and Korean ICT professionals that will increase the innovation capacity and

competitiveness of European software hubs and help underpin education, research, innovation, trade and economic development for years to come.

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