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# Innovation, graduate labour markets and regional economic development

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# Abstract

This paper uses Waterford Institute of Technology (WIT) (now part of South East Technological University, SETU) as a case study to explore the extent to which graduates from HEIs contribute to the innovative capability and capacity in the region in which they are educated. The overall focus is on how HEIs contribute to regional human capital and knowledge endowments in their own and neighbouring regions through retention, inflows and outflows. When these impacts happen, as in the case of WIT, HEIs contribute to the growth and development of high-tech, knowledge-driven, high-growth enterprises in their home region.


## 1 Introduction

It is broadly accepted that innovation is a key and critical element leading to regional and national economic development and competitiveness (Dereli, 2015; Pons, 2014; OECD, 2007). Furthermore, it is broadly understood that innovation in technology and technology-related enterprises often depends on the relevant accumulation, development, exchange and transfer of knowledge between Higher Education Institutions (HEIs) and industry actors. Just like any other large organisation in a region, HEIs produce highly localised conditions for knowledge accumulation (Cooke, 2007). They do this through their dual roles of teaching and research. These roles of human capital formation and innovation include some of the various roles of universities as 'anchor institutions' (Assimakopoulos, et al., 2022). For example, recruiting and retaining graduates within the local labour market thereby provides a pool of talent that may attract new companies as well as increases the propensity of existing companies to remain in the region.

Advantages of having close proximity between industry and universities leading to the increase of human capital and regional economic development has been demonstrated in many contexts (Harrison and Turok 2017; Haapanen and Tervo, 2012; Venhorst et a., 2011 and Breznitz, et al., 2022). However, whilst evidence does exist that HEIs contribute significantly to regional economic development through their graduates (Rérat, 2014, Krabel and Flöther, 2012, Venhorst, et al. 2011, and Venhorst, Van Dijk and Van Wissen, 2010), the extent to which graduates from HEIs contribute to the innovative capability and capacity in the region in which they are educated is less well explored.

This paper, therefore, using Waterford Institute of Technology (WIT) (now part of South East Technological University, SETU) as a case study, begins to address this deficit. While Champion et al. (2024) focused on university-related migration in the UK, this paper presents a dual perspective using data on human capital (skills) and on industrial structures to address the question: *What has WIT contributed to its region, the South East of Ireland, in terms of innovation?* In doing so, it adds value to existing literature on innovation systems by reflecting on the different phases of the process.

To perform the first element of the analysis, the demographics of WIT's undergraduates and first destination jobs of its graduates from 2011 to 2017 is explored within the context of Ireland's changing Higher Education landscape and

policy agenda using data on the growth of high-tech enterprises in South East Ireland. Upskilling the local economy is an explicit objective of WIT. Therefore, this analysis can be seen as a 'micro-mission' which is defined as 'missions to address specific place-based issues at subnational scales' (Henderson et al., 2023, 208). A factor considered is how national higher education policy affects HEIs' 'anchor' missions'.

The study's starting point, 2011, was a significant year in Ireland. In January 2011, a new *National Strategy for Higher Education to 2030* was published, establishing the long-term goals and expectation of HEIs, setting the parameters and the paradigm within which individual HEIs and the sector as a whole would function. In part the strategy was informed by the economic turmoil after the demise of the "Celtic Tiger" and the demands for increased efficiency and effectiveness within the public service. HEIs were not alone in this period in feeling the impact of government austerity. A new government was formed in February 2011 and, from a HE point of view, continued the policies in the national strategy of the previous government.

The new government issued a *Programme for Government* which focused on job creation, support for Research & Development and the introduction of initiatives to encourage the creation of new and the expansion and growth of existing enterprises. Influenced by the Programme for Government 2011, the Higher Education Authority (HEA) of Ireland published a policy document *Towards a Future Higher Education Landscape* in February 2012, essentially an addendum to the national strategy. These documents had a significant impact on Ireland's economic recovery.

Since 2011, HEIs in Ireland have been operating within a policy and strategy framework that; (a) insists on HEIs taking a role in driving economic development as a priority, (b) compels HEIs to work closely with other partners to identify and address the needs of enterprises, (c) focuses on developing the necessary skills within the labour force to meet enterprise needs, either through modifying existing educational programmes or developing new bespoke enterprise-facing programmes and; (d) supports innovation-centredness of the future Irish economy (see National Strategy[1]).

This paper proceeds as follows. Following the introduction is the paper's theoretical frame. Next, Ireland's higher education landscape is presented. The methodology and data analysis section contains details about WIT as well as South East Ireland's graduate and industry profiles. The paper concludes with a discussion on WIT's contribution to innovation-led regional economic development.

## 2.Theoretical framing: Universities, human capital and regional anchors

According to Faggian et al. (2019), the critical role that HEIs play in regional development is to interact with their regions to generate multiplier effects, through innovation particularly in high tech sectors. Different theories consider the role of HEIs in high-tech industry sectors and regional economic development, such as (i) human capital; (ii) systems of innovation; and (iii) anchor institutions.

[1] National-Strategy-for-Higher-Education-2030.pdf

A key component of multiplier effects is through the provision of high-skilled labour to different regions. HEIs are expected to continuously produce graduates who will advance innovation and develop new technologies to increase the sustainable economic development of the region in which they are based (Harrison and Turok, 2017, Leyden and Link, 2013).

## 2.1 Human capital

Within the context of human capital theory, Schultz (1961) and Becker (1964) posited that education can improve people's skill levels and thereby the human capital of localities and regions, directly and indirectly. Relevant effects include improving productivity and innovation capacities. Contextual factors include human capital migration, location and sector.

Human capital accumulation can play a direct effect because graduates can play a pivotal role in boosting the economic growth of their local economies through their contributions to improving innovation-led productivity (Champion et al. 2023). This is in addition to other effects arising from employment of people such as lecturers, researchers, engineers, technicians, administrative staff, service providers (such as caterers, cleaners, grounds' staff) and the knock-on effect of creating additional jobs in enterprises supporting the HEIs' operational activities and staff social and living needs (Rérat, 2014; Krabel and Flöther, 2012; Lindahl and Canton, 2007). Furthermore, other qualified and experienced people will be attracted into a HEI's city and region.

Human capital migration involving movement of people into a region is another relevant aspect of human capital theory. The concept was introduced by Sjaastad (1962) who suggested that migration and education acquisition are investment options with associated costs and returns. In general, while labour is particularly mobile between regions in the same country, it also moves abroad. The decision to migrate happens only when the net present value of a migration investment is positive. In this sense, high-skilled labour is more likely to migrate because of lower costs (of moving to another region/jurisdiction) and higher returns (Faggian et al., 2019). The reasons for these differences are fourfold (Table 1).

| **Decision to migrate** | **Explanation** | **Reference** |
|---|---|---|
| Lower information costs | education allows easier and less costly access to information | Levy and Wadycki, 1974 |
| Adaptability | high-skilled people are more receptive to change | Wadycki, 1974 |
| Path-dependency | when people start to leave their place of origin to study in another place it becomes easier for other people to follow them | DaVanzo, 1983 |
| Lower risk | due to more and better chances to find a job in the new destination | Faggian, et al., 2019 |

Table 1 Decisions to migrate

Empirical approaches to human capital migration research include inward, outward and return. For example, Rérat (2014) explored the propensity of young graduates to return to their rural home region by comparing graduates' current place of residence with characteristics related to their socio-familial, migration and professional trajectories. The propensity varies not only within labour market variables

(employment opportunities), but also with other factors such as a graduate's life course position, their partner's characteristics and their family background.

Haapanen and Tervo (2012) examined the inter-regional migration of university graduates in Finland 1991-2003). Their results show that two-years before and during the graduation year the "hazard rates" of migration (i.e. the probability of a person migrating to elsewhere) increase and then decrease thereafter. In addition, the mobility of university graduates from their region of studies decreases considerably within 10 years of graduation. They found that migration is significantly higher among graduates from universities in peripheral regions than among those located in growth centres or for those studying away from their home region.

Krabel and Flöther (2012) investigated German graduates' mobility when entering the labour market using a large survey-based dataset from 36 universities. Based on both employability and the likelihood of a graduate to leave the university region after securing a job, they found that characteristics of the university region and graduates' contacts with local employers are key determinants of mobility.

Venhorst et al., (2011) investigated the relationships between migration and both regional economic circumstances and individual characteristics through a micro-dataset of Dutch college and university graduates. Based on their study of 183,000 graduates (college 120,000; and university 63,000) (ROA School-leaver Information System) from the period 1997-2008, they examined the determinants for regional migration. They found that the presence of a large labour market is the most important economic determinant for regional migration. Other factors having an effect on migration are: (i) the type of HEI, for example university graduates are more likely to move than college graduates; (ii) gender, male graduates are more mobile than female graduates; (iii) education background, graduates from the sciences are more likely to migrate than those from behavioural and social sciences; and (iv) grades, graduates with higher grades are more likely to move abroad than graduates. They also found that, usually, over 50% of university graduates in economics and agriculture move to another region; while 70% of university graduates in healthcare, and behavioural & social sciences (mainly psychologists) stay in the study region.

Other research has identified intra-regional spillover effects from shorter distance mobility for example between neighbouring regions (Lawton Smith and Waters 2021; Champion et al., 2024). Social factors can influence those decisions. Champion et al. (2024) also point out that decisions also vary with personal characteristics including gender, ethnicity and family background. This may in turn relate to industrial structure (for example, effects of de-industrialisation or location in a remote area with relatively small local labour markets).

### 2.2 Systems of innovation

Interpreting innovation processes within a region through a focus on HEIs lends itself to an innovation system perspective. According to Mercan and Göktas (2011), an innovation ecosystem consists of economic agents and economic relations as well as non-economic aspects such as technology, institutions, sociological interactions and a culture of innovation. Oh et al., (2016), suggest that there are six distinguishing features of innovation ecosystems: (a) they are more explicitly systemic in that

innovation diffuses through a social system and through connections among the many innovation actors; (b) there is a focus on digitalisation in that Information and Communication Technologies (ICT) plays a prominent role in the creation and development of new products and services, and in connecting the innovation actors; (c) open innovation is critical as it allows ideas from diverse sources to be combined into new products and services; (d) the term 'innovation ecosystem' is valued and embedded by the general public and denotes a 'public relations value' in the uses of the term; (e) there is a greater emphasis on differentiated roles or niches occupied by organisations and industries within the system which can correspond to links in industry value chains; and (f) within innovation ecosystems there is a greater focus on market forces compared to government driven agendas.

Critically, university-industry collaboration is an important factor due to the traditional function of universities providing qualified labour for private and public sector organisations. University teaching and increasing human capital thereby contribute systemically to innovation process, through transfers of knowledge. Students' and graduates' contributions to regional economic development stemming from how what they are taught feeds into economic and innovation activity in employment, from their increasing propensity to be entrepreneurial, and as contributors to local labour markets.

From a regional innovation systems (RIS) approach: university academics' region-based networks operating through joint research programmes, policies, and social networks in an institutional milieu, "combine learning with upstream and downstream innovation capability" (Cooke and Morgan, 1998, 71). Reichert (2019) adopted an explicit RIS approach to exploring how universities work in their regional environment including aspects of the teaching of students. She highlighted the role of students as active participants in the RIS: "Students are strongly motivated by challenge-driven approaches, in learning and teaching as well as in their entrepreneurial initiatives" (p.8). Through such mechanisms, knowledge in a RIS becomes the *most strategic resource and learning the most important process* of economic development (Breznitz et al., 2022). Breznitz et al argued that the role of universities in RIS has tended to over-emphasise the role of research and third mission activities such as academic spin-offs and various forms of contractual relationships compared to relationships based on teaching and research.

Even though the role of HEIs varies by region, best examples comprise HEIs having an essential role in infusing the region with knowledge, resources and co-creation and renewal capabilities. This in effect is an entrepreneurial ecosystems approach such as that adopted by Wright et al., (2017). Their analytical focus on university students in entrepreneurial ecosystems identified entrepreneurship courses, incubators, accelerators, grants, and business plan competitions as ways in which students participate in experiential learning. Thus, according to Markkula and Kune (2015), the main role of HEIs should be as the knowledge-exchange platform provider of the region, which includes: (i) connecting generations, people to processes, knowledge to process and ecosystem partners to each other; (ii) infusing the region with knowledge and understanding, and enhancing smartness and intelligence in the older sense of thinking and knowing; (iii) learning from curriculum and practice and making this learning accessible throughout the ecosystem; (iv) keeping active foresight and be early-warning facilities for the regions and the communities they serve; and (v)

helping young people to prepare for opportunities of many possible futures including career options.

### 2.3 Anchors, micro-missions and "sticky" regions

Building on both human capital and innovation ecosystems approaches is the role of HEIs as anchors in developing "sticky regions". Universities and colleges are locationally- fixed anchor institutions (see Hayes, 2022). The concept of anchor organisations, such as 'anchor institutions' and 'anchor firms' emerged in the 2000s as a new way of understanding the role that place-based keystone research organisations and major firms play in building successful local economies and communities. Assimakopoulos et al. (2022) illustrate how anchors can play a crucial role in terms of bringing about different kinds of interconnectivity within clusters.

Anchor characteristics include spatial immobility, embeddedness in the local economy and community, and having a large resource base that is manifested in local purchasing, employment and business support across large and small actors alike. As Henderson et al. (2023) point out, universities represent anchors through their broad range of expertise and may act as brokers in bringing together different local actors including academics, policymakers and practitioners. The role of HEIs as regional anchors varies according to national policy agenda.

HEIs, by accident or design, often serve as agents of change through their gatekeeping role as anchors of absorptive capacity (Cohen and Levinthal 1990) within a region. Their agency (through internal leadership) can be variously that of initiators, catalysts, consolidators or sustainers. They raise the level of absorptive capacity in firms because of their teaching and research but they also involve reflective and reflexive engagement with firms and policy makers. This feeds back enabling learning processes within HEIs which they continue to circulate with the organisations involved.

This in turn relates to the quality of institutional arrangements for engagement, the autonomy of universities to decide their own teaching and research agenda as well as national education priorities and through, for example, the adaptation of teaching to reflect local demand by supplying industry with skill sets that are inter-related with research and hard information. The perspective is that multiple sources of knowledge flows and flexible institutional settings in universities, firms and policy action have the effect of re-contextualising and diffusing knowledge within localities and regions (Vale and Carvalho, 2013).

The concept of 'anchor firms' was introduced to explore the regional concentration and specialisation of emerging industries (Feldman, 2003). There is a clear link to human capital theory as such firms attract skilled labour pools and provide knowledge spillovers that benefit regional firms active in key enabling technologies (KETs) (Niosi and Zhegu, 2010). They also have a key role as technological gatekeepers, acquiring knowledge outside cluster boundaries and contributing to diffusing knowledge to other local firms over time (Giuliani, 2011). In many industries knowledge flows in innovation processes retain a distinct localised nature, focusing on the knowledge mediating roles of focal firms in industrial districts, as technological 'gatekeepers' (Munari et al., 2011).

Anchor organisations, therefore, often facilitate the mobility of innovation knowledge in clusters both technical and organisational, through churn of academic staff (Kasabov and Sundaram, 2016) and through both retaining graduated students and through attracting new people to the region. Thus, to varying extents HEIs form part of the gravitational field, along with local authorities and embedded major firms, that under certain conditions ties and develops innovation-based economic activity in regions. In turn such active and flexible roles have an impact on the quality of institutional environments (Nifo and Vecchione, 2014) for example, *better institutions beget a better business environment*.

Concepts of human capital, systems of innovation and anchor institutions intersect. This is because through the institutionalisation of region-based innovation ecosystems wherein universities play an active role in human-capital led local innovation, systematic interactions become institutionally embedded between organisations (Asheim et al., 2019). Interactions create reiterative activity whereby graduates stay by being recruited into local (anchor) firms, working relationships become effective and self-sustaining in turn creating an enabling environment with more opportunities happen.

## 3.Higher education, human capital and enterprise policy in Ireland

The expectations of HEIs in Ireland on enterprise and innovation have undergone a significant shift in recent years. In effect there has been a recalibration of the role and functioning of HEIs, particularly since the economic crash of 2011. Of relevance are: (a) the overarching approach to higher education in general as articulated in the *National Strategy for Higher Education to 2030*; (b) the focus of the various innovation-related strategies published by the Irish state; and (c) the approach to skills development nationally and regional manifestations of that approach, in the shape of Regional Skills Forums which brings employers and the education and training system together, to identify and meet the emerging skills need for their region[2]. However, the objectives of Irish universities set out in legislation make only very general reference to a relationship between the institution, enterprise and innovation. In the legislation universities are only required "to support and contribute to the realisation of national economic and social development" (Universities Act 1997, 12 (f)).

Institutes of Technology (IoT) operate under different legislation and with a more specific role. They provide human capital and are key actors in innovation systems as anchor institutions: "The principal function of a college [later, an IoT] shall […] be to provide vocational and technical education and training for the economic, technological, scientific, commercial, industrial, social and cultural development of the State with particular reference to the region served by the college" (RTC Act 1992, 5 (1)). The emphasis in policy guiding all HEIs, universities included, in more recent years has put much greater focus on the latter set of requirements—insisting on a greater emphasis on an approach normally associated with Institutes of Technology across *all* higher education.

[2] See https://www.neh.gov.ie/business-supports/regional-skills-fora

IoTs in Ireland established initially as Regional Technology Colleges (RTCs) were charged with the provision of largely vocational education in the regions where they were located. 1993 there were 13 RTCs, up from the initial 7. The re-badging as IoTs in the late 1990s, reflected the requirement that the organisations retain a focus on STEM-related education while recognising that most of the RTCs had long outgrown their initial missions as training colleges and were now attracting international students, offering degree programmes (some offering programmes up to PhD) and conducting research.[3]

The *National Strategy for Higher Education to 2030* (2011)[4] outlined a significant shift in policy that opening up opportunities for IoTs to be re-designated as universities but only (i) in the context of institutional consolidation and merger (with a list of potential mergers set out in a parallel policy document, "Towards a Future Higher Education Landscape" (2012)[5]. While flagged as a "possible configuration", this list acquired the status of policy position), and (ii) on the achievement of certain performance standards. Legislation was put in place in 2018 to allow for the creation of Technological Universities (TUs) and, to date, there is only one remaining IoT (Dundalk).

The establishment of TUs was seen as a critical contribution to the growth of Ireland's regions and a vehicle to achieve the "balanced growth" targets of Ireland's national development plan to 2040, *Project Ireland 2040.*[6] In broad terms, the development plan seeks to disrupt existing growth patterns that focus growth on Dublin and to strengthen regional population and economic development as alternative centres of gravity. The legislation establishing the TU sector is explicit in orienting the new institutions towards regional development. It specifies that all functions of the new university should have "particular regard to the needs of the region in which the campuses of the technological university are located" (Technological Universities Act 2018, 9(1)[7]).

By 2025, there were five TUs in Ireland with strong regional focus, remits largely inherited from their legacy institutions and missions focussed on regional human capital and economic development with an emphasis on innovation (especially STEM) and entrepreneurship. Deeply embedded in the strategy is the insistence on the role of HEIs in economic recovery and economic development, with a very strong emphasis on the critical need for the provision of high quality, highly skilled graduates to the labour force. A challenge, therefore, set out by the strategy is for HEIs to develop new approaches to curriculum development and research that will "bring increasing numbers of citizens up to the skill and competence levels associated with labour force competitiveness in the modern era" (p.39). Recommended actions to meet this challenge include greater flexibility in programme provision, enhanced collaboration between employers and academics in programme design and delivery, more internship and work placement opportunities, and a range of other measures.

Various action plans published by the Department of Education have sought to give substance and focus to the delivery of the Hunt Report's strategic goals. Amongst the

[3] See Thorn, R. (2018) *No Artificial Limits: Ireland's Regional Technical Colleges*. Dublin: IPA.
[4] National-Strategy-for-Higher-Education-2030.pdf
[5] Towards-a-Higher-Education-Landscape.pdf
[6] www.gov.ie/pdf/?file=https://assets.gov.ie/246231/39baaa8c-48dc-4f24-83bd-84bbcf8ff328.pdf#page=null
[7] Technological Universities Act 2018

objectives of the Department's *Action Plan for Education 2016-2019* is "systematically reducing the skills gap in areas of critical skill need in Higher Education by providing for 50,000 upskilling and reskilling places", "Increasing by a quarter the number of students undertaking a work placement or work project as part of their third level qualification by 2021", and "Developing a strong stream of employer supported apprenticeships and traineeships, providing places for 13,000 young people in 2020, in 100 career areas". All linked higher education graduate formation with the talent pool. Some of the actions identified in the *Action Plan* that will lead to the achievement of these objectives include "Developing Regional Skills Plans to respond to local needs", "Expanding Skillnets to reach more employers with new options for upgrading skills", and "Increasing the availability of quality entrepreneurship programmes and modules in schools, Higher and Further Education" (pp.3-4).

The higher education strategy echoes Ireland's innovation strategy statements. A 2010 report from a task force on innovation, *Innovation Ireland*, states as one of its principles that Ireland needs "an education system which fosters independent thinking, creativity and innovation" and proposes that "All levels of the education system must contribute to embedding these values in our population from the very young to the older members of our workforce. A particular focus must be on the development of creative, highly-skilled graduates as well as life-long learning, mentoring and continuous professional development" (p.24).

The report goes on to identify four roles for HEIs in fostering innovation. They articulate well the emphasis in higher education policy subsequently. The four roles set out for higher education institutions in *Innovation Ireland* are to: "(i) undertake excellent research, scholarship and teaching across all disciplines, which is reflected in the quality of graduates emerging into the labour market; (ii) develop strong research groups selected for funding in a competitive manner in identified areas of strategic priority which have the capacity to impact on the full research and innovation continuum; (iii) strengthen the commercialisation function and increasingly generate economic value from the intellectual property generated; and (iv) collaborate with and support entrepreneurs and enterprises in research, innovation and commercialisation and provide associated skills through life-long learning." (p.29)

Of particular relevance to this discussion is the emphasis on the provision of high-quality graduates to the labour market. *Innovation 2020: Ireland's Strategy for Research and Development, Science and Technology* (ICSTI, 2015) restates and develops the pillars: "the availability and quality of graduates is essential if we are to maintain our attractiveness as a location for investment" and "the quality of our undergraduate formation is critical to the development of the national talent pool, which, in turn, is essential to our research and innovation success" (p.36).

Consistent with these policies is the approach to skills development set out in the *Ireland's National Skills Strategy to 2025* (DES, 2016). The skills strategy sets out very clearly an objective that "education and training providers will place a stronger focus on providing skills development opportunities that are relevant to the needs of learners, society and the economy" (p.17). This policy also allowed for the creation of a number of "skills forums", regionally based co-ordinating agencies that provide an

interface between employers and further and higher education institutions in identifying and addressing the needs of enterprises at regional level.

The forum in which WIT participates is the South East Skills Forum and it also contains other higher education providers (IT Carlow and Limerick Institute of Technology, LIT, Tipperary Institute), regional education boards with responsibility for further education, the regional Chambers' of Commerce, local authority enterprise support offices (LEOs), the Industry Development Authority (IDA), Enterprise Ireland (EI), Ibec, and local industry representatives.

While the skills forum cannot prescribe the activities of HEIs, participation in the forum is increasingly incentivised through funding, with funding streams being opened up for programmes that are demonstrably linked with regional skills needs (for instance the Springboard funding for return-to-education and upskilling programmes[8]). Whether TUs will satisfy the demands of the region with regard to education and training or whether it will simply replicate the IoTs, is a question this paper and the papers to come in this series will in part reflect on.

## 4. Methodology and data analysis

The methodology employed here is a case study focusing on one HEI in Ireland, Waterford Institute of Technology (WIT). The data reviewed pertained to student enrolments, graduate destinations, and industry stock in South East Ireland. Data sources included WIT, Enterprise Ireland (EI), Industry Development Authority (IDA), South East Skills Forum, Local Enterprise Offices (LEOs), Higher Education Authority (HEA), Department of Enterprise, Trade and Employment (DETE), and the Central Statistics Office (CSO). The approach of using data on the input of skilled labour formed as graduates in a HEI is an indicator of innovation activity in macro-industries of a particular region. It should be noted that the employment of university graduates is only a specific *input* variable, which does not necessarily bring about the output of innovation in all cases in the same degree.

### 4.1 WIT

WIT merits attention for a number of reasons. It was established, along with 6 other RTCs, in 1970; it was dissolved in 2022 with a new institution, South East Technological University (SETU), created in its place. WIT was unique, however, in being the only RTC (subsequently the only IoT) located within an Irish city where there was no university: all other Irish major cities contained *both* a university and an IoT.[9]

The expectations from WIT with regard to the development of the city and the wider region. were thus exceptional and led to WIT developing an unusual profile. It was particularly distinguished in research and outperformed most IoTs and a number of universities in some research metrics; regional demand for high-end knowledge generation and transfer compelled WIT to invest heavily in research infrastructure

[8] See https://www.education.ie/en/Learners/Information/Upskilling-and-Training-options/Springboard.html

[9] The cities of the Republic of Ireland are, in order of size: Dublin (c.1.2 million population); Cork (c.200,000); Limerick (c.95,000); Galway (80,000); Waterford (55,000). The South East remains unique in being served currently by only one university, SETU, while all other Irish regions are served by at least two.

over several decades.[10] It also had a unique undergraduate programme portfolio, with courses available not normally associated with an IoT where programmes were traditionally focused on vocational, applied learning with an emphasis on STEM. Rather, WIT also offered programmes in liberal arts, including a traditional Arts degree, degrees in Psychology, Architecture, Social Science, and Spirituality and Religious Studies. Moreover, Humanities, Social Science and Business students made up just under half of all WIT undergraduate enrolments.

WIT also had a long history of offering graduate programmes, including PhDs, and was amongst the first institutions in the IoT sector to offer doctoral education. Thus WIT had the appearance of a university notwithstanding operating within the IoT tradition and legislative space.

### 4.2 South East Ireland industry, student and graduate profiles

In 2004, of the 307 enterprise that were receiving support from Enterprise Ireland (EI)[11] 2 (0.65%) were classified as software and 8 (2.6%) as electronics. In the same year 54 (8%) of the 678 enterprises supported by the City & County Enterprise Boards (CEBs)[12] were software related and 17 (2.5%) were electronics. High-tech and ICT (information communication technology) enterprises were then scarce in South East Ireland. Most of those classified as software enterprises were either website developers or marketing agents. Until 2004 there were no Financial Services or Medical Devices enterprises in the South East; but there were 4 Health/Pharmaceutical companies.

Based on an analysis by Dee (2004), the disposable income in the South East was only 88% of the national average. In 2004, even though there were two IoTs in the region, the participation rates of those eligible to attend third level colleges was only average compared with the rest of the country. It was estimated that 50% of 2nd level schools' leavers who attended 3rd level colleges did so outside the region; and 60% of those who graduated from the 3rd level colleges in the region left the region to find employment. The rate of unemployment in the South East Region, at almost 6%, was greater than the national average of less than 4%. Over 10% of the working population were directly employed in agriculture and forestry. Another 10% were involved in the construction industry with 19% of the working population employed in manufacturing.

However, 37% of these manufacturing companies were engineering companies, most of which were servicing the agri-business sector. The remainder of those employed in the region were in service-related industries including wholesale/retail, tourism and transport, financial and business services, education and health, and public administration. In general, 61% of the working population was employed by indigenous industries and 39% by foreign owned companies.

[10] See for instance the Interim Report of Irish Involvement in Horizon 2020, the European Union Framework Programme for Research and Innovation (ECORDA Last Update: 03/09/2019), published by Enterprise Ireland.
[11] Enterprise Ireland (EI) is the state agency responsible supporting Irish owned SMEs (employing more than10 people)
[12] The City & Country Enterprise Boards (CEBs) were responsible for supporting local micro-enterprises (employing less than 10 people). In 2014 the CEBs became part of local authorities in each country in Ireland and were renamed Local Enterprise Offices (LEOs).

Over half, 53%, of the indigenous companies had fewer than ten employees, and 31% of the foreign owned companies employed fewer than fifteen people. In total 85% of the indigenous companies and 55% of the foreign owned companies employed fewer than fifty people each. These firms do not meet the profile of ‘anchor firms’. This designation could only be applied to the 2% of the indigenous and 19% of the foreign owned companies that employed more than 200 people. Of these, only 14% of the companies in the South East Region were foreign-owned multinationals. This was significantly less than in the other regions of Ireland. However, as Tables 1, 2 and 3 show, the industry profile in Ireland and the South East changed between 2004 and 2024.

## Table 1: Total Sales of Goods Produced and Services Provided (including sales to the dairy board) in €m

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Food, Drink & Primary Production | 5.7 | 5.9 | 6.7 | 6.1 | 8.1 | 7.0 | 6.1 | 6.0 | 7.3 | 7.3 | 8.2 | 8.2 | 8.3 | 8.2 | 7.6 | 7.6 | 7.2 | 7.2 | 8.6 | 9.6 |
| % of Total | 6% | 6% | 6% | 6% | 7% | 6% | 5% | 5% | 5% | 5% | 6% | 5% | 4% | 4% | 3% | 3% | 2% | 2% | 2% | 2% |
| Traditional Manufacturing | 5.1 | 5.0 | 5.3 | 5.4 | 5.1 | 3.7 | 4.5 | 4.9 | 4.9 | 5.0 | 5.8 | 6.9 | 7.0 | 7.4 | 7.7 | 6.1 | 5.9 | 6.6 | 7.6 | 7.7 |
| %of Total | 6% | 5% | 5% | 5% | 4% | 3% | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 3% | 3% | 2% | 2% | 2% | 2% | 2% |
| Modern Manufacturing | 49.7 | 52.4 | 54.5 | 57.9 | 58.2 | 52.6 | 55.9 | 59.0 | 56.7 | 51.6 | 51.9 | 62.0 | 67.5 | 73.5 | 88.7 | 88.9 | 95.9 | 100.3 | 111.4 | 118.4 |
| % of Total | 54% | 53% | 51% | 50% | 49% | 48% | 49% | 47% | 42% | 38% | 35% | 36% | 35% | 34% | 36% | 31% | 31% | 28% | 28% | 28% |
| Energy, Water, Waste & Construction | 0.01 | 0.01 | 0.1 | 0.2 | 0.1 | 0.01 | 0.01 | 0.1 | 0.01 | 0.01 | 0.1 | 0.01 | 0.1 | 0.1 | 0.4 | 0.3 | 0.4 | 0.3 | 0.2 | 0.2 |
| % of Total | 0.1% | 0.1% | 0.11% | 0.14% | 0.11% | 0.06% | 0.05% | 0.09% | 0.07% | 0.07% | 0.07% | 0.05% | 0.05% | 0.05% | 0.15% | 0.12% | 0.14% | 0.10% | 0.05% | 0.04% |
| Information & Communication Services | 28.8 | 31.6 | 37.5 | 41.8 | 43.9 | 42.1 | 45.0 | 53.1 | 62.4 | 68.7 | 77.0 | 90.0 | 102.2 | 114.9 | 132.2 | 168.5 | 184.7 | 230.6 | 254.3 | 258.8 |
| % of Total | 31% | 32% | 35% | 36% | 37% | 38% | 39% | 42% | 46% | 50% | 52% | 52% | 53% | 54% | 53% | 59% | 60% | 64% | 63% | 62% |
| Business, Financial & Other Services | 2.7 | 3.1 | 3.5 | 4.1 | 3.8 | 4.1 | 3.4 | 3.5 | 3.2 | 3.5 | 4.4 | 6.3 | 7.8 | 9.2 | 11.3 | 13.3 | 13.9 | 17.4 | 21.4 | 23.7 |
| % of total | 3% | 3% | 3% | 4% | 3% | 4% | 3% | 3% | 2% | 3% | 3% | 4% | 4% | 4% | 5% | 5% | 5% | 5% | 5% | 6% |
| **Grand Total** | **92.1** | **98.0** | **107.5** | **115.9** | **119.3** | **109.6** | **114.8** | **126.7** | **134.8** | **136.2** | **147.3** | **173.5** | **192.9** | **213.3** | **247.8** | **284.7** | **308.0** | **362.4** | **403.5** | **418.4** |
| **South-East** | **2.5** | **2.1** | **2.2** | **2.7** | **3.1** | **2.8** | **3.2** | **3.5** | **3.8** | **4.2** | **4.2** | **4.4** | **5.6** | **8.0** | **10.5** | **14.4** | **16.8** | **14.1** | **12.0** | **8.2** |
| **% of Total** | **2%** | **2%** | **2%** | **2%** | **3%** | **3%** | **3%** | **3%** | **3%** | **3%** | **3%** | **3%** | **3%** | **4%** | **4%** | **5%** | **5%** | **4%** | **3%** | **2%** |

*(Source: adapted from Department of Enterprise, Trade and Employment, 2025)*

## Table 2: Total Employment in ‘000

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 20`7 | 20`8 | 20`9 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Food, Drink & Primary Production | 8.9 | 9.5 | 10.5 | 9.7 | 10.3 | 9.8 | 9.3 | 9.0 | 8.2 | 8.2 | 8.3 | 7.9 | 7.9 | 7.3 | 7.4 | 7.8 | 7.5 | 7.5 | 7.5 | 7.7 |
| % of Total | 6% | 6% | 7% | 6% | 7% | 7% | 7% | 6% | 5% | 5% | 5% | 5% | 5% | 4% | 4% | 4% | 3% | 3% | 3% | 3% |
| Traditional Manufacturing | 24.5 | 23.7 | 22.9 | 21.7 | 19.7 | 16.6 | 16.5 | 17.0 | 16.4 | 16.6 | 16.3 | 17.1 | 16.8 | 18.0 | 18.1 | 17.4 | 17.4 | 17.2 | 18.2 | 18.7 |
| % of Total | 16% | 15% | 15% | 14% | 13% | 12% | 12% | 11% | 11% | 11% | 11% | 10% | 10% | 10% | 9% | 8% | 8% | 7% | 7% | 7% |
| Modern Manufacturing | 67.9 | 69.3 | 67.6 | 70.5 | 68.1 | 62.9 | 58.4 | 59.4 | 57.4 | 57.2 | 57.0 | 58.0 | 60.4 | 62.7 | 67.5 | 70.2 | 80.3 | 82.1 | 88.9 | 89.9 |
| % of Total | 45% | 45% | 44% | 46% | 45% | 44% | 41% | 40% | 38% | 38% | 37% | 35% | 35% | 34% | 34% | 33% | 35% | 34% | 34% | 34% |
| Energy, Water, Waste & Construction | 0.7 | 0.6 | 0.6 | 0.6 | 0.6 | 0.4 | 0.2 | 0.5 | 0.4 | 0.6 | 0.4 | 0.4 | 0.4 | 0.7 | 0.9 | 0.7 | 0.5 | 0.7 | 0.6 | 0.7 |
| % of Total | 0.48% | 0.44% | 0.42% | 0.41% | 0.42% | 0.29% | 0.20% | 0.34% | 0.29% | 0.42% | 0.27% | 0.26% | 0.26% | 0.37% | 0.46% | 0.33% | 0.23% | 0.27% | 0.23% | 0.26% |
| Information & Communication Services | 37.5 | 39.6 | 38.7 | 38.4 | 39.9 | 36.3 | 41.2 | 45.4 | 49.4 | 51.9 | 53.4 | 58.3 | 61.7 | 68.7 | 74.6 | 83.1 | 92.3 | 98.6 | 105.3 | 104.1 |
| % of Total | 25% | 26% | 25% | 25% | 26% | 25% | 29% | 31% | 33% | 34% | 35% | 36% | 36% | 38% | 38% | 40% | 40% | 40% | 40% | 39% |
| Business, Financial & Other Services | 9.8 | 10.9 | 12.0 | 12.9 | 13.2 | 17.0 | 15.8 | 17.0 | 18.3 | 17.2 | 19.3 | 22.4 | 23.9 | 24.7 | 27.3 | 31.0 | 32.3 | 37.4 | 41.1 | 42.7 |
| % of Total | 7% | 7% | 8% | 8% | 9% | 12% | 11% | 11% | 12% | 11% | 12% | 14% | 14% | 14% | 14% | 15% | 14% | 15% | 16% | 16% |
| **Grand Total** | **149.4** | **153.7** | **152.3** | **153.9** | **151.8** | **143.1** | **141.5** | **148.4** | **150.2** | **151.8** | **154.8** | **164.1** | **171.2** | **182.1** | **195.8** | **210.2** | **230.4** | **243.4** | **261.8** | **263.7** |
| **South-East** | 10.4 | 10.6 | 9.8 | 9.8 | 9.3 | 8.5 | 8.6 | 8.6 | 8.5 | 8.8 | 8.9 | 9.2 | 9.7 | 10.1 | 10.2 | 13.1 | 13.8 | 12.9 | 13.9 | 14.0 |
| **% of Total** | 7% | 7% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 5% | 6% | 6% | 5% | 5% | 5% |

*(Source: adapted from Department of Enterprise, Trade and Employment, 2025)*

## Table 3: Total Sales per Person Employed in Manufacturing and Int. Traded Services in ‘000

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total – All Ireland | 617 | 638 | 706 | 753 | 785 | 766 | 812 | 854 | 898 | 898 | 952 | 1,057 | 1,127 | 1,171 | 1,266 | 1,354 | 1,337 | 1,489 | 1,541 | 1,587 |
| South-East | 196 | 201 | 226 | 280 | 333 | 335 | 376 | 411 | 454 | 480 | 477 | 481 | 581 | 788 | 1,029 | 1,093 | 1,213 | 1,098 | 864 | 583 |

*(Source: adapted from Department of Enterprise, Trade and Employment, 2025)*

Table 1 shows that the percentage of sales from goods and services provided in Traditional and Modern Manufacturing which has been declining continuously from 2004 to 2023. By contrast, the value of sales has increased dramatically in Modern Manufacturing compared to Traditional Manufacturing.

In the service sector, the percentage of sales of Information & Communication Services in relation to Ireland's total sales figures has been continuously increasing from 2004 to 2023. Values of sales for both Information & Communication Services sectors have been steadily growing since 2004 even during the economic crisis period 2008 to 2011. The increase in sales value has also increased steadily from 2004 to 2022 in the South East regions. This may reflect the growth in ICT, Financial Services, Medical Devices and Pharmaceutical industry sectors, especially since 2011, possibly spurred by the 2011 New Programme for Government.

Table 2 shows similar reductions and increases in the levels of employment by each industry sector. The South East, however, shows a steady decline in employment between 2008 and 2012. This may be due to the fact that the hardest hit industry sectors during the economic crisis were Construction and Tourism; upon both of which the South East was heavily reliant. However, since 2013, there has been a steady increase in employment. Table 3 shows that the South East had a steady increase in Total Sales per Person Employed in Manufacturing and International Traded Services, especially since 2001. This may be the result of changes in low value-add and construction industry jobs to more high value-add jobs in the more R&D intensive sectors ICT, Financial Services, Medical Devices and Pharmaceutical sectors.

We contend that the three Technology Gateways[13] based in WIT have had significant inputs into changing the South East's industry sectors' profile. Each of the three Technology Gateways was closely aligned and integrated with a relevant WIT faculty. Therefore, the research activities of each had an impact on human capital development and systemic change. Education programmes generated highly educated and skilled graduates and postgraduates in Information & Communication Systems; Pharmaceutical & Molecular Biotechnology and; Advanced Manufacturing & Applied Materials. In 2022, there were over 30 SMEs and large Technology companies in the South East[14].

In particular, the TSSG[15] (founded in 1996) had a significant systemic impact on the South East's ICT landscape. TSSG built a community of researchers and innovators. From 2004 to 2014 it had spun-out 10 companies directly from TSSG and created 600 jobs in the region (Silicon Republic, 2014). The methodology and framework pioneered by TSSG enabled the creation of PMBRC[16] and SEAM[17].

[13] The Technology Gateways Programme is an Enterprise Ireland initiative that is co-financed by the Government of Ireland and the European Union through the ERDF Southern, Eastern & Midland Regional Programme 2021-27 and the Northern & Western Regional Programme 2021-27. In 2004 there were 17 such centres spread across the 13 Institutes of Technology. There of which were based in Waterford Institute of Technology (WIT).
[14] See https://www.idaireland.com/latest-news/infographics/tech-companies-in-the-south-east-map
[15] TSSG – Telecommunications Software & Systems Group
[16] PMBRC – Pharmaceutical & Molecular Biotechnology Research Centre was established in 2009
[17] SEAM – South Eastern Applied Material Research Centre was established in 2009

Compared to the dearth of FDI companies in the South East in 2004, the number in 2024 was 85 (see Figure 1).

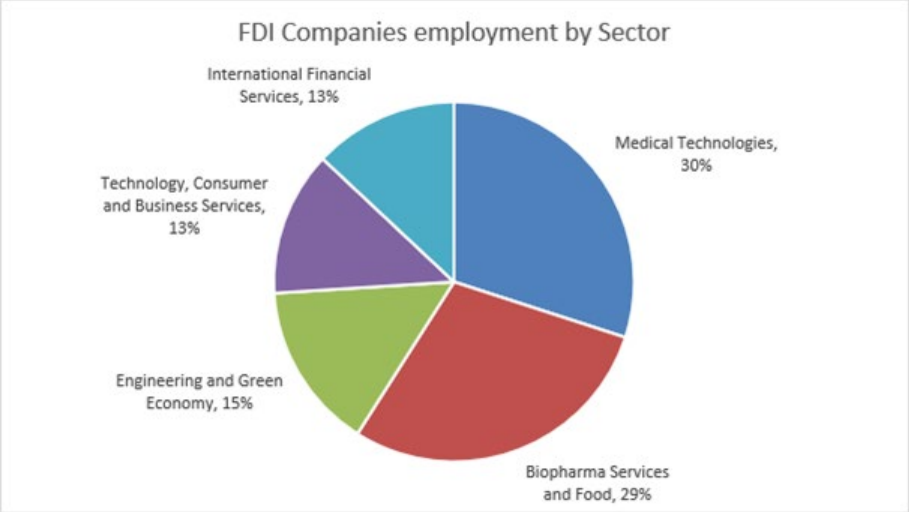


*Fig. 1 Employment if FDI companies in South East Ireland in 2024 (Source: Ireland South East Development Office, 2025)*

### 4.2.1 South East Industrial structure

According to the South East Regional Skills Forum (SERSF, 2019), there is a significant and growing ICT (Information and Communication Technology) sector in the South East [Ireland] comprising in excess of 100 ICT companies. The report also states that most SMEs and larger scale enterprises in the South East region employ ICT staff in support roles. In total the number of ICT practitioners based in the South East region in 2016 was 4,673, representing a growth of 14.3% compared to the figures issued the Ireland's Central Statistics Office (CSO) in 2011. In Q1 of 2018 the number of ICT practitioners in the region had grown to 5,700; an increase of 22% on 2014 (SERSF. 2019, p.7).

Because of the importance of innovation, technology and technology-based enterprises to the economic growth of regions in general and specifically because of the growth in ICT practitioners in the South East region, this paper focuses on entrants and graduates from technology, engineering and science disciplines as well as on high-tech, high-value-add, high-growth industry sectors. Many researchers would consider this a limitation of this research, as many non-science and non-engineering students do get employment in high-tech, high-value-add, high-growth industry sectors and do make positive contributions to the innovation capacity and capability of these firms. However, the authors specifically focused on the disciplines listed in Table 4.

4.2.2 Human capital

First, the study looks at student intake into the high-tech disciplines between 2010 and 2017.

| | 2010 /11 | 2011 /12 | 2012 /13 | 2013 /14 | 2014- /15 | 2015 /16 | 2016 /17 | 2017 /18 |
|---|---|---|---|---|---|---|---|---|
| **Natural sciences, mathematics and statistics** | 26 | 60 | 60 | 78 | 75 | 85 | 98 | 141 |
| **Information and Communication Technologies (ICTs)** | 227 | 208 | 281 | 224 | 159 | 174 | 169 | 163 |
| **Engineering, manufacturing and construction** | 278 | 225 | 275 | 235 | 146 | 177 | 188 | 170 |
| **Agriculture, forestry, fisheries and veterinary** | 105 | 114 | 153 | 130 | 137 | 127 | 110 | 143 |
| **Total** | 636 | 607 | 769 | 667 | 517 | 563 | 565 | 617 |

*Table 4 Intake of students into WIT's technology, engineering and science disciplines between 2010/2011 and 2017/2018 (source: WIT records).*

From Table 4 it can be seen that there is good growth in the intake of students into the discipline of 'natural sciences, mathematics and statistics', which includes the sub-disciplines of biology, bio-chemistry, environmental sciences, chemistry and physics. The largest growth intake of students was for chemistry (from 22 in 2010/2011 to 64 in 2017/2018). This increase may be accounted for by the increase in the number of pharmaceutical and chemical companies in Ireland's South East, South West and mid-West regions.

In contrast, the ICT and engineering, manufacturing and construction disciplines have seen a considerable drop in intake of students over the period reviewed, apart from the very considerable large intake of students to these disciplines in 2012/2013. The sub-disciplines affected the most were electronics & automation (down from 114 in 2010/2011 to 42 in 2017/2018); food processing (from 41 in 2010/2011 to zero in 2017/2018); and building & civil engineering (from 71 in 2010/2011 to 56 in 2017/2018). It is relatively easy to understand the decline in intake of students for the building & civil engineering sub-discipline because the whole construction industry in Ireland was devastated in the wake to the demise of the Celtic Tiger. Conversely, it is not easy to understand the decline in intake for the food processing and electronics & automation as both sectors are still performing strongly in the region and across Ireland in general.

Notwithstanding its evolution towards a university in terms of its levels of research activity and the comprehensive breadth of disciplines, WIT continues to recruit strongly in the traditional STEM areas and to supply graduates from these disciplines. Table 5 represents a map of new entrant recruitment by area of study (determined by the UNESCO ISCED codes for the various fields of education) for areas most obviously linked to technology.

The regional remit of WIT is realised not just by the provision of educational opportunities to students from the South East but also through the provision of graduates to the region. Approximately 70% of WIT's graduates are from within the

South East region. The greater proportion of graduates from the region is from the immediate vicinity of WIT in that by far the largest number of graduates are from county Waterford with numbers diminishing with distance from the Institute (the smallest numbers are from further away, in county Carlow).

| Field of Learning (ISCED) | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 |
|---|---|---|---|---|---|---|---|---|
| **Natural sciences, mathematics and statistics** | **26** | **60** | **60** | **78** | **75** | **85** | **98** | **141** |
| (0510) Biological and related sciences not further defined or elsewhere classified | | | | | 16 | 27 | 28 | 31 |
| (0511) Biology | | 10 | 12 | 15 | 16 | 12 | 19 | 28 |
| (0512) Biochemistry | | | | | 8 | 13 | 14 | |
| (0521) Environmental sciences | 4 | 23 | 22 | 19 | 10 | 5 | 6 | 14 |
| (0531) Chemistry | 22 | 22 | 20 | 33 | 18 | 25 | 24 | 64 |
| (0533) Physics | | 5 | 6 | 11 | 7 | 3 | 7 | 4 |
| **Information and Communication Technologies (ICTs)** | **227** | **208** | **281** | **224** | **159** | **174** | **169** | **163** |
| (0610) Information and Communication Technologies (ICTs) not further defined or elsewhere classified | 208 | 178 | 239 | 203 | 114 | 138 | 126 | 125 |
| (0611) Computer use | 19 | 30 | 42 | 21 | | | | |
| (0613) Software and applications development and analysis | | | | | 45 | 36 | 43 | 38 |
| **Engineering, manufacturing and construction** | **278** | **225** | **275** | **235** | **146** | **177** | **188** | **170** |
| (0711) Chemical engineering and processes | 14 | 15 | 23 | 17 | 11 | 21 | 12 | |
| (0713) Electricity and energy | | | 25 | 13 | 8 | 10 | 12 | 14 |
| (0714) Electronics and automation | 114 | 96 | 91 | 72 | 65 | 57 | 65 | 42 |
| (0721) Food processing | 41 | 34 | 50 | 64 | | | | |
| (0731) Architecture and town planning | 38 | 48 | 23 | 31 | 31 | 45 | 50 | 58 |
| (0732) Building and civil engineering | 71 | 32 | 63 | 38 | 31 | 44 | 49 | 56 |
| **Agriculture, forestry, fisheries and veterinary** | **105** | **114** | **153** | **130** | **137** | **127** | **110** | **143** |
| (0811) Crop and livestock production | 64 | 61 | 76 | 72 | 84 | 75 | 75 | |
| (0812) Horticulture | 18 | 20 | 29 | 36 | 35 | 29 | 20 | 18 |
| (0819) Agriculture not further defined or elsewhere classified | | | | | | | | 98 |
| (0821) Forestry | 23 | 33 | 48 | 22 | 18 | 23 | 15 | 27 |
| | **636** | **607** | **769** | **667** | **517** | **563** | **565** | **617** |

*Table 5 WIT New Entrants 2010-2018 by Selected ISCED Code (Source: HEA)*

A significant number of graduates from the South East are from within the technology-related fields of education and training listed, as shown in Table 6. (Changes in ISCED coding in 2013 necessitates the following representation).

| | Old ISCED | Current ISCED | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 421 | Biology and biochemistry | | 14 | 20 | 21 | | | | | | 55 |
| 422 | Environmental Science | 521 | 8 | 3 | 10 | 19 | 16 | 13 | 12 | 11 | 92 |
| 510 | | Biological and related sciences not further defined | | | | 3 | 2 | 4 | 20 | 17 | 46 |
| 511 | | Biology | | | | 15 | 22 | 19 | 26 | 26 | 108 |
| 512 | | Biochemistry | | | | 6 | 5 | 6 | | | 17 |
| 441 | Physics | 533 | 5 | 4 | | 3 | 3 | 7 | 4 | | 26 |
| 442 | Chemistry | 531 | 9 | 18 | 23 | 12 | 21 | 18 | 26 | 34 | 161 |
| 524 | Chemical and process | 711 | 13 | 3 | 13 | 10 | 11 | 20 | | | 70 |
| 481 | Computer Science | | 93 | 109 | 135 | | | | | | 337 |
| 482 | Computer Use | | | 6 | 7 | | | | | | 13 |
| 610 | | Information and Communication Technologies (ICTs) | | | | 99 | 98 | 106 | 102 | 73 | 478 |
| 613 | | Software and applications development and analysis | | | | 15 | 14 | 14 | 18 | 16 | 77 |
| 522 | Electricity and energy | 713 | | | 15 | 15 | 23 | 12 | 11 | 6 | 82 |
| 523 | Electronics and automation | 714 | 87 | 98 | 106 | 104 | 86 | 77 | 68 | 66 | 692 |
| 581 | Architecture and town planning | 731 | 71 | 55 | 53 | 46 | 25 | 8 | 2 | 12 | 272 |
| 582 | Building and civil engineering | 732 | 75 | 94 | 74 | 58 | 57 | 36 | 31 | 29 | 454 |
| **Total** | | | **375** | **410** | **457** | **405** | **383** | **340** | **320** | **290** | **2980** |

*Table 6 WIT Graduates from the South East by Select ISCED Code (Source: HEA)*

The data show a steady supply of graduates from the South East from within WIT out into the graduate marketplace. The total number of graduates into these domains is around 3,000 over 7 years. A number of trends are evident:

1. The significant drop in graduate numbers in 2014 and in the years following represents the post-2012 recession impact on student recruitment. It is particularly noteworthy that there was a significant drop in graduate numbers in Architecture and Town Planning and in Civil Engineering after 2014 with numbers plummeting by well over two thirds.
2. There was a relatively static supply of ICT graduates. ICT graduates number about a third of all South East graduates produced by WIT in the period.
3. There was a small drop in numbers graduating in Electronics and Energy related disciplines.
4. There was a notable growth in numbers in Chemistry, Biochemisty and other health related areas.

A graduate survey is conducted yearly by all HEIs in Ireland to determine the first destinations of graduates. A survey of WIT students from the South East has been considered to establish how many graduates remain within the South East (see Table 7).

| | **County of Employment** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **County of Origin** | **Carlow** | **Cork** | **Dublin** | **Galway** | **Kildare** | **Kilkenny** | **Limerick** | **Meath** | **Tipperary** | **unknown** | **Waterford** | **Wexford** | **Wicklow** | **Total** |
| **Carlow** | 17 | | 2 | | 2 | 1 | | | | | 2 | | | 24 |
| **Kilkenny** | 4 | 3 | 9 | | 2 | 85 | 4 | | 4 | | 18 | 5 | | 134 |
| **Tipperary** | 1 | 4 | 6 | | 1 | 8 | 5 | | 115 | 1 | 11 | 1 | | 153 |
| **Waterford** | 2 | 9 | 8 | 1 | | 14 | | | 11 | 1 | 265 | 5 | | 316 |
| **Wexford** | 1 | 2 | 12 | 1 | | 4 | 1 | 1 | 1 | | 11 | 91 | 1 | 126 |
| **Total** | **25** | **18** | **37** | **2** | **5** | **112** | **10** | **1** | **131** | **2** | **307** | **102** | **1** | **753** |

*Table 7 Distribution of South East WIT 2018 Graduates by County of Employment (Source: WIT Graduate Survey)*

Table 8 summarises the graduates from the survey sample who were retained within the region and those who were employed outside the region:

| **County of Origin** | **Employment Outside the South East** | **Employment within the South East** | **Total** |
|---|---|---|---|
| **Carlow** | 4 | 20 | 24 |
| **Kilkenny** | 18 | 116 | 134 |
| **Tipperary** | 17 | 136 | 153 |
| **Waterford** | 19 | 297 | 316 |
| **Wexford** | 18 | 108 | 126 |
| **Total** | **76** | **677** | **753** |
| | **10%** | **89%** | |

*Table 8 Employment Destination by County of Origin for WIT 2018 Graduates (Source: WIT Graduate Survey)*

The high numbers of graduates from Waterford retained within Waterford is perhaps attributable to the attractiveness and "gravitational" pull of the city of Waterford and the industries located in the city. It is assumed that the retention of this level of human

capital in Waterford and the South East supports economic development of the South East and the growth of FDI and indigenous industries in the region.

## 5. Conclusions

This paper has addressed the question of *What has WIT contributed to its region, the South East of Ireland, in terms of innovation?* It has explained the policy context to this question being asked. It positions the analysis within a framework of interrelated concepts: human capital, innovation systems and anchor institutions. Collectively they can be used to investigate how localized conditions for both knowledge accumulation (Cooke, 2007) and deployment contribute to innovative capabilities in the region. It has juxtaposed data on changes in the industrial structure in the region with that of patterns of student market places.

From the analysis there is clear evidence of human capital formation, innovation and economic growth in South East Ireland. The major trends are major changes in the structure of the local economy and associated patterns of human capital accumulation which represent systemic change. Hence the growing importance of WIT as an anchor institution

In 2004 high-tech and ICT (information communication technology) enterprises were a scarce community in South East Ireland. But by 2014 the TSSG had spun-out 10 companies creating 600 jobs in the region. There was a significant and growth in the ICT sector in the South East to 100 ICT companies. Most SMEs and larger scale enterprises in the South East region employ ICT staff in a range of support roles. ).

WIT is the anchor institution: 9 out of 10 of WIT's graduates secure employment in the South East region. This supports the concept that HEIs form part of the gravitational field that ties and develops innovation-based economic activity in the region. It also reinforces that through the institutionalisation of region-based innovation ecosystems, systematic interactions become institutionally embedded systemic interactions between organisations (Asheim, et al, 2019). These interactions create reiterative activity whereby graduates stay by being recruited into local firms, working relationships become effective and self-sustaining which in turn creates an enabling environment in which more opportunities happen.

An anomaly is that even though there is clear evidence of economic growth and development in the region with an increase in the number of hi-tech, hi-value-add enterprises in the region, the intake of students (and subsequently graduates) in ICT and engineering has declined over the period of analysis. This observation echoes what Green (2024) wrote, "The underlying philosophy for [this] policy is that increases in the supply of skills will, over time, create an increased demand for skills from employers as firms upgrade their productive and product market strategies in response to a more qualified and skilled workforce.

This approach has its critics with an alternative school of thought arguing that "while skills are an enabler of economic growth, the relationship between improving skills and indicators of economic performance is complex, conditional and patchy", (p.50). In summary, education policy on its own will, not nessarily impact regional economic

development positively; rather it needs to work in tandem with enterprise, innovation and regional development policies.

In Ireland, the establishment of the TUs was seen as a critical contribution to the growth of Ireland's regions and a vehicle to achieve the "balanced growth" targets set out in Ireland's national development plan to 2040, Project Ireland 2040. The legislation establishing the TU sector was explicit in orienting the new institutions towards regional development. The next paper in this series will focus on the impact of SETU on Ireland's South East region from 2023 onwards.

## 6. Acknowledgements

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