TORONTO Backgrounder

January 8, 2020

Toronto Employment Survey 2019 Special Topic: Toronto's Technology Sector

TORONTO'S TECHNOLOGY SECTOR

Introduction

A key feature of Toronto's economy in 2019 is the rise of its technology sector. In 2019 CBRE Group Inc. ranked Toronto as both one of the top technology markets in North America, and the fastest growing. It also ranked Toronto as Canada's top technology city. In line with this, recent results from the Toronto Employment Survey show evidence of the growth and spatial clustering of the sector, with both employment and the total number of technology establishments almost doubling within the past 5 years.

To understand the growth and evolution of this propulsive sector of the city's economy, staff explored why technology firms cluster in Toronto, where in Toronto they cluster and why. Such an analysis will help to better comprehend this growing sector of the economy and its relationship to employment, land use, and transportation requirements.

The piece begins by defining the technology sector and placing it within the context of the Toronto Employment Survey. Using results from the Survey, the definition is followed by a quantitative time-series analysis of the sector's economic growth overall and performance by subsector. The spatial clustering of the sector within Toronto is then presented, with links made to key theories from urban economic growth literature. This is complemented by interviews conducted with local technology firms to explore their locational preferences. A series of accompanying figures, maps, and tables is included in the "Appendix of Figures".

Previous studies suggest that technology firms choose to locate in Toronto for a variety of reasons including a strong labour force, transportation, the presence of other technology firms, and knowledge spillover. Prior research also suggest sectoral spatial concentration in the downtown area because of proximity to highly skilled labour, transportation, clients, competitors, and services (Bourne, Britton, and Leslie, 2010; Duvivier, Polèse, and Apparicio, 2018; López and Páez, 2017). The research presented here supports some of these findings, while simultaneously offering a different perspective on others. Results indicate that the labour force, and access to it, are the dominant drivers shaping the technology sector in Toronto today.

Defining the Tech Sector

The "tech sector" is a distinct set of economic activities within the city's space economy. Media, academic, and industry literature describe the tech sector in a variety of ways, reflecting the evolution of the sector and the changing economic and land use coding systems used in economic research. Blais et al (2018) employ archetypes, "coherent groupings of industries that share both economic and geographic characteristics" (p. 51), to aid with classification. There are two which pertain to technology: "Soft" technology, which spans computer systems design; data processing; web hosting; software design, publishing and distribution, as well as business to business electronic markets, and "Hard" technology, which includes the manufacturing and wholesaling of tech products, such as computers and peripheral equipment, communications equipment, semiconductors, and other electronic components.

While the tech sector is an economic and industrial conception, the addition of geographic data make it possible to profile the locations and activities of tech firms using the Toronto Employment Survey, an establishment-based tool. In order to undertake a meaningful exploration, a distinct definition was required so that the sector could be monitored consistently over time.

Through staff discussions, we arrived at the boundaries of a working definition whereby the tech sector encompasses the creation of technological platforms that enable services or industries to occur that would otherwise not be possible. The tech sector engages with technological innovation rather than adaptation, with pioneering or disruptive technology often at the core. The approach used here excludes establishments for which technology is an enabler, rather than a core feature of the work undertaken.

Influenced by Blais et al's (2018) use of archetypes, two profiles of firms which may be included in our definition were created. The first, *Pure Tech*, is comprised of firms that are rooted solely in the development of technological products or services. The second, *Hybrid Tech*, is comprised of firms that disrupt a previous ecosystem with technology in order to connect manufacturers or service providers with people in a more efficient way. These profiles were used to identify two categories of technology firms, one in which technology is a service, and one in which technology is a product.

Of important note is the distinction of the tech sector from other economic sectors that use technology to continue or refine the output of already established goods and services. Such sectors use new technologies to adapt already existing products or services in order to avoid becoming obsolete. As such, these sectors are not included in our definition.

Tech establishments, however, exist in a larger context of an ecosystem that includes clients, investors, financial institutions, and the labour force, as well as support organizations such as academic institutions and research facilities. In examining the spatial and economic concentration of these establishments, the analysis reviews the relationship of these to the larger tech ecosystem.

NAICS Coding of the Tech Sector

The tech sector is identified through economic activities. To relate this concept to the Toronto Employment Survey, a survey of business establishments, we sought to identify employment activities that represent the tech sector. The Survey uses the NAICS classification to document employment activity, assigning a six-digit code to each establishment based on its predominant economic activity. The Survey's NAICS classification was used to identify establishments as examples of the tech sector. Statistics Canada has a classification of the tech sector based on NAICS. This classification can be likened to Blais et al's (2018) division of the tech sector into Soft and Hard archetypes. A list of the NAICS codes comprising the Statistics Canada classification, with shortened versions of the full titles for convenience, is provided in the Appendix.

In using NAICS to identify tech establishments, it must be noted that while Statistics Canada applies NAICS coding to workers, the Toronto Employment Survey is an establishment-based tool. There are establishments that are wholly comprised of "tech sector" activity, and many others where "tech sector" activities are occurring within them, yet the establishment as a whole may not fit the definition of the sector. Consequently this classification will necessarily differ from other sources. Further, this investigation addresses the composition of a single urban entity, while the tools of Statistics Canada have been developed for use at national and international scales. The use of NAICS in conjunction with the Statistics Canada classification of the tech sector represents a narrowing of the definition for the purpose of counting establishments where employment is enabled by the innovative or disruptive use of technology. In applying the definition narrowly, certain establishments were excluded that might otherwise fall under the category of tech sector. For example, in cases where the primary function of the establishment was administrative, such as in the case of head offices, these were excluded. While the business as a whole might have some tech sector activities, the application of this approach to each establishment or business location enables the distinction of technology enabled employment from more typical office employment.

Additionally, businesses were identified whose economic activity would fall within our definition of the tech sector, but which were assigned a NAICS code outside of the scope of the Statistics Canada definition. In order to include such firms within our analysis, the NAICS code under which the firm is classified would have to be included as part of the definition. To do so would require a more detailed analysis of establishments under each code to determine if the predominant employment met the stated definition of tech. Refining the boundaries of the sector is an area for further research and analysis.

NAICS coding has been revised by Statistics Canada over time, and the different coding systems were incorporated into the Toronto Employment Survey prior to 2014 and 2018. This resulted in various changes, such as a single tech subsector being split into multiple codes, and multiple tech subsectors combined into a single code. These changes resulted in two sets of codes: one for the 2014 Survey results and another for 2018 and 2019. Therefore, while the definition of the tech sector was unchanged, adjustments needed to be made to the codes included in the definition in order to produce a consistent set of information that could be analyzed over time. A

concordance was created so that when NAICS codes had been combined, individual codes could be related to the corresponding single code in the later Survey years when performing analysis over the five-year period.

ECONOMIC GROWTH

Economic growth of the tech sector in Toronto was examined through an analysis of the total number of establishments in the present year, as well as their growth over the most recent one and five year periods. The same analysis was then performed for total employment. We expected to find evidence of economic growth of the tech sector over both time periods. Following this, an analysis of total number of establishments and their growth by subsector was performed. The same was also done for total employment by subsector.
There were 1,729 tech establishments in 2019, representing 2.0% of all establishments in the city. This is an increase of 15.5% from 2018 and 85.7% from 2014. Total employment within tech firms in 2019 was 60,408, representing an increase of 16.6% from 2018, and 84.6% from 2014. In 2019, jobs in tech establishments represented 4.0% of all jobs in Toronto.

Establishments by Subsector

In 2019, 947 establishments were Computer Systems Design, comprising 54.7% of all tech establishments. Software Publishers followed with 147 establishments in 2019.

In terms of growth, Computer Systems Design, Software Publishers, and Electronic Repair respectively claimed the top three spots over both the one and five year time periods. The number of Electronic Components Wholesalers experienced the biggest decline in both time periods, followed by some of the manufacturing subsectors.

Employment by Subsector

Computer Systems Design dominated the overall sector in 2019, with a workforce of 35,144, comprising 58.2% of total tech employment. Telecomm Carriers followed with a workforce of 9,788, comprising 16.2% of total tech employment.

Computer Systems Design and Software Publishers were first and second respectively, over both the one-year and five-year time periods. Of interest is the rise of Video Game Design, which claimed the third spot in the one-year period, growing by 30.1%, and the decline of Telecomm Carriers, which lost 783 jobs in the last year.

Analysis

The performance of the Computer Systems Design subsector is in line with Blais et al's (2018) findings that identify a growth of Soft Tech subsectors such as computer systems design, while noting a decline in Hard Tech subsectors such as the manufacturing and wholesaling of tech products. Potential factors contributing to these trends include the “knowledge-intensive” nature of Soft Tech subsectors, while Hard Tech subsectors may be facing competitive pressure from the global market, in conjunction with the disruption of the wholesaling subsector by e-commerce.

SPATIAL CLUSTERING

Clusters play an important role in the economic performance of both industries and the city-regions in which they are situated. Indicators of industry strength such as employment growth, wages, and rates of employment tend to be higher for industries that are clustered. City-regions subsequently have stronger economies when they have higher rates of employment in clusters (Spencer, 2015). Spatial clusters and their location within the metropolitan urban structure may be a significant indicator. Past research suggests that the Central Business District is no longer the only concentration of employment. Scholars have found varying evidence of decentralization in Canadian metropolises. Among these are phenomena of polycentricity and dispersion in varying forms (Shearmur et al., 2007).

Toronto's Tech Clusters

Two distinct locational patterns can be observed with respect to the clustering of the tech sector in Toronto. The first is a clustering in the downtown area south of Queen Street, as well as in Liberty Village, both of which are within the South Employment Monitoring Area (EMA). The South EMA encompasses the approximate areas of the former municipalities of The City of Toronto, York, and East York. Clustering within the South EMA comprises 63.4% of total tech employment within Toronto.

A second series of clusters was also found within the Official Plan geographies of Downtown, the Centres, and the Employment Areas. Altogether, the Official Plan geographies comprise 90.7% of all tech sector employment, and 80.7% of all tech sector establishments, with the most significant clusters appearing in Downtown, followed by the Employment Areas (see the Appendix for a further breakdown). Clustering within these geographies demonstrate the importance of land use policy in supporting economic growth in the city.

Although there remains a large concentration of tech establishments in and around downtown, our results support the literature as Toronto's tech sector displays patterns of polycentricity, with multiple clusters throughout the city. Lending further support to the literature is the reach of the downtown cluster beyond the Central Business District. Finally, dispersion can also be seen with tech establishments choosing to locate along the city's major subway lines, and in close proximity to major highways. Theories behind these locational patterns will be explored in more depth below.

The topics of industrial spatial concentration and associated locational preferences are areas of expansive economic and geographical research. Key theories from the literature are summarized below, including those around urban structure and economic growth, industry clustering, and industry clustering as it pertains to the tech sector. In order to relate these more general theories to the Toronto context and the tech sector specifically, these are paired with observations derived from interviews of tech sector firms in Toronto to document the reasons behind their locational choices.

Regional Scale

Given the relationship between clusters and economic health outlined earlier, it is useful to understand the factors that influence the creation of urban economic clusters. Two primary themes emerge from the literature. The first pertains to local input conditions, and the second to knowledge production. Regarding the former, the strength and depth of the local labour market along with the presence and support of local education and research institutions have been identified as the most critical (Bourne, Britton, and Leslie, 2010; Wolfe, 2009).

Regarding the latter, Blais et al (2018) emphasize the transition to the knowledge economy, identifying knowledge production and innovation as being at the core of economic growth in the present day. Koo (2005) elaborates on this by stating that knowledge production, in the form of technological spillover, is inherently linked with agglomeration economies as agglomeration facilitates spillover through formal and informal information flows that lead to the development of "local innovation networks". A feedback loop is thus created whereby information about new technology is dispersed, which leads to new technological discoveries, which in turn attracts more firms and leads to a higher level of agglomeration.

Wolfe (2009) points out however, that the strength of knowledge is contingent upon the strength of the local inputs, such as labour and institutions that aid the initial cluster development. Thus lending further support to Koo's feedback loop and the interdependence of local inputs and knowledge production.

Urban scholars have identified a shift in economic growth towards knowledge production and innovation (Blais et al, 2018). Scholars argue that knowledge production and innovation benefit from co-location with related firms, industries, and resources (Blais et al, 2018; Koo, 2005). Associated with this are urban environments, which foster innovation through attracting both agglomeration economies and labour (Blais et al, 2018). This is echoed in more specific discussions of cluster development, where scholars cite the influence of both labour and knowledge production in cluster formation and growth (Bourne, Britton, and Leslie, 2010; Wolfe, 2009). This lends support to the significance of knowledge production in economic growth, while also asserting the importance of a strong labour force. Labour and knowledge production are further linked by the assertion that the latter is contingent on the strength of the former, as well as the strength of other local inputs such as institutions (Wolfe, 2009).

Greater Toronto Area

The significance of clusters in the Greater Toronto Area (GTA) is discussed by Bourne, Britton and Leslie (2010) who make special note of those that rely on new technologies. Identifying auto, finance, information and communication technologies (ICT) and life sciences, the authors echo the significance of knowledge exchange to cluster development and growth, while also alluding to the larger significance of the local tech sector as a whole.

Clustering of the tech sector throughout the GTA has been attributed to access to transportation and skilled labour, which were found to be the most statistically significant factors in one study (López and Páez, 2017). While transportation, coupled with the

availability and cost of commercial space, as well as proximity to related industries, were found to be the most significant factors in another (Duvivier, Polèse, and Apparicio, 2018). The former also found that technology clusters in the GTA tend to concentrate towards the core of Toronto, suggesting that downtown Toronto provides the access to transportation and labour that establishments seek (López and Páez, 2017).

City of Toronto

Blais et al (2018) observed that in 2016 the largest number of Soft Tech jobs in the Greater Golden Horseshoe (GGH) were located within Toronto (almost 44,000). Toronto also accounted for the largest increase of Soft Tech jobs in the GGH, adding 13,000 new jobs between 2006 and 2016, with a significant amount downtown. Hard Tech employment decreased in the GGH significantly over the 2006-2016 period, with a net loss of over 21,000 jobs, a decline of almost 30%.

FIRM INTERVIEWS

The Toronto Employment Survey reveals spatial clusters of the tech sector in and around Downtown. To investigate the reasons behind this spatial concentration, and to assess whether the findings from the literature explain the locational preferences of tech establishments in Toronto's largest clusters, interviews were conducted with eleven establishments of various size and subsector, located in and around Downtown and Liberty Village. Representatives of selected establishments were interviewed about their locational preferences on both inter- and intra-metropolitan scales, whether their current location met their needs, whether they were looking to grow the number of employees in the next few years and whether such growth would require a change in location.

Toronto is a Tech Centre

The findings support the significance identified in the literature pertaining to the attractiveness of urban environments for knowledge-producing industries such as the tech sector. When asked why they chose to locate in Toronto, participants stated that Toronto is "a tech centre", offering a "diversity of education and culture which builds successful organizations." The diversity of people that Toronto offers was also referenced, with links made between it and economic strength. The relative simplicity and speed of Canada's immigration system in comparison to that of the United States, in conjunction with quality of life attributes such as health care and education, were also factors influencing locational choice, particularly for internationally headquartered firms. With respect to Toronto in particular, one firm cited the City's "forward-thinking" and "pioneering" attitude in terms of relevant policy and regulations.

Local and Regional Location

To further understand the factors which bear the greatest weight with respect to locational preference, participants were given a list of attributes to rank independently from 1 to 5. Attributes were selected based on those identified in the literature as influencing locational choice, and included the following: presence of an anchor firm, presence of research institutions, access to skilled workers, co-location with similar firms and industries, proximity to the central business district, availability and cost of commercial space, neighbourhood amenities (e.g. restaurants, parks, cafes), access to

public transit, and access to highways. Each participant was asked to apply this ranking to the neighbourhood, while those originating from outside of Toronto completed an additional ranking at the metropolitan scale. With slight variances in ranking, the top 3 attributes overall on both metropolitan and neighbourhood scales were: access to skilled workers, access to public transit, and neighbourhood amenities. Despite the variance in ranking, discussions revealed the significance of public transit and neighbourhood amenities to be directly in response to accessing skilled workers, with many firms stating that they were competing to acquire talent.

Talent

With regard to the type of talent being sought, firms are largely seeking to attract younger employees from new graduates to those approaching their early thirties. There was a general consensus among establishments that employees belonging to this demographic do not tend to own cars, and prefer to work in a "hip, urban area" such as Toronto, rather than in a suburban area. Therefore, establishments sought a location that was both accessible and attractive to the talent pool they were seeking.

Locational Accessibility

In terms of accessibility, being located in close proximity to both local TTC lines as well as GO Transit stations proved essential for each establishment. Firms asserted that they would not be able to compete for labour if they were located in a suburb or far from transit. Regarding GO Transit specifically, being located near Exhibition Station for Liberty Village establishments, and Union Station for establishments Downtown, enables access to labour from the entire Greater Golden Horseshoe area, rather than just Toronto. This in turn allows firms to establish partnerships and recruit from a variety of higher education institutions outside of Toronto, such as the universities of Waterloo and Guelph. In fact, access to GO Transit was often a higher priority than access to the TTC.

Urbanity

In terms of attractiveness, participants stated that younger employees are looking to work in a "hip", vibrant, neighbourhood with a variety of amenities such as cafes and restaurants. Proximity to large entertainment venues were not a factor. Locating in a vibrant area was not only due to employee preference. Establishments themselves expressed the desire to be in creative, energetic, and vibrant neighbourhoods as such environments were seen to foster community and thus inspire both creativity and productivity. One firm cited their use of the basketball court and grassy areas across the street as an example, while another spoke to their practice of holding one-on-one meetings in cafes. Toronto's central business district did not necessarily meet these characteristics, and was associated by some with congestion, a lack of community, and diminished productivity. Building character was similarly referenced, with a strong preference expressed for brick-and-beam buildings and their associated history. Again, inspiring creativity and productivity was the primary theme, with being in a historic space likened by one firm to "working in a piece of art", noting that "cubicles do not breed community". The same firm also spoke to the role of diversity and its relationship to fostering community and creativity. Citing its location in a building that also houses a

dance studio and architecture firm, the role this plays in avoiding the creation of a "vanilla tech place where everyone's doing the same thing" was emphasized.

Community Services

As employees age and begin to start raising families, quality of life attributes such as housing affordability and daycare access begin to take precedence. Concern over housing affordability and daycare access was expressed by a number of those interviewed in relation to employee retention over time. While Toronto is affordable in comparison to some of the international tech centres, a concern was raised that as employees start families they may have to move further away, potentially resulting in higher staff turnover. Liberty Village in particular was identified as lacking in daycare options.

Co-location

Past research had identified co-location with similar firms to be a significant determinant of location. This was not found to be the case among the establishments interviewed. While the size and reputation of Toronto's tech sector was cited among establishments that were not Toronto based, access to labour, followed by access to public transit, remained the top ranked attributes regarding the decision to locate in Toronto versus another municipality. This was echoed with regard to neighbourhood scale, where co-location with similar firms was not found to be a top-ranked attribute. Further, interview results did not reference opportunities for technological spillover and innovation stemming from co-location. This finding is also supported by Huber (2012) in his survey of Research and Development workers in Cambridge, UK's IT Cluster. He found that membership in the Cambridge IT Cluster did not influence innovation, nor was the prospect of collaboration with other IT firms in the Cluster a locational driver.

Commercial Space and Support Infrastructure

Two other themes emerged in the interviews: the cost and availability of commercial space, and the importance of support infrastructure.

The former was particularly prominent during discussions of growth when establishments were asked whether their current location was sufficient to meet their needs over the next few years. Participants described having a difficult time finding affordable space. Smaller firms related that there was a lack of available space between 1,000 – 2,000 ft^2 and that landlords were reluctant to rent to them if they were not venture-capital funded. Larger firms also expressed similar challenges finding adequate space to accommodate their projected growth over the coming few years. Many were uncertain of their growth and spatial needs in the next few years, making commitment to a lease challenging when the majority of commercial leases require a tenure of 5 to 10 years. These firms did not want to commit to space they would not yet need or be locked into a space that may become too small. As a result, some of the firms interviewed were either sub-leasing their space, or sub-lessors of space.

The presence of support infrastructure such as grants and programs from various levels of government and research institutions such as MaRS was mentioned as being significant in allowing smaller tech firms to develop and grow. Many of the firms

interviewed were affiliated with the MaRS institute in some respect. One firm was involved in a research partnership with the University of Toronto.

Conclusion

Prior research has anticipated continued expansion of the tech sector components that depend on the creation of platforms and platform technologies relied on by other industries (Blais et al, 2018). To the extent that tech employment depends on agglomeration economies, the sector is likely to continue to grow, while competition may contribute to a continuing shift into soft technology such as online platforms and e-commerce.

Our findings demonstrate the importance of access to the highly skilled labour force of the city and region, which is in turn dependent on access to public transit, neighbourhood amenities, and quality of life. Therefore, rather than taking tech firms as the basis of analysis and framing the discussion in terms of what attracts establishments to locate where they do, it may be useful to contextualize the conversation in relation to what attracts the labour force to locate where they do. Examining the issue from this angle, we can see that the attraction and retention of the labour force which supports the tech sector is a key consideration in supporting the growth and development of this sector in Toronto, and in turn, the economic growth of the city.

CONTACT

City Planning Division
Strategic Initiatives, Policy & Analysis
Research and Information
Metro Hall, 22nd Floor
Toronto, Ontario M5V 3C6

Tel: 416-392-9422
Fax: 416-392-3821
TTY: 416-392-8764
Email: cityplanning@toronto.ca

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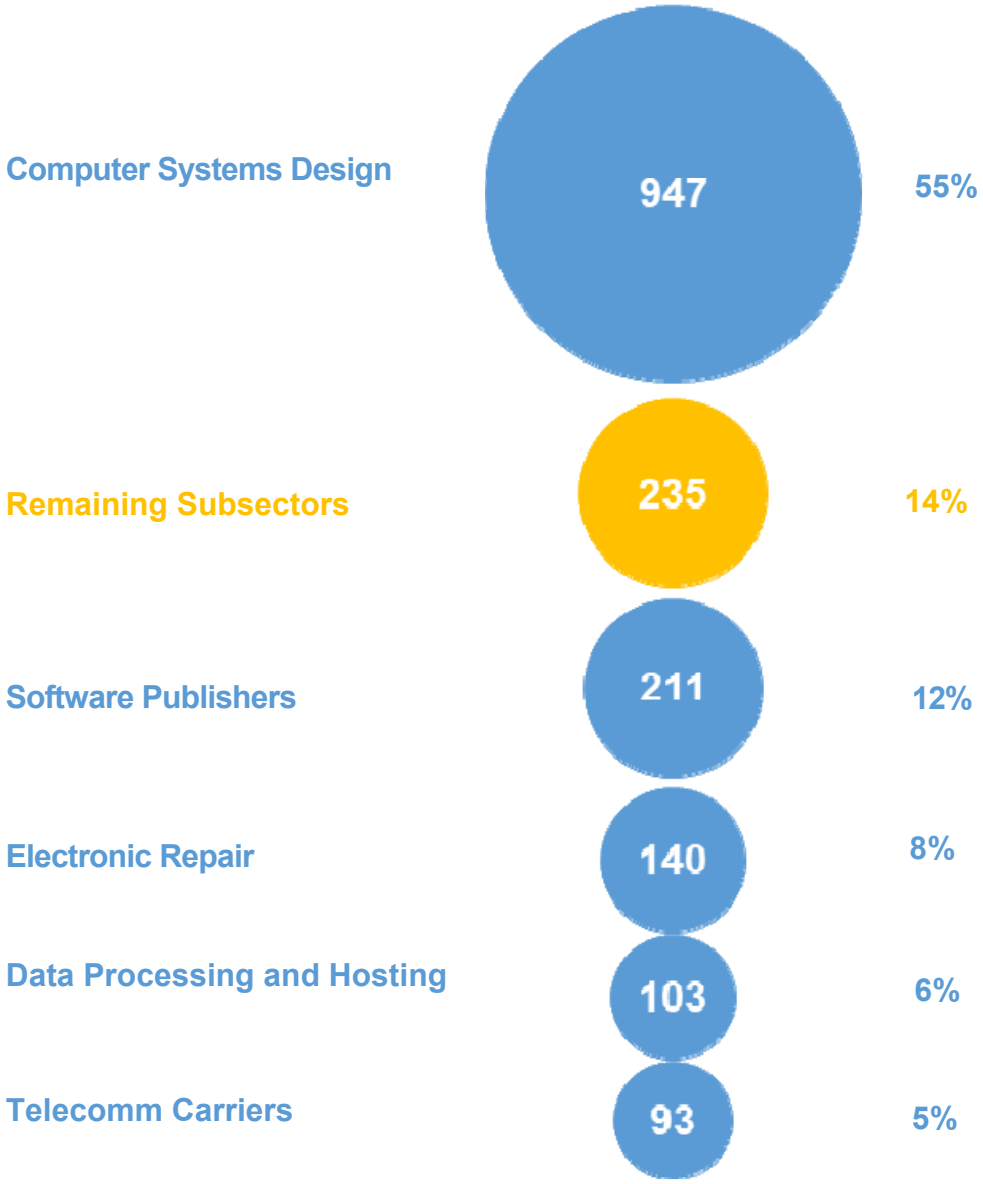
APPENDIX OF FIGURES

2019 NAICS Codes for the Tech Sector as defined by Statistics Canada

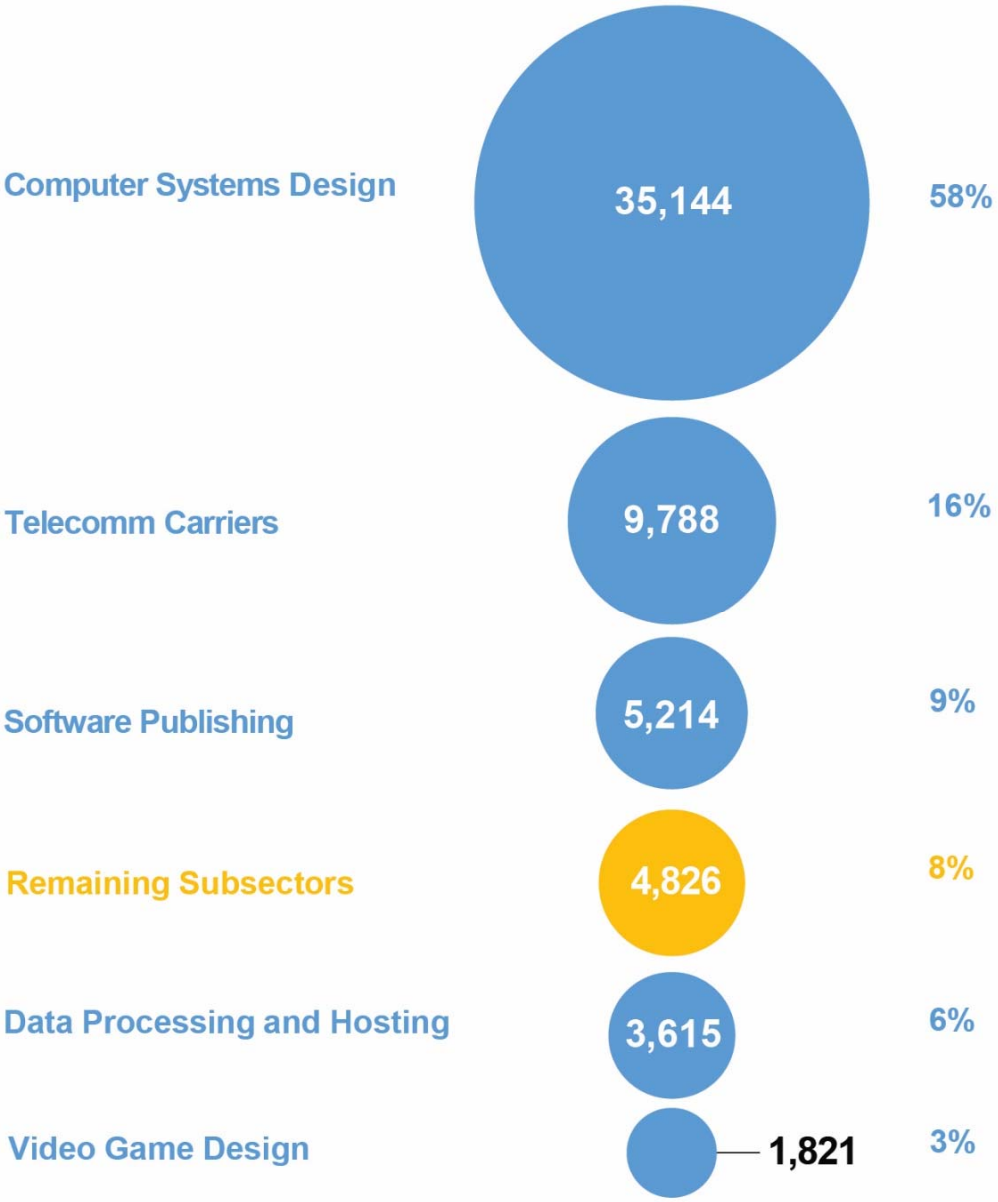
334110: Computer Manufacturing
334210: Telephone Manufacturing
334220: Radio and Television Equipment Manufacturing
334290: Other Communications Equipment Manufacturing
334310: Audio and Video Equipment Manufacturing
334410: Semiconductor Manufacturing
334610: Magnetic and Optical Media Manufacturing
417310: Computer and Software Wholesalers
417320: Electronic Components Wholesalers
511211: Software Publishers
511212: Video Game Publishers
517310: Telecomm Carriers
517410: Satellite Telecommunications
517911: Telecommunications Resellers
517919: All Other Telecommunications
518210: Data Processing and Hosting
541514: Computer Systems Design
541515: Video Game Design
811210: Electronic Repair

Top 5 Tech Subsectors by Total Number of Establishments, 2019



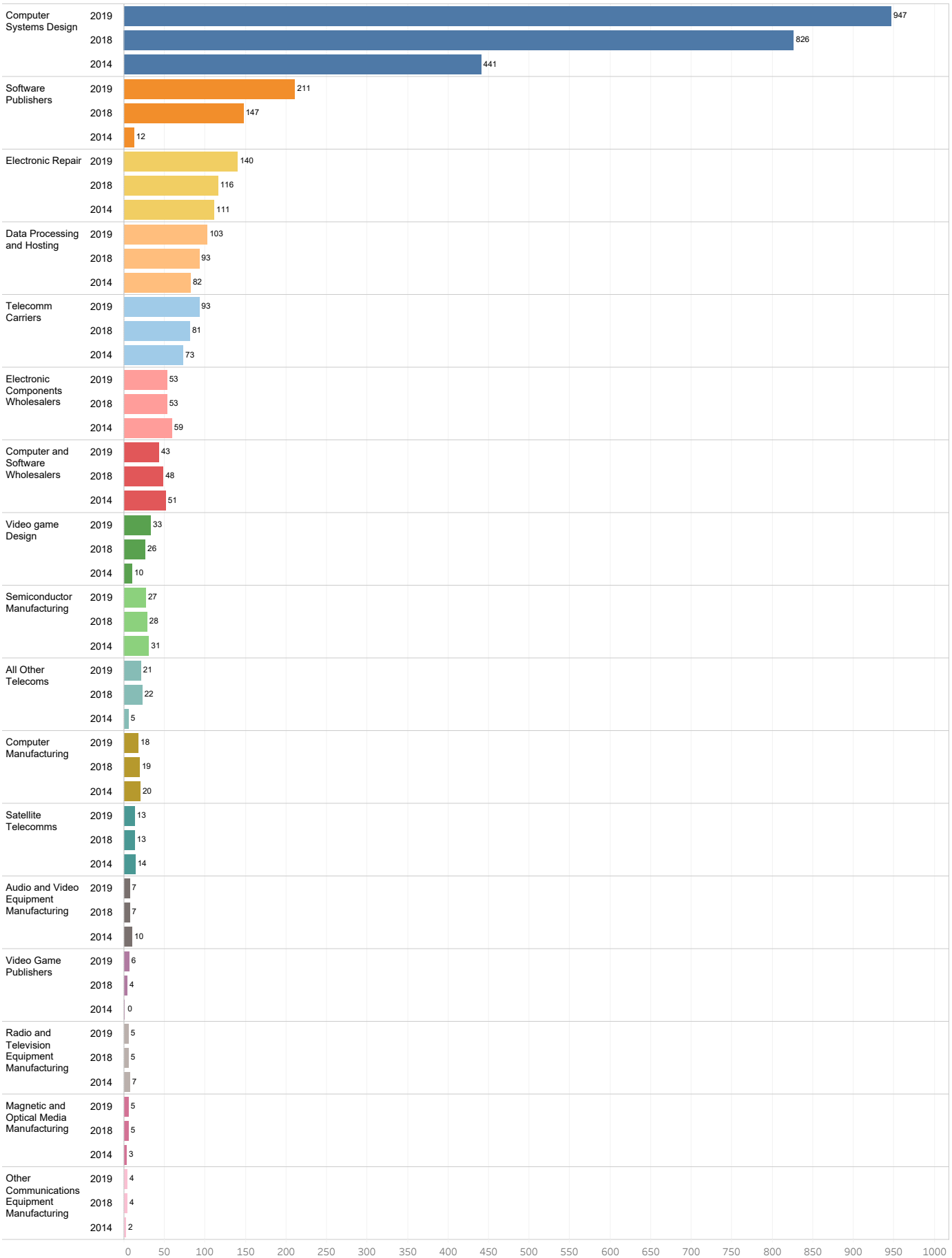
Total	**1,729**

Top 5 Tech Subsectors by Total Employment, 2019

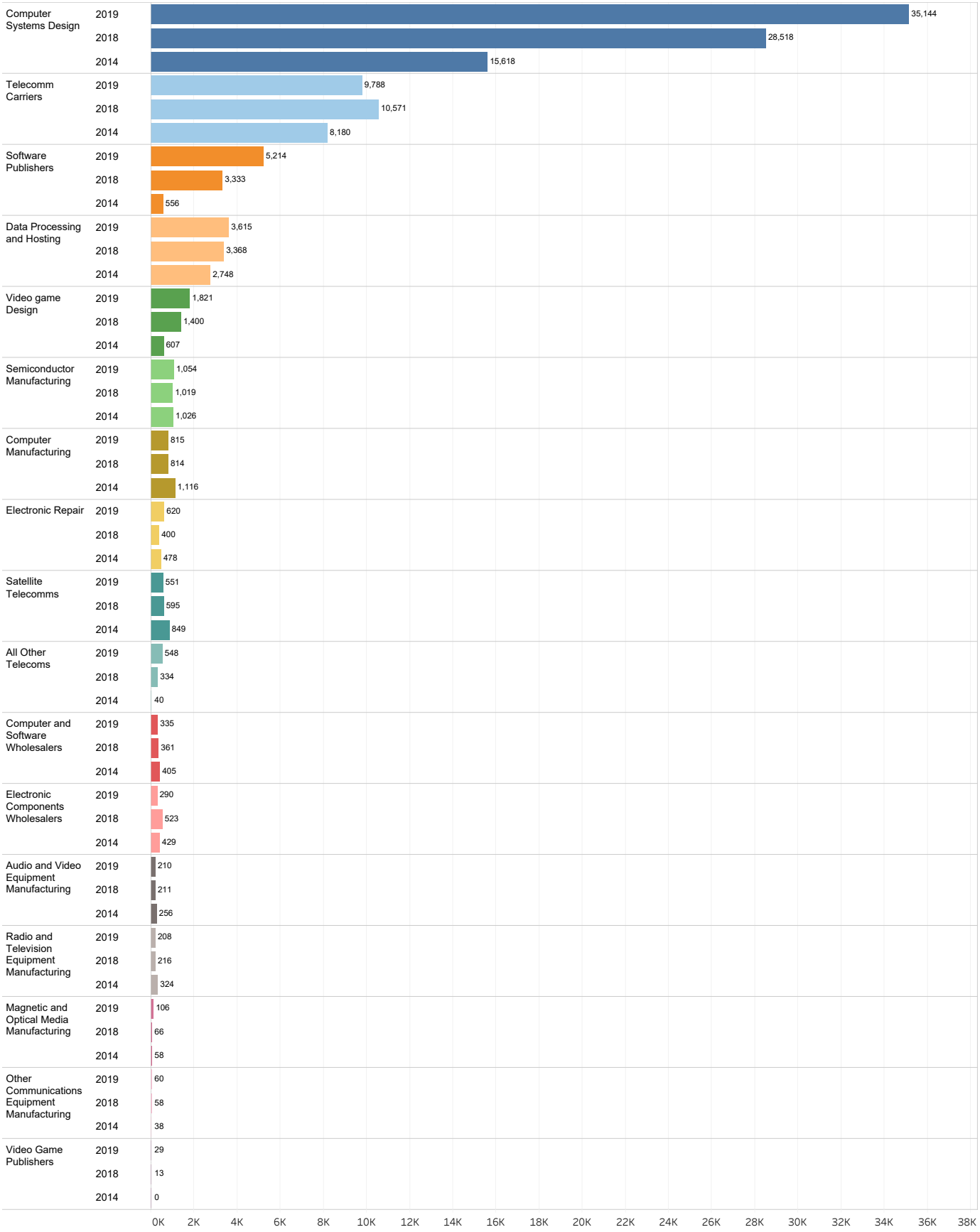


Total	**60,408**

Total Number of Establishments by Tech Subsector 2014, 2018, 2019

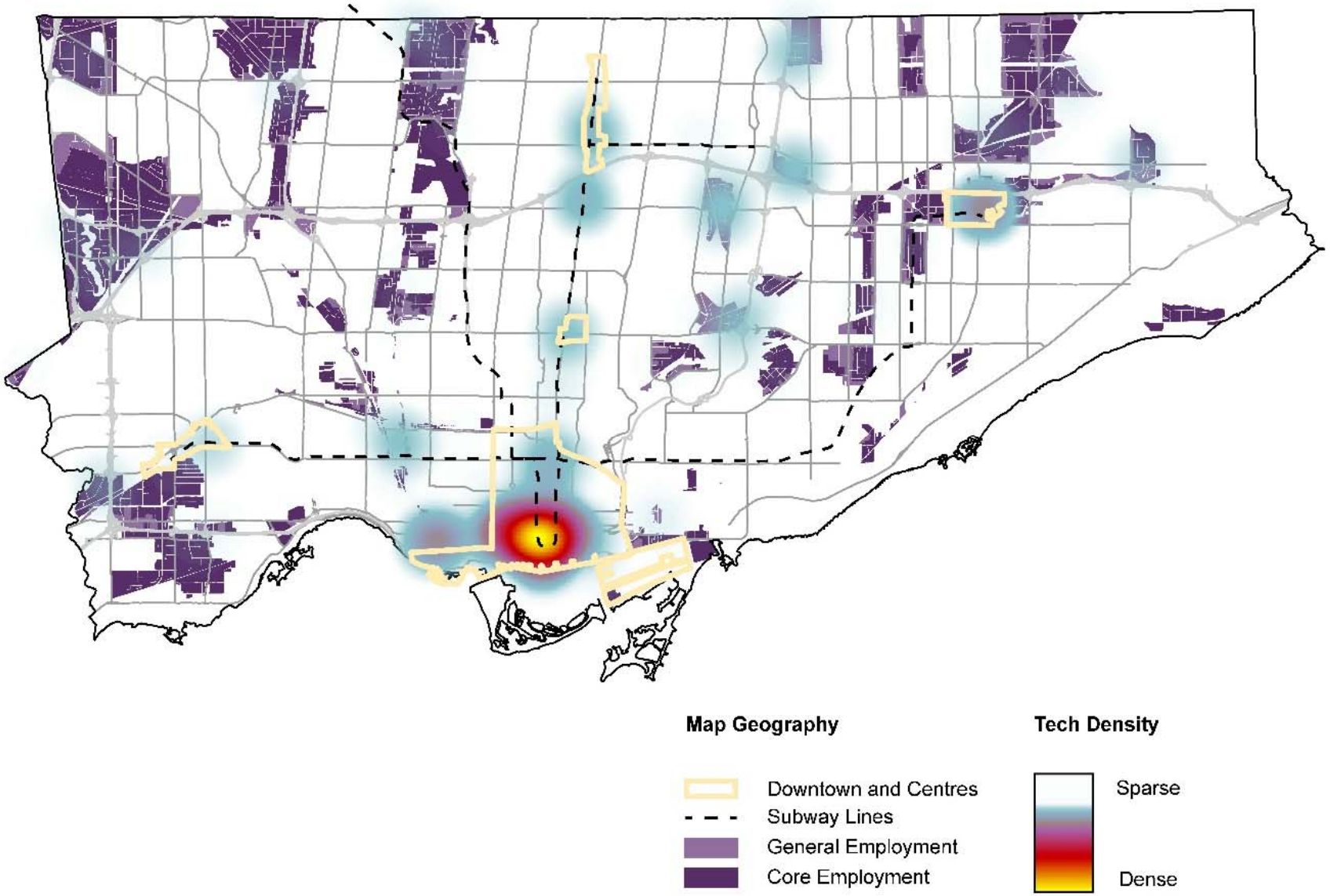


Total Employment by Tech Subsector 2014, 2018, 2019



TORONTO

Tech Sector Clusters in Toronto, 2019



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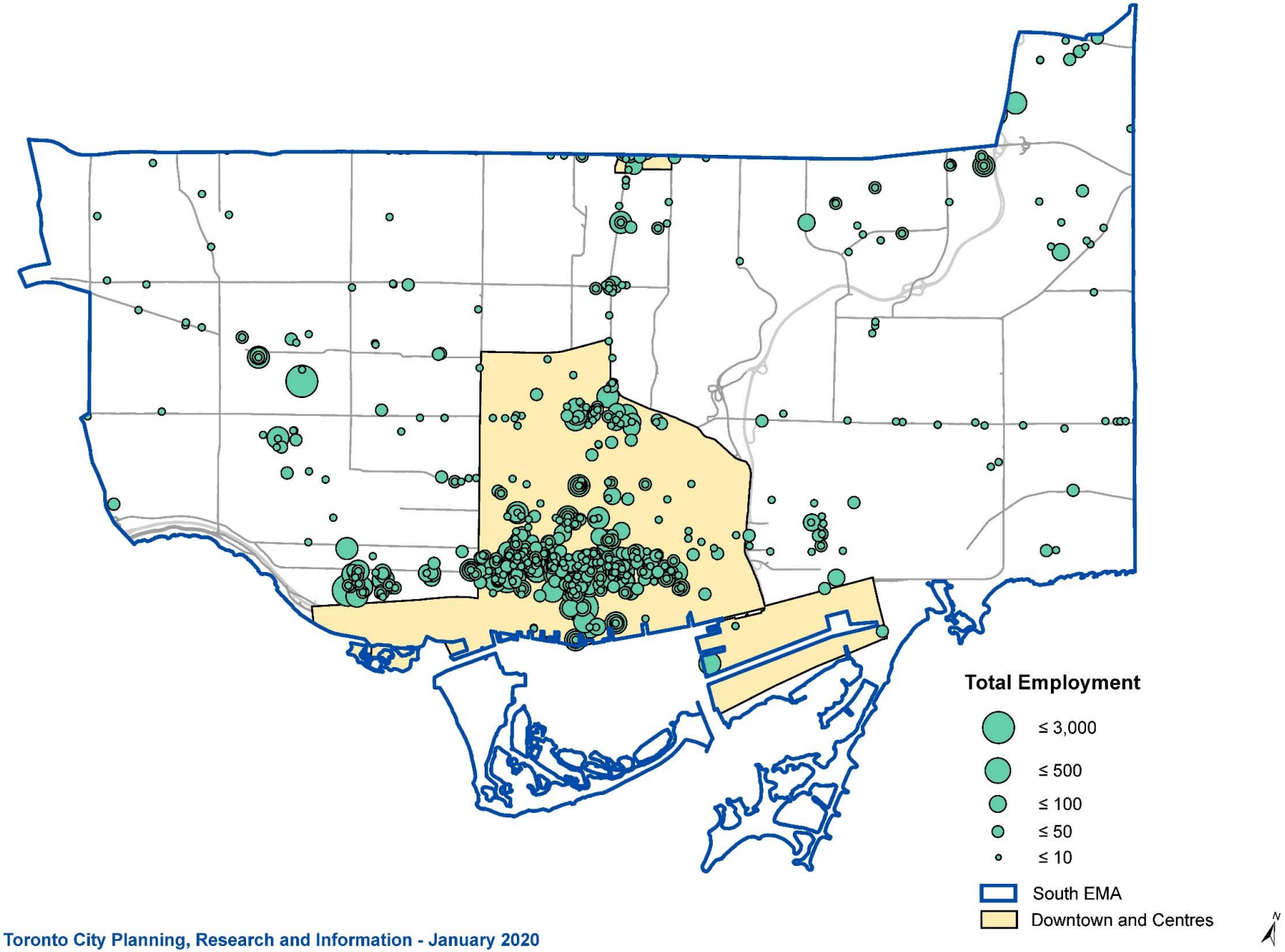
South EMA Spatial Distribution, 2019



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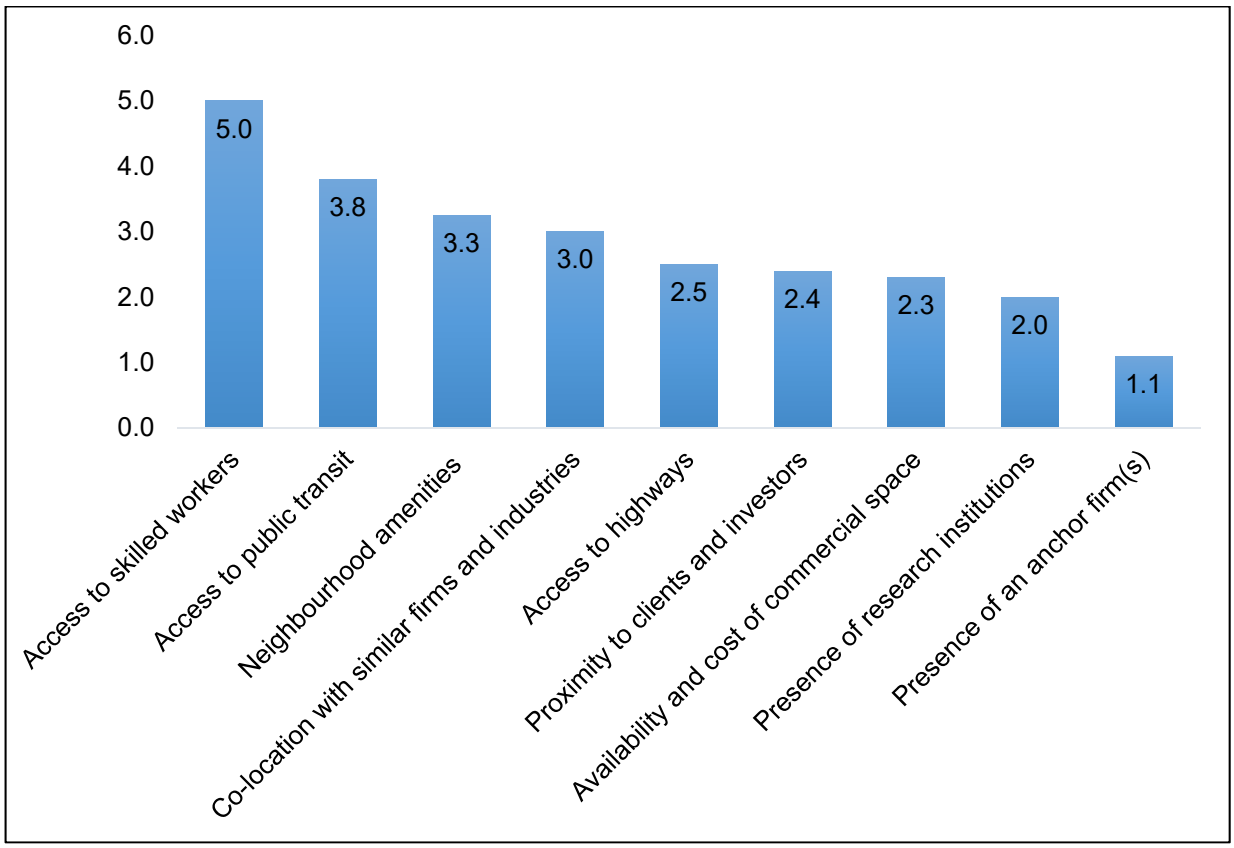
Tech Sector Clustering within the Official Plan Geographies, 2019

Geography	Total Employment	% of 2019 Tech Employment	Total Establishments	% of 2019 Tech Establishments
Downtown	29,701	49.2%	689	39.8%
Centres	7,262	12.0%	114	6.5%
Employment Areas	17,836	29.5%	589	34.1%
Rest of City	5,609	9.3%	337	19.5%

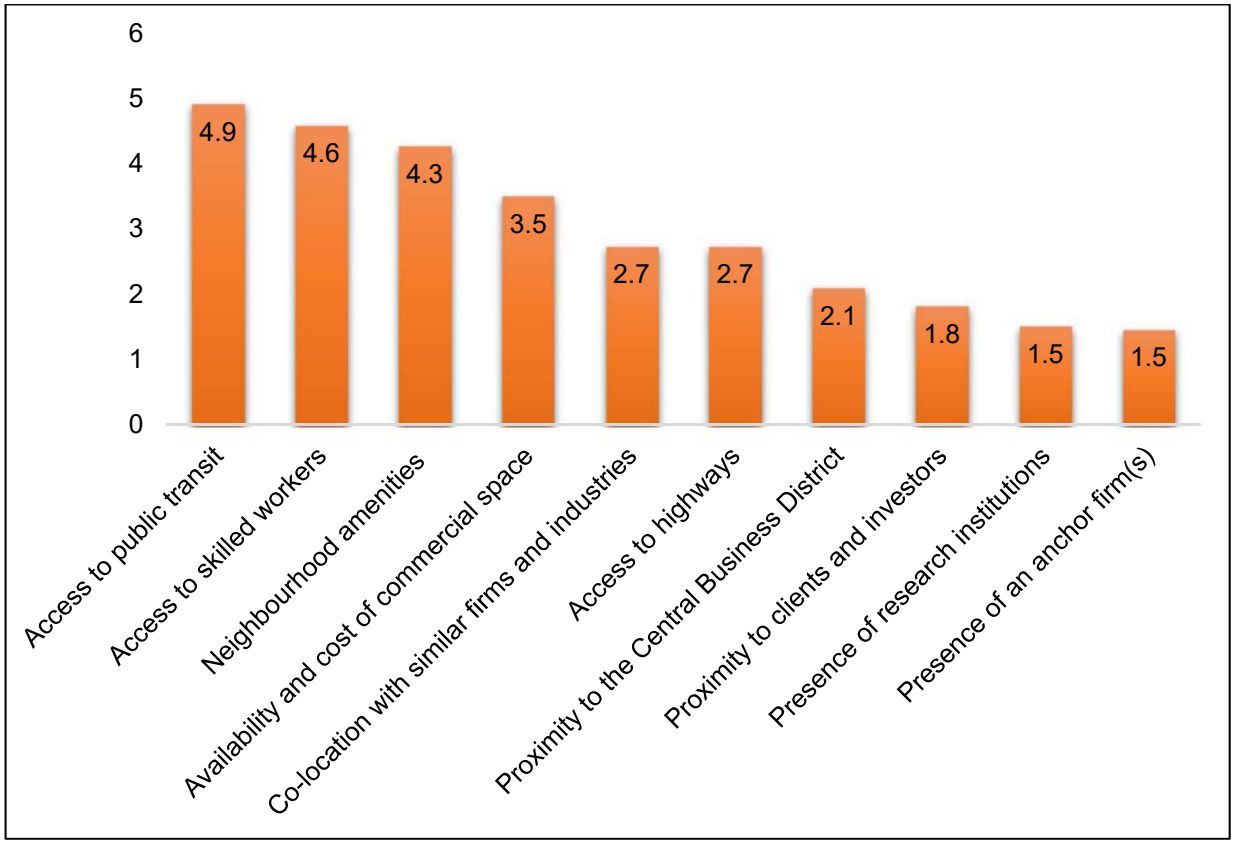
Tech Sector Clustering in the South Employment Monitoring Area, 2019

Total Employment	% of 2019 Tech Employment	Total Number of Establishments	% of 2019 Tech Establishments
38,316	63.4%	994	57.5%

Attribute Ranking for Toronto



Attribute Ranking on the Neighbourhood Scale



Interview Questions

1) What does your company do?

2) Why are you in Toronto?

3) What attributes drew you to Toronto and to the specific location in Toronto where you have your office? Rank the following attributes independently on a scale of 1-5:

o Presence of an anchor firm(s)
o Presence of research institutions
o Access to skilled workers
o Co-location with similar firms and industries
o Proximity to clients and investors
o Proximity to the Central Business District
o Availability and cost of commercial space
o Neighbourhood amenities (i.e. restaurants, cafes, parks etc.)
o Access to public transit
o Access to highways
o Other

4) In one sentence, can you sum up why you are located in the neighbourhood you're in?

5) Were you in another location in Toronto or the GTA previously? If so, why did you move?

6) Is your current location in Toronto ideal for your company's needs?

a. If so, why? If not, what would be the ideal location for your company and why?

7) Are you looking to grow the number of employees in your company in the next few years? If so, how will it impact your office space needs? Would you stay at your current location or move? If you would move, why?