SPATIAL QUALITIES OF INNOVATION DISTRICTS:
How Third Places are Changing the Innovation Ecosystem of Kendall Square

By

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ABSTRACT

This thesis analyzes the spatial dimensions of an urban high-tech cluster in the changing socio-economic landscape of American cities. Using Kendall Square as the primary case study, I analyzed the spatial qualities and characteristics that define an urban high-tech cluster and provide recommendations for how future "innovation districts" should be developed. My in depth study of the built form of Kendall Square reveals that workplaces for the high-tech industry have extended beyond the conventional office setting to include both retail and public spaces: such as cafes, restaurants; and streets, sidewalks, plazas, and open spaces. I label these emerging workplaces as "Third Places" and further emphasize that Third Places are critical catalyst to the success of innovation districts.

Through my findings, I argue that urban high-tech clusters will develop from old urban areas, rather than from newly-born districts, and that such clusters will be concentrated within a walking distance of one or two transit stops, not extending beyond what could be described as a "district." Furthermore, my findings indicate that successful innovation districts are likely to develop spontaneously by incremental private real estate developments, rather than from the urban renewal era's approach of masterplanning. Comparison of the existing development projects in Kendall Square also revealed that an ideal form of innovation district is a mixed-use neighborhood that could accommodate living, working, and playing activities of everyday life.

As a result of my investigation, I provide some policy and design recommendations on how to establish innovation districts. For physical spaces, I offer basic principles of designing urban spaces in a way that could stimulate social interaction, chance encounters and interfirm collaboration, which will contribute to the innovation ecosystem of a place.

Thesis Supervisor: Eran Ben-Joseph
Title: Professor of Landscape Architecture and Planning

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Chapter 1.
Introduction and Research Question

Since 2011, the City of Cambridge has been going through a major planning study to assess the existing value of Kendall Square and envision what its future should be. I have had the opportunity to participate in the process as a project assistant for the city from July 2012 to now. Sitting at numerous planning board meetings and advisory committee meetings, discussing what the future of Kendall Square should be, I couldn't help but notice the recurring concept of *innovation* as an integral identity of the place. As the planning study proceeded, Kendall Square came to be referred as an "innovation district." Although no one could offer an exact definition of the term, it was accepted as a norm by various stakeholder groups, such as residents, business owners, private developers, the city staff, and MIT students, without any objection. When people describe Kendall Square, they describe it as a place with a high concentration of highly-educated people and where collaboration of those people happens naturally, particularly owing to the physical proximity and density of the place. Furthermore, many people believe that such interaction between smart minds leads to innovative ideas and products, such as drugs, software, online services, and other types of knowledge-based products.

For as long as any of us can remember, high-tech industries have flourished in the suburban office parks that are so ubiquitous in Silicon Valley, North Carolina's Research Triangle, and other "nerdistans." But in recent years, high tech companies has been taking an urban turn (Florida 2012). Consequently, the creation of urban districts that aim to attract the highly-educated population, the "knowledge workers," has become a popular economic development strategy for U.S. policy makers, real estate developers, architects and urban planners. Boston's Innovation District has been one of Mayor Menino's most important policy and planning initiatives; New York City's Silicon Alley is home to more than 500 new startup companies like Kickstarter and Tumblr; South Lake Union in Seattle is becoming a new hub for life science organizations; and, San Francisco is in the midst of developing Mission Bay and the 5M Project. Such projects are a few of many district-making attempts nationwide. Even small cities such as Dublin, Ohio and

Holyoke, Massachusetts are in the process of developing their version of an urban district for high-tech industry. To date, it has been reported that more than 300 U.S. mayors have declared the establishment of an innovation district within their jurisdictions.

The new urban districts may vary in size and names, but they share common characteristics: their foremost goal is to attract knowledge workers, which will eventually attract the high-tech businesses; the districts also tend to promote entrepreneurial activities and idea exchange among knowledge workers for the advancement of ideas; and lastly, they aim to achieve the above goals by offering diverse urban lifestyles. Therefore, despite many different titles, in this thesis, I would like to label such districts as "innovation districts." My research goal is to offer guidance for the nationwide attempts to create innovation districts by investigating Kendall Square as a case study. This thesis studies the spatial characteristics of Kendall Square to learn what works and what does not work as the built environment of an innovation district.

The existing study of the high-tech clusters primarily investigates the impact of regional agglomeration from an economic geographer's point of view. A large body of literature claims that firms that are spatially concentrated gain benefit from positive externalities of physical proximity (Castells 1989; Castells and Hall 1994; Hall and Markusen 1985; Saxenian 1994; Markusen 1996). Empirical studies that measured patents also tend to confirm that firms located near knowledge sources such as universities and research centers show higher innovation performance than firms located elsewhere (Jaffe et al. 1993; Audretsch and Feldman 1996; Van Oort 2002). Nevertheless, these statistical studies do not explain *how* physical proximity contributes to increasing the level of innovation (Boschma 2005). In other words, sharing the same neighborhood, or the same building may generate a vital spark, but how?

Despite the fact that prior research works have also emphasized the importance of physical proximity in increasing knowledge spillover, face-to-face conversation, and interfirm collaboration, the impact of physical proximity has only been investigated at a regional scale. Such unbalanced attention given to regional networks is possibly due to the fact that Silicon Valley was such a dominant model for a successful high-tech cluster. In the old Silicon Valley model, the stereotypical built form was a series of discrete office parks dispersed over suburban land. In contrast, the desired built form of the emerging innovation districts is dense urban neigh-

borhoods where buildings are close to each other and where there is high level of pedestrian traffic on the streets.

Saxenian (1994) in describing the significance of physical proximity of the Silicon Valley network mentions "the de facto headquarters for venture capital activity on the West Coast was the office complex located *just a few miles* from Stanford University where the venture capitalists met up frequently to exchange information." Nevertheless, the same sense of proximity does not apply to dense urban areas such as Boston, Cambridge, New York, Seattle, and San Francisco where a new generation of high-tech clusters are emerging. Where and how does knowledge spillovers happen in these urban high-tech clusters, namely, the innovation districts? What are the spatial characteristics that stimulate innovative activities in highly urbanized areas? What we have learned so far from studying the phenomena of agglomeration of high-tech industries at regional scale is insufficient to understand how innovation districts function in reality. We need to acknowledge this knowledge gap caused by the difference of scale and turn our attention to the emerging urban districts that are notably different from its past.

Therefore, the question for urban high-tech cluster is: where and how does that interaction happen? What Kendall Square brings into focus is the value of understanding how innovation happens at a district level. The Boston Consulting Group study called "*Protecting and Strengthening Kendall Square*," authored by Ranch Kimball (2010), stated that Kendall Square has the highest number of biotech and information technology workers per square mile in the world. Although Kendall Square is nothing like the Silicon Valley in sheer size, in fact, it has been traditionally understood as only one part of Boston's Route 128 network, the value of its density, urban environment, and innovative activities attracted much attention as an innovation district worldwide. This shift of focus from a regional to district-level perspective offers a new opportunity to understand how the face-to-face conversation, idea sharing and collaboration actually takes place.

Through in depth analysis of how knowledge workers live, work, and play in Kendall Square, this thesis aims to identify the spatial qualities and characteristics that supports innovative activities and therefore are contributing to the establishment of innovation districts. As a designer, my interest was to test the power of physical design in fostering economic development of an area. Therefore, to understand how physical spaces are influencing economic activities, I undertook spatial studies of urban spaces in Kendall Square. By doing so, my ultimate goal is to offer policy

recommendations and design guidelines to the nationwide attempts to create and enhance innovation districts. Using Kendall Square as the primary case study, this research strives to answer the central question of:

What form does high-tech clusters take in an urban setting? What are the spatial qualities and characteristics that constitute such clusters?

The core question is supplemented by the following sub questions:

1. How did Kendall Square evolve from an office park to an innovation district?
2. Where and how do the innovative activities, i.e., interaction between knowledge workers, happen?
3. How do knowledge workers utilize urban spaces?
4. What physical/non-physical characteristics of urban spaces are effective in stimulating social interaction, chance encounters and interfirm collaboration?

Through my findings, I argue that urban high-tech clusters will develop from old urban areas, rather than from newly-born districts and that such clusters will be concentrated within a walking distance of one or two transit stops, not extending beyond what could be described as a "district." Furthermore, my findings indicate that successful innovation districts are likely to develop spontaneously by incremental private real estate developments, rather than from the urban renewal era's approach of masterplanning. Comparison of the existing development projects in Kendall Square also revealed that the ideal type of real estate development for innovation districts is a mixed-use project that could contain living, working, and playing activities of everyday life within a single development. If accommodating such varied uses is not feasible within a single development due to scale and complexity of a development, I recommend an intervention from the government to balance the mix of uses among different projects.

My conclusions also include some design recommendations for physical spaces of innovation districts. Although I could not find an answer to the question of whether or not urban amenities and quality of life are influential enough to initiate economic development by attracting highly-skilled workers and high-tech businesses, my analysis of the urban spaces in Kendall Square revealed that urban amenities have been effective in increasing the level of innovative activities and consequently have accelerated the growth of high-tech industry and entrepreneurial activities.

Therefore, I offer basic principles of designing urban spaces in a way that could stimulate social interaction, chance encounters and interfirm collaboration, which will contribute to the innovation ecosystem of a place. I label these good urban spaces the "Third Places" in this thesis. Third places include retail spaces such as cafes, restaurants, and cultural amenities; and public spaces such as streets, sidewalks, plazas, and open spaces.

I believe that the built form of Kendall Square is especially worthwhile investigating at this point for two reasons. The first reason is immediately practical. The MIT real estate investment company, Mitimco, has recently got approval from the City of Cambridge to develop approximately an additional million square footage of commercial development right in the heart of Kendall Square, along the south side of Main Street. This development is extremely contentious among the community and is sure to influence the innovation ecosystem of the area. Therefore, a careful examination of the existing condition of Kendall Square and how it is functioning, especially with regard to the influences of the built environment, will become an invaluable guidance for future planning of MIT's real estate developments.

The second reason has a more theoretical value. Creating innovation districts or even broadly, the creative centers, is being deployed as a popular policy to attract businesses and people of the twenty-first century (Florida, 2002). However, very few of them are proven to be successful. Through a careful study of how the innovation ecosystem works in Kendall Square, this thesis will aims to critically assess the potentials and limitations of real estate developments in creating a successful innovation district.

Research Methods

While my data collection encompasses many different methods such as interviews, archival research, survey, photography, and onsite observation, my data analysis method is primarily composed of two distinct approaches: process-tracing and environment-behavior research. The two research analysis methods structure the organization of my thesis. Chapter three is mainly composed of the process-tracing method and chapter four offers the results from environment-behavior research.

Process-tracing method is mainly used to identify the history of Kendall Square with special focus to understand the influence that built environment have had on economic development of the area and vice versa. The rapid transformation of

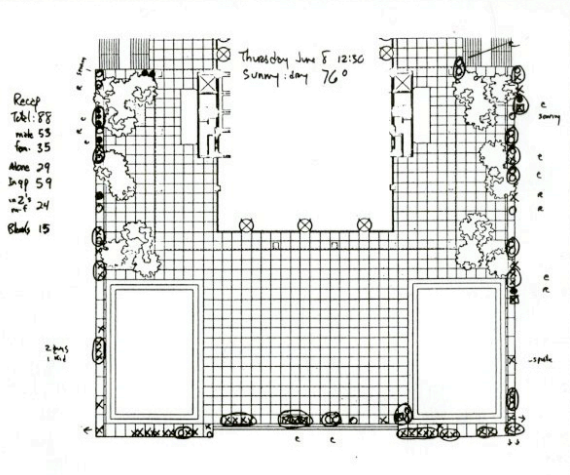


Figure 1-1. Typical head count map of William H. Whyte's investigation of the public plazas in Manhattan, (Whyte 1961)

Kendall Square within the last two decade is rigorously traced back to understand how Kendall Square evolved from an industrial wasteland to an innovation district. A combination of qualitative methods such as content analysis of archival materials, planning documents and newspaper articles, interviews of the city officials, real estate developers, entrepreneurs, and MIT academics have been utilized to make sense of how Kendall Square came to be an innovation district and the interrelationship between built environment and economic development of a place.

Environment-behavior research is used to observe how the knowledge workers of Kendall Square are using its urban spaces and to analyze the economic impact of such behavior of the knowledge workers. To do so, I have conducted onsite observations, interviews, and a survey to triangulate the findings. First, I observed how the knowledge workers make use of the urban spaces outside their conventional workplace as places for innovative interactions. Multiple onsite visits were conducted at different times of the day throughout the month of April to capture a comprehensive set of activities happening in Kendall Square. I also conducted semi-structured interviews and surveys of the knowledge workers asking how they are actually using the physical environment of Kendall Square and how interfirm collaboration, idea sharing, and social networking is happening in those spaces. Some of these interviews were carried onsite and often happened by chance. Therefore these interviews were unstructured and were not recorded. Nevertheless, the informal conversations I had with the workers of Kendall Square also played a critical component of understanding how the urban spaces are being used. The combined result of onsite observations, semi-structured interviews, survey results, and informal conversations will offer in depth knowledge about what types of physical environment stimulate or does not stimulate innovative activities.

Organization

This chapter is followed by chapter two that overviews the current research and practice of the high-tech clusters. The chapter two divided into three subsections that concentrate on different fields. First section provides general overview of the socioeconomic context of the technology-based postindustrial society. The concept of well-known theories such as Peter Drucker's Knowledge Economy, Alvin

Toffler's Information Age, Manuel Castells' Information City, and Richard Florida's Creative Class are reviewed. Second section provides a literature review of the high-tech clustering theory of economic geography. It presents past research that was conducted to understand the phenomena of regional agglomeration of the high-tech industries. The last section offers a literature review of the theory and practice of the field of architecture in advancing the workplace for the evolving demand of high-tech society. This is a section that describes the evolution of workplace that has been happening inside individual office buildings.

The focus of chapter three is to process-trace how Kendall Square came to be an innovation district. It starts out by briefly reviewing two other examples of innovation districts to emphasize the common characteristics of such districts. The second section focuses on the economic development perspective of the history. It looks into the rise and fall of high-tech industry in Kendall Square and points out the milestone events that triggered the past changes. The third section provides the history of Kendall Square's built environment by looking at the history and effect of major real estate developments in the area. The last section synthesizes the two branches of history and tries to make connections between the two seemingly irrelevant histories.

Chapter four concentrates on the spatial characteristics of Kendall Square with special attention given to some good urban spaces, what I call Third Places, in the area. The aim of this chapter is to argue how and why Third Places of Kendall Square are enhancing the innovation ecosystem of the place. The first section attempts to introduce the inventory and typologies of the Third Places in Kendall Square. The second section is a summary of environment-behavior research of the actual spaces. It presents results of the onsite observations weaving in interviews and survey results to construct a narrative of how the urban spaces of Kendall Square is being used by the knowledge workers.

The thesis ends with a concluding chapter that synthesizes the findings presented in the previous chapters to construct an argument about how future innovation districts should be developed. The purpose of the last chapter is to propose some policy and design recommendations for future innovation districts and delineate opportunities and limitations of district-making approaches.

Limitations and Recommendations for Future Research

Despite my endeavor to conduct a research that is as comprehensive as possible, there were clear limitations to the scope of my research. So here I set forth such limitations and offer some recommendations for future research that could be done to further the findings of this research. First of all, due to the time constraints, I did not get to talk to as many people as I would have wanted to. Talking to more entrepreneurs in general and conducting more focused interviews as a follow-up of the informal conversations at the networking events I attended would have offered a more profound knowledge about the behaviors of knowledge workers. Along the same line, collecting more survey responses would have helped to generalize data and even to conduct some statistically significant analysis with the data. Additionally, following up with the survey respondents, who were willing to share their experiences, will give a better sense of how Third Places are being used and perceived by knowledge workers. Lastly, it would have helped much to conduct a similar in-depth study of urban spaces of an another innovation district to compare the results.

Definitions

High-tech Industry

This thesis investigates urban industrial clusters that have high concentration of high-tech industries. However, the definition of the term high-tech industry is somewhat amorphous. So I used the North American Industrial Classification System (NAICS), which is the standard used by Federal statistical agencies in classifying business establishments, to define the economic activities present in Kendall Square. It is also important to note that many startup companies in the area fall out of the NAICS definition of high-tech industry and therefore was considered as an another important component of the business mix in Kendall Square.

The NAICS classifies the high-tech industry into 29 manufacturing and 10 services industries. The business profile in Kendall Square is composed of the Pharmaceutical and Medical Manufacturing (3254) and all of the ten service industries:

5112 Software Publishers
514191 On-Line Information Services
5142 Data Processing Services
5182 Data Processing, Hosting, and Related Services
5413 Architectural, Engineering, and Related Services

5415 Computer Systems Design and Related Services
5416 Management, Scientific, and Technical Consulting Services
5417 Scientific Research and Development Services
6117 Educational Support Services
811212 Computer and Office Machine Repair and Maintenance

"Innovation District", "Technopole", "Tech-Pole", "Creative Center"

High-tech centers have many names and the varied terms are used interchangeably even when the concepts are slightly different. Therefore, some of the most commonly-used terms are clarified in this section. This thesis defines Kendall Square as an innovation district due to its small scale and its history of having been developed through incremental private developments.

- Technopole: Technopoles are planned developments, which are promoted by governments at various scale in association with potential tenants such as universities and private companies (Castells, 1998). They conceptualize the largest development among the terms that define places where high-tech industries are concentrated. Castells characterizes its urban form as "series of discreet buildings … with a campus-like atmosphere."
- Tech-Pole: Tech-Poles are regional concept that indicates metropolitan area of technology production centers with gravitational pull (DeVol 1999).
- Creative Center: Creative Centers are similar to Tech-Poles but include wider range of industries outside the high-tech industry. Creative Centers have high levels of innovation and high-tech industry and very high levels of diversity (Florida, 2002).
- Innovation District: Innovation Districts, Centers, Clusters are generally neighborhood-scale places with high concentration of high-tech industries. Most of such places are composed of smaller scale individual real estate development projects that ranges from one building to 30 acres building complexes.

Knowledge Workers

Many researchers have attempted to characterize the rise of a new economic class in the knowledge economy of the twenty-first century. During the 1960s, Peter Drucker and Fritz Machlup described the growing role and importance of the new group of workers they labeled "knowledge workers." (Drucker, 1969; 1993; Machlup, 1962) In his book, *The Post-Industrial Society* 1973, sociologist Daniel

Bell also recognized the rise of the new meritocratic class of scientists, engineers, and administrators of the postindustrial economy. Sociologist Erik Olin Wright has written about the rise of what he called a new "professional-managerial" class for decades through series of publications: *Classes* in 1990; *Class Counts* in 1996; and *Class Crisis* in 1996. Robert Reich advanced the term "symbolic analysts" to describe the members of the workforce who manipulate ideas and symbols in this book, *The Work of Nations* published in 1991. Most recently, the concept of the "creative class" coined by Richard Florida has become commonplace description of the new highly-educated population that is leading the postindustrial economy. According to Florida, the creative class are the people who add economic value through their creativity and the class is consisted of two distinct subclasses. First, tier is the super creative class that includes artists, filmmakers, scientists, and engineers, and the second tier is the creative professionals, which includes professional service workers (Florida 2002).

Majority of the workforce in Kendall Square is well represented by Florida's definition of the creative class, since Kendall Square's economic activity can be classified as mostly high-tech and other entrepreneurial. Therefore, much of the workers such as scientists and engineers fall under the definition of super creative class. The entrepreneurs and other professional service workers such as lawyers whose business is not defined as high-tech industry could fall neatly under the term creative professionals. However, I avoid using the term creative class and instead chose to use a more general term "knowledge workers," because of the misconception creative class might convey, as the term has been widely used in practice to describe artistic and bohemian population.

Chapter 2.
Literature Review

Tracing the historical and theoretical background of the technology-focused district development requires an interdisciplinary literature review. I have identified three distinct academic research fields relevant to the high-tech centers. The first field is the general overview of the theory of postindustrial society, which goes under a variety of labels: 'the knowledge economy', 'the information age, 'the creative class.' Here, I provide an overview of how economists and sociologists have defined the era of high-tech industry and selectively synthesize the theories to frame my research question. The second part is a review of the clustering theory of the high-tech industries in the field of economic geography and sociology. The ultimate purpose of the second section is to point out the logical leap that results from trying to understand innovation districts at a regional scale. By acknowledging this knowledge gap, I emphasize the need to analyze innovation districts from an urban planner's point of view. Lastly, the third section focuses on an overview of how urban planners and architects have been revolutionizing workplaces to meet the needs of the high-tech industry. This section highlights the past and current practice of building workplace for the high-tech industry through case examples. The purpose of this section is to extract what we have learned from the built environment at building scale and apply it to design an innovation district. Somewhere in between regional network and individual buildings, we will be able to develop appropriate guidelines to create a thriving innovation district.

2.1. Socioeconomic context of the High-tech Industry

To understand how innovation district of the high-tech industry came into being, one must first characterize the specific economic era and development context from which that industry has emerged. The idea that the advanced nations are moving toward knowledge-based economies has become a commonplace in social analysis and public discourse (Drucker 1993, 8; 1999; 2001). However, a number of terms in current use emphasize related but different aspects of the emerging

global socioeconomic order: Information Society, Knowledge Economy and Creative Economy. Despite the subtle differences between each terminology, there is a consistent element among the different theories in that knowledge is the key factor in production and that it mostly consists of new science-based industries and the professional service industries (Brint 2001). Therefore, I wish to highlight the similarities and differences of the theories in an attempt to reformulate the knowledge economy idea to provide an appropriate background context of analyzing innovation districts.

However one defines the economic era of the postindustrial society, one common ground is the technological evolution of the information transfer and communication methods. Tom Foresters' 1987 book, the *High-Tech Society* provides an extensive overview of such technological evolution and its impact on the way we live, work and think. To summarize, the proliferation of personal computers made possible by cheap and powerful microchips and the digitization of information, which resulted in the explosion of telecommunications, have had a significant impact on our lives. Computers have influenced every sector of the economy, even agriculture, and in offices, we witnessed a dramatic shift from traditional paperwork to the electronic office (Forester, 1987).

Therefore, the Information Society tends to be the most encompassing concept that characterizes the postindustrial society. Despite the fact that there is currently no universally accepted concept, most theoreticians agree that a transformation can be seen that started somewhere between the 1970s and today and is changing the way societies work fundamentally (Wikipedia contributors 2013). Under its definition, Knowledge Economy could be defined as an economic concept that is a subset of a society. An information society is a society where the creation, distribution, use, integration and manipulation of information is a significant economic, political, and cultural activity. The aim of the information society is to gain competitive advantage internationally, through using information technology (IT) in a creative and productive way. The term Information Age is somewhat limiting, in that it refers to a 30-year period between the widespread use of computers and the knowledge economy, rather than an emerging economic order.

The term Knowledge Economy is perhaps the most frequently used word in describing the economic counterpart of the Information Society. It originated from the 1962 book of Princeton economist Fritz Machlup, *The Production and Distribution of Knowledge in the United States*, and was popularized by Peter Drucker's

1969 book, *The Age of Discontinuity*. The basic idea is that capital and labor are no longer the major structural features of the major economic resources. It is information and knowledge that are driving the economic production (Bell 1973).

Knowledge Economy alone has various explanations defined by different scholars. Brint (2001) provides a comprehensive overview of this entire field and divides up the field into three major branches. The first branch is the work of Machlup, where the purpose of the knowledge-based industry is to make an impression, any impression, on the minds of other persons (Machlup 1962). However, because of the fact that definition of knowledge was too broad, Machlup's theory have not been widely accepted to fully portray the shifting postindustrial society. Later on, Porat and Rubin reinvent Machlup's idea and relabeled it as the Information Economy in their report prepared for the U.S. Dept. of Commerce, Office of Telecommunications in 1977. The OECD has employed Porat and Rubin's definition for calculating the share of the information economy in the total economy (e.g. OECD 1981, 1986). Based on such indicators, the information society has been defined as a society where more than half of the GNP is produced and more than half of the employees are active in the information economy.

The second branch perceives knowledge as a factor of production with special emphasis on the application of intellect to constant innovation and growth in large-scale enterprises (Galbraith 1967; Drucker 1993). Management theorists argued that 'cutting-edge' corporations were 'knowledge-centered' because they had developed tools for creating self-consciousness about innovation. According to Drucker, 'knowledge is applied to knowledge itself.' (Drucker 1993). A follower of Drucker's, Ikujiro Nonaka, described how this process works in Japan, where project teams constantly searched for ways to innovate the production process so as to create a more consumer-oriented goods (Nonaka and Takeuchi 1995).

The third branch has its focus on the scientific and professional knowledge generated and transmitted through high-level institutions such as universities. Theorists of this branch have not agreed on how the scientific and professional knowledge should be defined. For instance, Daniel Bell (1973) focused on high-tech industries and non-profit services such as health, education, and government. Thomas M. Stanback (1979) focused on the professional services such as finance, accounting, consulting, etc.

To date, there is no consensus among scholars on what should be the most ap-

propriate definition of the Knowledge economy. Therefore, I have selectively chosen to apply the term that is most suitable to describe the economic activities happening in Kendall Square. Since Kendall Square is mostly represented by the high-tech industry and the knowledge transfers from MIT and high-level research institutions, I adopt Bell and Stanback's concept and interpret the socioeconomic context of Kendall Square's economic growth.

On the other hand, an influential concept emerges in 2002 that focuses on understanding the emerging social class of the Information Society. The argument of the Creative Economy is that creativity, the creation of useful new forms out of knowledge, is the key driver. "Knowledge" and "Information" becomes the tools and materials for creativity. "Innovation", whether in the form of a new technological artifact or a new business model or method, is its product (Florida, 2001)

It is noteworthy recognizing the Creative Class theory because it delineates how our everyday lifestyles and choices are changing. According to Florida, the economy is moving from an older corporate-centered system defined by large companies to a more people-driven one. This is not to say that big companies are dying off. In the era of the Creative Economy, people are the critical resource of the new age as the fundamental source of creativity. This has tremendous effects our economic and social geography and the nature of our communities. First of all, contrary to some observers have predicted at the dawn of the technological revolution, place has become the central organizing unit of our time. Second, people don't just cluster where good-paying jobs are located. They cluster in places that are centers of creativity and also where they like to live. Successful places are multidimensional and diverse. They don't just cater to a single industry or a single demographic group; they are full of stimulation and creativity interplay (Jacobs, 1961; 1969; 1984). Our fundamental social forms are shifting as well. The decline in the strength of our ties to people and institutions is a product of the increasing number of ties we have. In the new world, people no longer define themselves by the organizations they work for.

The theoretical idea of Bell and Stanback's Knowledge Economy and Florida's description of the emerging societal class seems to capture the people and activities of Kendall Square collectively. Nevertheless, there is one last emerging theory that is worth covering, which is the Innovation Economy, coined by Enrico Moretti, Professor of Economics at the University of California, Berkeley. According to Moretti, the high-skill activity and high-wage employment are concentrated

in specific places and that these places have a strong innovation-based economy, which includes high-tech manufacturing, science and engineering, some financial services, parts of the creative economy, and the whole of the digital economy (Moretti, 2012).

The growth Kendall Square has been driven by groundbreaking innovations. Innovation has been a critical factor shaping long-term national economic development (Schumpeter, 1962) New ideas, as embodied in human capital and research and development have served as the foundational conditions for economic growth (Lucas, 1988; Romer, 1990). Therefore, I define the socioeconomic context of Kendall Square as Innovation Economy in the Information Society.

2.2. High-tech Clustering Theory

> *"There's a temptation in our networked age to think that ideas can be developed by e-mail and iChat. That's crazy. Creativity comes from spontaneous meetings, from random discussions. You run into someone, you ask what they're doing, you say "Wow," and soon you're cooking up all sorts of ideas"*
>
> - Steve Jobs

Clustering of the companies in a likely industry is not a concept that only applies to the high-tech industry. Rather, the study of such phenomena dates back to 1920 when Marshall argues that concentrating specific industries creates several advantages and has been developed subsequently by other economists such as Hirschman, Perroux, and Jacobs. At the dawn of the information society and technological evolution, some futurists have gone far enough to argue there will not be need to cluster due to the advancement of technology. Nevertheless, the paradox of the information society where virtual communication is so prevalent is that cities and regions are increasingly becoming critical agents of economic development (Castells, 1994). As a result the importance of space and territory as a crucial economic factor of the high-tech industry has been a focus of interest by industrial economists.

In general, clusters are defined as groups of firms, related actors, and institutions that are located near one another and that draw productive advantage from their mutual proximity and connections. Porter stresses the importance of local clusters

in easing the management of modern value chains in which more firms contract out not just traditional parts of production or support services by manufacturing, IT systems and management, training, design, and R&D (Porter 1990). Furthermore, he characterized clusters as follows: 1) Strong pre-commercial R&D capabilities-Defense, National Institutes of Health funding, etc; 2) Ongoing private sector investment-i.e. venture capital; 3) World class universities as sources of scientific personnel, equipment, and knowledge spillover; 4) Social Capital: Networking fostered by proximity to major institutions of higher learning is critical high-tech clusters tends to thrive when customers, talent pools, and thought leaders consistently interact (Porter 1998).

In field of high-tech industrial clustering, a major impact of the economic literature is in the importance relating to the notion of "knowledge spillover" effect as a key for clustering of the high-tech firms. For innovative activities, knowledge are regarded to be effectively transmitted only through interpersonal contacts and interfirm mobility of workers and therefore, geographically bounded within regions (Audretsch and Feldman 1996). Especially the case studies of successful high-tech clusters have advocated for the importance of social relationships and informal interactions between people based upon common instrumental goals and sharing work culture in the transmission of tacit professional knowledge (Saxenian 1990; Castells 1989, 72). In other words, the face-to-face contact and discussions over lunch or on the golf course is remain crucial to the success of industrial clusters like Silicon Valley.

So we know why high-tech companies cluster: to benefit from the network of knowledge sharing. Therefore, a key feature of successful high-tech clusters is related to the high-level of embeddedness of local firms in a very thick network of knowledge sharing, which is supported by close social interactions and by institutions building trust and encouraging informal relations among actors (Breschi 2001). Nevertheless, despite its emphasis on the face-to-face interaction and knowledge spillovers through informal interactions, the existing literature of economic geography does not illustrate a good picture of how such interactions are happening in the physical space of clusters. There is still little positive empirical evidence for the knowledge spillovers through social interactions and recent empirical studies have shown mixed-results for the validity of spatial proximity and knowledge exchange (Smit 2012).

Aside from the advantage of knowledge spillovers, over recent decades, research of the location choice of knowledge-intensive firms in post-Fordist, knowledge-based urban economies has increasingly recognized soft location factors as influencing firms and worker location behaviors (Florida, 2002; Musterd 2004; Scott, 2007). For instance, a research of American artists' decisions over where to work and live revealed that proximity to the inner city with professional institutions and night life, and the provision of living and work spaces dedicated to cultural industries influenced (Markusen, 2006). Such studies stress the importance of the good urban environment in influencing the clustering of knowledge-intensive firms.

In *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Saxenian's comparison of the underlying cultures that influenced the success of these two high-tech clusters, she argues that the difference between the two regions was social capital in that Silicon Valley's dense social networks and open labor markets encouraged experimentation and entrepreneurship. Nevertheless, Kendall Square, which was a mere part of Route 128, is becoming a new locus of entrepreneurship and innovation. In fact, this thesis argues that Kendall Square's good urban environment may be furthering knowledge spillovers, even more so than the social ties of Silicon valley by increasing the chance of spontaneous social interaction and by attracting more knowledge workers to a place.

2.3. Evolving Workplace

Rightfully represented by Malcom Gladwell's analogy between office space and an urban neighborhood, which was introduced in a New York Times article on December 11, 2010, office spaces have been learning from thriving urban neighborhoods to create innovative work environment. Thriving urban neighborhoods like the Hudson Street, as described in Jane Jacob's book "The Death and Life of Great American Cities," was created by the particular configuration of the streets and buildings of the neighborhood. When a neighborhood is oriented toward the street, when sidewalks are used for socializing and play and commerce, the users of that street are transformed by the resulting stimulation: they form relationships and casual contacts they would never have otherwise (Jacobs 1961).

In the eighties and early nineties, the fashion in corporate America was to follow what designers called "universal planning" - rows of identical cubicles. Univer-

sal planning has fallen out of favor because it turned out the classical approach of arraying identical cubicles lowers productivity, communication between workers, and hampers creativity. Empirical studies have proven that the classical approach of arraying offices in a linear fashion maximizes the separation distance between occupants of the offices and is hardly the best way to promote communication. A decade-long study of the way in which engineers communicated in research-and-development laboratories revealed that the frequency of any two people communicating about technical or scientific matters drops off dramatically as the distance between their desks increase (Allen 1977).

As innovation is at the heart of knowledge economy, companies strive to create office space with diversity of uses learning from the thriving neighborhoods because they believe that innovation is fundamentally a consequence of social activities. Ideas arise as much out of casual conversations as they do out of formal meetings and this is what generates innovation. A study after another has demonstrated that the best ideas in any workplace arise out of interdepartmental communication and casual contacts among organizations (Allen 1977; Kahn 1996). Since the late nineties, such desire to increase innovation resulted in explorations of creative office design within a building or a complex of buildings for a single company. The new type of office planning, often called open floor plan, flexible space, and "nonterritorial" office plan, began to set norm as the way to increase interdepartmental collaboration and casual conversations, and creative work environment. More interestingly, the emerging offices are looking more and more like the thriving streets depicted by Jacobs. Employees are encouraged to walk around the corridor and interact with other employees, so the common areas are now located at the center of the office to be used for socializing and play.

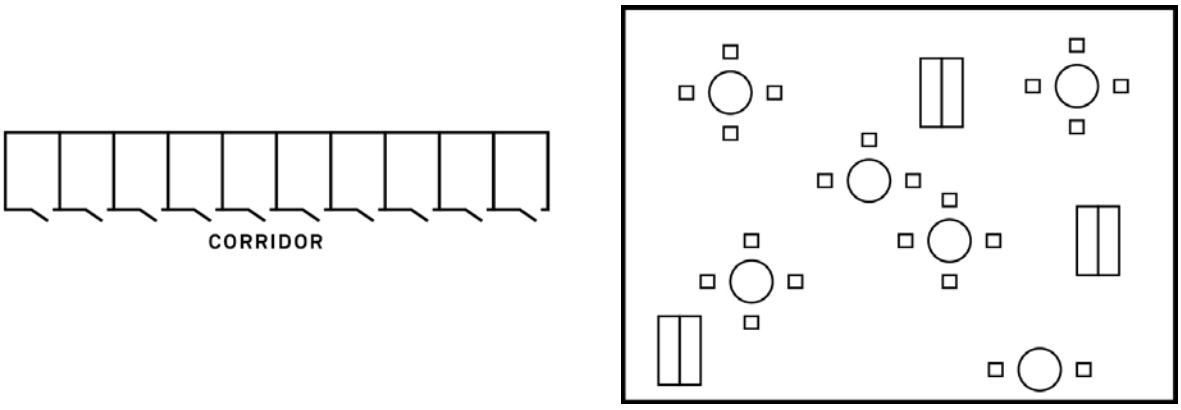


Figure 2-1. Diagrams illustrating the traditional office layout with a corridor and identical cubicles (left) and the contemporary trend of nonterritorial office layout (right)

The headquarter of the advertising agency TBWA\Chiat\Day is one of the first design that realized the concept of nonterritorial office resembling a vibrant urban neighborhood. In 1998, the agency moved into its new office in LA, which was formerly a huge old warehouse: three stories high and the size of three football fields. Sometimes called the Advertising City, the designer Clive Wilkinson Architects who also designed Google's Mountain View headquarters literally constructed an artificial urban neighborhood for the agency. The floor is bisected by a central corridor called Main Street and in the center of the room is an open space, with cafe tables and a stand of ficus trees, called Central Park. There's a basketball court, a game room, and a bar. Most of the employees are in snug workstation known as nests, and the nests are grouped together in neighborhoods that radiate from Main Street like Paris arrondissements. The top executives are situated in the middle of the room. Sprinkled throughout the building are meeting rooms where employees can closet themselves when they needed to.

(left) Figure 2-2. TBWA\Chiat\Day's nonterritorial office design (Clive Wilkinson Architects)
(right) Figure 2-3. MIT Building 20, as it looked circa 1946 (MIT Museum)

In fact, it is ironic that the idea of flexible and nonterriotrial office planning has already been tested and proven its value at MIT in the 1940s and 1950s. Originally built in 1943 as a temporary building for part of Radiation Laboratory, the Building 20 was supposed to be demolished immediately following the end of World War II. The building was described by many people as shabby, dingy, or unpretentious. However, its lack of style and low-visibility have allowed its occupants to be wonderfully creative and successful within its walls (Brand, 1994).

People were literally bumping into each other and breaking into serendipitous conversations in Building 20. Many people believe that the horizontal layout of Building 20 encouraged collaborations. People who met in the lobby, or in one of the long hallways, or on a wooden staircase could easily share information and ideas.

Although some people felt as if they were being overlooked, it was liberating for others who felt freer to be creative and made the most out of the available space.

Best of all, Building 20 was made out of wood. This is a feature that many of the building's occupants have commented on. Jerome Lettvin, Professor of Electrical Engineering and Bioengineering, says: "You could do anything you wanted within your own confines. You could put up partitions, take them down, rewire anything you wanted to." In 1952, Professor Jerrold Zacharias knocked out two floors of the building to make room for a three-story metal column that became the world's first atomic clock. Professor Walter Rosenblith took out the floors and walls in one lab and made a floating room to measure very small signals without any chance of vibration. "The whole thing was made of plywood. If you didn't like what you had, you just changed it." Jerome Wiesner, who later became founder of the MIT Media Lab referred to this building as "the best building in place" (Garfinkel, 1991).

Perhaps, the interdepartmental, entrepreneurial spirit of the Media Lab was once again originated from the flexible Building 20, the plywood palace. Wiesner, who worked in Building 20 for more than a decade and later became the director of RLE, praised the building as the "best building in place." RLE, the Institute's first interdepartmental lab established as the legacy of the Rad Lab, thrived in Building 20. And while RLE's mix of the best and the brightest electronics experts in the world was surely responsible for the lab's success, the building itself was a player as well: "I think that a lot of things were better because of Building 20."

Nevertheless, despite many corporate's attempt to create unparalleled workplace for their employees, a new trend is once again changing the workplace and this time change is outside the scope of architecture. The fine line between where people work and where people carried on their everyday activities are dissolving. More and more people are working in their homes, cafes, restaurants, and even when they are on the move. This convergence work and life has been made possible largely due to the technological advancement. With the emergence of portable, wireless laptops, wifi internet networks, increased use of personal smart phones and email services changed how everyday people live and work. Consequently, activities that used to be confined within an office building are dispersing throughout spaces that used to accommodate other daily activities.

This blurring between life and work is a game changer, and this is not equivalent to saying that that there is no need for office space in the future. In fact, face-to-face

interaction is ever more important than it has been in the past. In February 2013, Yahoo CEO Marissa Mayer called all of their telecommuters to report back to the headquarter:

> *"To become the absolute best place to work, communication and collaboration will be important, so we need to be working side-by-side. That is why it is critical that we are all present in our offices. Some of the best decisions and insights come from hallway and cafeteria discussions, meeting new people, and impromptu team meetings. Speed and quality are often sacrificed when we work from home."*

Yet, there is another layer that is changing our workplace: location. The new trend of convergence of work and life is happening in urban areas. The closer an office is to rich urban neighborhoods, the richer amenities and expansion of workspace the companies get to benefit from. Offices are turning their attention to urban locations. Zappos CEO Tony Hsieh is planning to move the company's headquarters to the old city hall in downtown Los Angeles. "When you're in a city, the bar or the restaurant becomes an extended conference room," he says in his interview with the CNNMoney in 2012.

In the corporate culture of the 1950s, well depicted in Whyte's class book, *The Organizational Man* (1956), the desired location and type of corporate office was a secluded suburban office park in a middle of beautiful natural landscape. Suburbs were favored by the established management group, because suburbs had better education and nicer homes at a cheaper price. It was perceived as a safer place to raise children and lead family life than an urban location. The improvement of transportation infrastructure such as highway system and railroad made it even more convenient for the companies to spread out to the suburbs. As a result, the

(left) Figure 2-4. John Deere World Headquarters in Moline, Illinois. Designed by Finnish architect, Eero Saarinen in the 1960s (source not identified).
(right) Figure 2-5. Pepsi Co World Headquarters in Purchase, New York. Designed by EDSA in the 1970s. (EDSA)

corporate headquarters were built in tranquil suburban areas, surrounded by lakes and trees and not to mention, huge parking lots. Some of the most representative of the era are: General Motors Technical Center (Warren, MI); Deere and Company World Headquarters (Moline, Illinois); Pepsi Co World Headquarters (Purchase, Harrison, NY); and Union Carbide World Headquarters (Danbury, CT).

The tendency to prefer urban locations does not only come from the employers but also from an employee's perspective. No matter how well Google replicates a thriving urban neighborhood in their office complex in Mountain View, with well-stocked salad bars, Wii stations, and bean bag chairs, employees are not excited about having to travel to Mountain View everyday where there is no real city around their work. Turning office into a fabricated neighborhood is not enough. Companies are their attention to urban locations.

Fifty years ago, people lived in neighborhoods like the West Village and went to work in the equivalent of suburbs. At the turn of the century, in one of the odd reveals that mark the postindustrial economy, they live in suburbs, and, increasingly, go to work in the equivalent of the West Village. Now, knowledge workers desire to live and work in a same urban location.

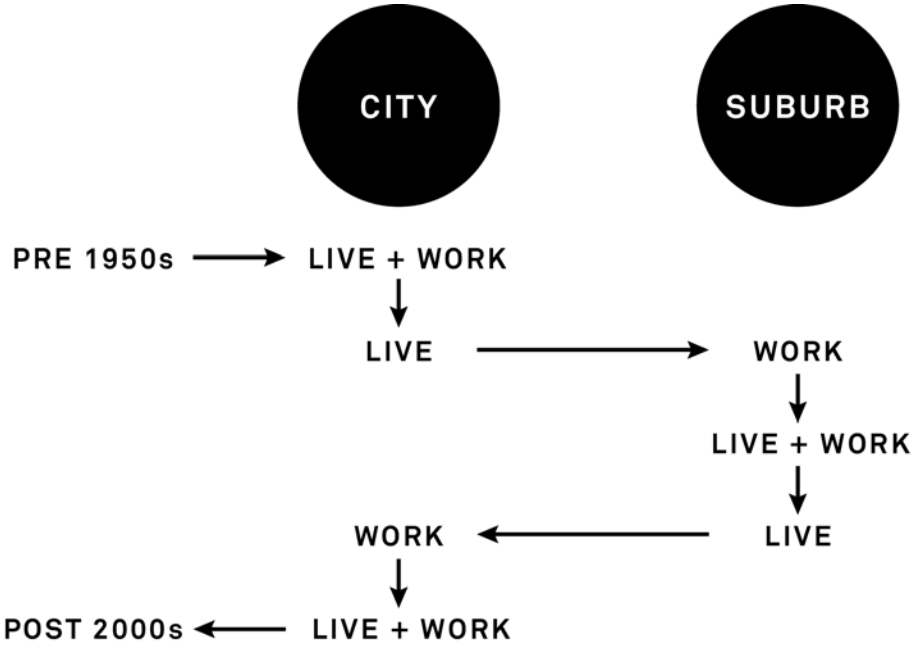


Figure 2-6. Diagram summarizing the trend of preferred locations for workplaces

2.4. Synthesis

In this chapter, we have looked at existing bodies of literature that studies the workplaces of the postindustrial society. From the perspective of the economic geographers, studies were done about the location choices of knowledge workers and knowledge-based firms. The consensus of the discipline is that clustering are important for theses firms because knowledge spillovers happen within a geographically boundaries and that physical proximity is a vital component of successful high-tech clusters. In the field of architecture and design, the concept of open plan office with flexible space became the norm of creative office design. Another emerging trend of office design is that offices are coming back to the crowded cities, as companies desire urban locations for many reasons: creativity, demand of their employees, and expanded workplace. Learning from the arguments of each discipline, I argue that what we see nowadays is the emergence of new workplace. Office buildings are pushing their boundaries out to the cities and regional networks are contracting to a walkable, sizable area.

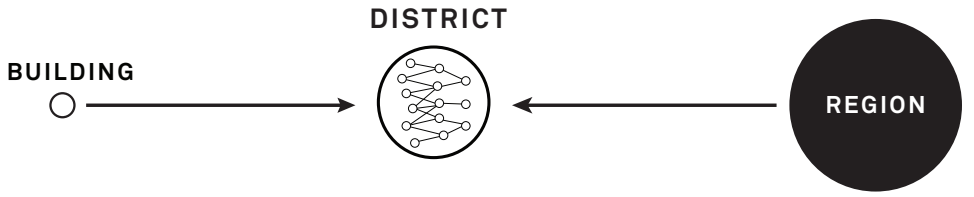


Figure 2-7. Diagram illustrating the need to bring together existing literatures of high-tech clusters into a district-level study

We are now witnessing the three major trends of the high-tech industry workplace coming together: regional agglomeration; rising importance of face-to-face communication; and urban locations. Therefore, the workplace of the future will be clustered in an urban environment where urban spaces become the new extended workplace. I believe that such urban clustering will result in the form of districts, which are city areas that have some common character and where the observer can go mentally inside of (Lynch, 1960). I name the emerging urban high-tech clusters, the "Innovation Districts."

As illustrated in the literature review, there is no body of research done for the urban high-tech clusters, which falls somewhere in between the regional network and individual buildings in size. In the following chapters, I conduct in depth analysis of Kendall Square's present and its past, looking at what makes it an innovation district, how it became one, and what are the spatial characteristics of an innovation district. Through such endeavor, this thesis starts to outline what the new research of innovation districts should be.

Chapter 3.
The Murky Process of Building an Innovation District

Kendall Square is becoming the hub of the entrepreneurial activity and the icon of an innovative urban district. According to the 2012 analysis by CB Insights, a venture capital database management company, Cambridge, among the entire Greater Boston area, has been the dominant leader in attracting VC deals and dollars. Despite the rising rent in Kendall Square, startups are desperate to be in Kendall Square where they could be surrounded by their fellow entrepreneurs, graduates from MIT, engineers from high-tech companies, venture capitalists and angel investors who would fund young tech companies.

This buzz does not only apply to the startup industry but for big corporations as well. Major information technology (IT) corporations like Google, Amazon, and Microsoft have expanded their operations in Kendall Square to tap into the innovation activities happening in the area. Biotechnology and pharmaceutical giants such as Novartis, Genzyme, Biogen, Sanofi, Millennium Pharmaceuticals, and Pfizer have been expanding their Kendall Square branch. It is also worth noting that Biogen Idec., which moved out to its Weston location off Route 128, is returning to its birthplace in Kendall Square.

Why has Kendall Square become such a desirable destination for high-tech companies and startups? The proximity to MIT does not offer a complete answer as Kendall Square has always been and will be the gateway to MIT. Since the 1950s Kendall Square always has been the incubator place for high-tech companies that spun off from MIT. However, what is different from today is that such spin-offs moved out from Kendall Square to somewhere off of Route 128 once the company grew in search for cheaper land and ample room for growth. Nevertheless, the trend has reversed over time. The startups are reluctant to move outside of Kendall Square even after they've grown to a considerable size. Some of them are even coming back to the area. Why is this happening? What is the driving force behind this sudden attention shed upon Kendall Square as the place to be for entrepreneurs and high-tech corporations?

This chapter picks up where the previous researchers took off and offers an updated story about the economic growth of Kendall Square as an innovation district. And my goal here is to complete the puzzle with two seemingly distinct perspectives: the physical transformation of the place and the non-physical events that have shifted the economic profile of Kendall Square. I believe the stories of the two different realms have intersected, influenced, and converged, which resulted in establishing a thriving innovation district in Kendall Square. But first of all, I start this chapter by providing general definition and description of what I mean by innovation districts with two other examples.

3.1. Innovation District: A New Model for High-tech Clusters

So what is an innovation district *per se*? In many parts of the world, the term is being used in many different ways. Generally, it refers to an urban neighborhood that could be defined as a district with some consistent attire with high concentration of high-tech firms and entrepreneurial activities. In this section, I provide three examples of a thriving innovation district and generalize some of the characteristics of an innovation district.

South Lake Union in Seattle

South Lake Union (SLU) is a neighborhood in Seattle, Washington. The official boundaries of the City of Seattle Urban Center are Denny Way on the south, Interstate 5 on the east, Aurora Avenue N. (State Route 99) on the west, and E. Newton Place on the north. Historically, it started out as a manufacturing area for large mill factories. Other manufacturing industries were established in the area as well. Cabinetry and furniture led the way in the 1890s, followed by shipbuilding, Boeing's first airplane factory, manufacturing seaplanes and, in Cascade, Seattle City Light's Hydro House (1912) and Lake Union Steam Plant (1914) and the first Ford Model T assembly plant west of the Mississippi River (1914).

Figure 3-1. Aerial photography of South Lake Union (Vulcan Inc.)

Due to recent development plans by Microsoft co-founder Paul Allen's Vulcan Inc., as well as other prominent developers, South Lake Union is becoming a hub for innovation economy. Some in the area include tech companies such as Amazon, and life science organizations, such as Fred Hutchinson Cancer Research Center, Zymogenetics, Battelle, Seattle Biomedical Research Institute, Seattle Children's Hospital, PATH, Rosetta (now part of Merck & Co.), Bio-Rad, and University of Washington Medicine.

The aim of the developer, Vulcan Inc., is to develop an urban neighborhood where knowledge workers not only work, but live and play in the area as well, which is very consistent with the concept of innovation districts. New lofts and retro-looking brick condominiums have sprouted over the years and the private developers are striving to create mixed-use district with diverse urban amenities. The Seattle Streetcar, a new, 2.6-mile route that links South Lake Union to downtown Seattle, have been in operation to help the residents and workers get around.

Figure 3-2. Images of the streetscapes of South Lake Union (Joel Rogers Photography)

Silicon Roundabout in London

The term Silicon Roundabout, also called as the Tech City, refers to the high number of web businesses located near the Old Street Roundabout in east London. The name originated in 2008, when a number of tech startups started to create community and networks in the area. What is interesting about the Silicon Roundabout is that it emerged without government support or direct links with universities. On the Economist article of November 25, 2010, the author analyzes the congregation of startups owing to the advantage of London generally: its wealth, its appeal to global talent, the English language, but especially because of its bohemianism and relatively cheap rents for young creative workers. In the November 2010, Prime Minister David Cameron announced a program to boost the area's startup cluster

and since then technology giants such as Cisco, Facebook, Google, Intel, McKinsey & Company and Vodafone are among the companies, which have invested in the area. Tech City Investment Organisation (TCIO) was founded by the government department UK Trade & Investment to manage and support the growth and development of the area, although their authority and efficacy is still under scrutiny as of now.

The Silicon Roundabout is hard to define with geographic boundaries. It broadly occupies the part of London's East End between Old Street (the boundary of Central and East London) and the Queen Elizabeth Olympic Park in Stratford, with its main focus around the Shoreditch area. There has been several attempts to identify the physical boundaries, but it is considered as an amorphous concentration of tech companies, rather than a clearly defined district. The Tech City Map uses crowdsourcing to create an interactive map that locates startup businesses in the area.

Figure 3-3. Images of Silicon Roundabout (Flickr: ogoco, left; Flickr: Timo, right)

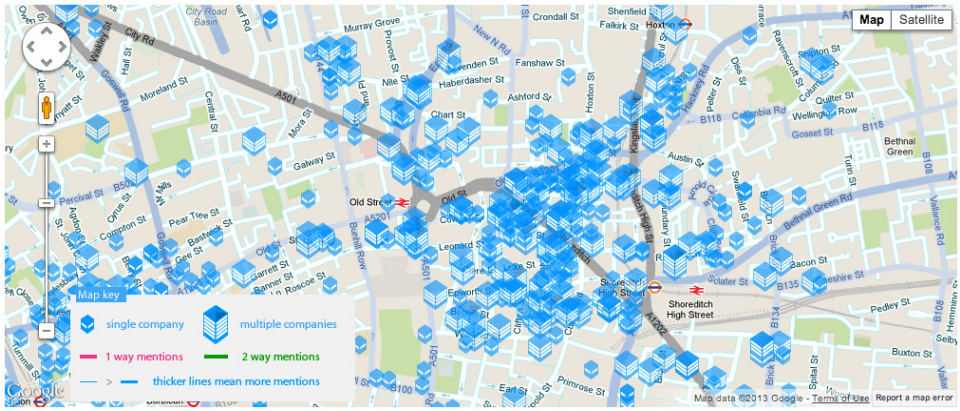


Figure 3-4. An interactive crowd-sourcing map of Silicon Roundabout that identifies the location of startup businesses around the area (techcitymap.com)

Kendall Square in Cambridge

Kendall Square is located adjacent to the east side of the MIT campus. It generally refers to the area within walking distance of the Kendall Square T station. The area was a marshland in the until the mid 1800s and then was the center for manufacturing-oriented industrial growth until the 1960s. The area gradually received attention from the private developers of the need to meet market demand mainly for tech companies before the 1990s dotcom bubble, spin-offs from MIT, and then biotechnology and pharmaceutical companies in the 1990s. Project by project, Kendall Square have become a favorable location for entrepreneurs, life science, and tech companies to do business and research. In the post 2000s era, innovation activities and networks in Kendall Square, especially the Cambridge Innovation Center (CIC), attracted much spotlight from outside.

In 2010, a presentation to the Cambridge City Council prepared by the Boston Consulting Group emphasized the value of Kendall Square as an innovation district. The density of startups, high-tech companies, and knowledge workers in Kendall Square is unparalleled by any other place worldwide. Now it is home to tech giants like Amazon, Google, and Microsoft; biotech and pharmaceutical companies like Novartis, Sanofi, and Genzyme; and thousands of small to middle size startup companies.

Innovation District: What does it look like and how do they get developed?

When I traced back to the story of how the three districts came into their being, they shared a common development history: there was no masterplanning done for these places. The three districts grew spontaneously from market-driven decision making-process of the stakeholders. The Economist article of 2010 reports that In the case of London the idea that state intrusively shaping the private economy has tended to lack credibility. In all three cases, the transformation came from the private sector: in the case of Silicon Roundabout, from the spontaneous concentration of the startups; and in the case of SLU and Kendall Square, from few key private real estate developers who all aimed to meet the needs of the market they've seen.

Nevertheless, the most interesting recurrent theme of the three districts was the idea of 'bumping into people.' When the knowledge workers of the districts were interviewed, they all mentioned the frequent chance encounters with others in the neighborhood, which they describe it as 'bumping into people' in the street and cafes.

"There's a lot of impromptu networking here. We've had a lot of experience that we wouldn't have had if we hadn't been here"

"I like the fact that you bump into interesting people or people that you might sort of read something that someone's written online and then meet them down at the pub. Which is nice... when I worked in South Kensington that never happened."

Interviews from "A Tale of Tech City," Center for London

"Here, I can walk next door to talk to a Nobel Prize winner. I bump into my friend, a designer at The Hot New Start-up, on my way to lunch. I have coffee with a venture capitalist to talk about how to get more women into tech. I attend a lecture given by a famous scientist downstairs in my building."

Sara Spalding, senior director of
Microsoft NERD Center in Cambridge

"Geography does matter, and the reason it matters is because of serendipitous encounters."

Paul Maeder, general partner of
Highland Capital Partners, an international VC firm
in his interview with MIT News, Nov 23, 2011

The common spatial characteristic of the three districts is that they are densely populated urban neighborhoods. The three districts are comparable in their sizes: Kendall Square, measuring up to 250 acres; Silicon Roundabout, approximately 400 acres; and South Lake Union 325 acres. They are all concentrated within approximately 10 minute walking distance from one to two subway stations, or multiple streetcar stops in the case of Seattle. Therefore, the density of firms doing similar things in the neighborhood and the propensity of the workforce to socialize in bars and cafes increases the likelihood of such accidents. The area's cafes, bars, and amenities provide what Currid (2007) describes as 'the social life of creativity': a set of spaces where creative works get done.

Additionally, because the districts are very urban in their character, they have human-scale and pedestrian-friendly walking environment. This agreeable walking environment is drawing people out to the streets, encouraging them to go to their meetings, lunches, and coffee breaks on foot. Consequently the 'hurly burly life

of streets', as described by Jacobs (1961), is naturally generated, making the place vibrant, which in turn greatly increase the chance of knowledge workers to meet, share ideas, and collaborate, whether or not it is intentional. This is what an innovation district should look like. In order for an innovation district to thrive, it should emanate the same quality of any other thriving urban neighborhood.

In the next chapter, I begin to drill down the details of the evolution of Kendall Square into an innovation district to find out how that spontaneous growth happened and its relationship with the built environment. This analysis will become a valuable guide to cities that are planning to establish innovation districts as a way to leverage economic growth.

3.2. Evolution of the High-tech Industry in and around Kendall Square

Since Kendall Square has been traditionally viewed as part of the Route 128 network, it is impossible to present a complete explanation of Kendall Square's history without understanding the Boston's Route 128 growth, which dates back to the 1950s and early 1960s. Many studies of Route 128 have been conducted to understand why and how it came to be one of the top tech poles in the U.S (Castells 1989; Saxenian 1985, 1994; Lécuyer 2006).

Castells argues that the growth of Route 128 is mainly linked to MIT and especially to particular processes: the technological shift in warfare, first during World War Two, later during the Cold War. He summarizes the historical evolution of Boston's high-tech industry growth into three distinct periods: the World War Two and Cold War buildup of defense contractors; the spin-off entrepreneurial firms in the 1960s and 1970s that built a new, civilian computer industry; and the remilitarization of the computer industry during the 1980s, under the stepped-up demand from the new Pentagon technological frontier (Castells, 1994). He ends with a remark that whether or not there will be a fourth reindustrialization of Cambridge is uncertain. Despite the pessimistic projection of several sociologists, Kendall Square is now thriving as an innovation district. Picking up from where Castells left off, here I start to investigate what has brought the post-2000 high-tech growth in Cambridge, presumably, Kendall Square. Here, I provided a slightly different perspective of understanding the growth of high-tech industry in and around Kendall Square.

War War Two and Cold War defense investment from the federal government

Since MIT had the oldest and most distinguished electrical engineering department in America, yet much less money than Ivy League universities, the institute was much more open to conduct contract research with the Government or with private firms. Such contractual cooperation still is an established policy at MIT and which caused the exponential growth of the institute from federal funding during the World War Two and the Cold War. Consequently, before the end of the wartime period, industrial spin-offs and research laboratories from MIT were the economic growth engine for the entire Boston region.

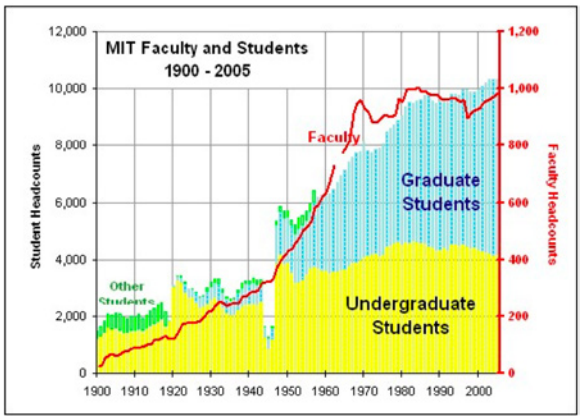


Figure 3-5. Graph showing the increase of MIT faculty and student population from 1900 to 2005 (MIT Campus Development presentation prepared in February 2007)

In 1920, an associate professor in electrical engineering at MIT, Vannevar Bush, created a company, Raytheon, to produce thermostatic controls and vacuum tubes. By 1950 Raytheon, which relocated to Waltham, Massachusetts became a major industrial force in the field of rockets and missiles. In the 1930s and 1940s, other advanced laboratories were founded at MIT: the Instrumentation Laboratory, Draper Labs today; and the Lincoln Laboratory, established to contract research for the Air Force on radar and computer technology.

The Radiation Lab (The Rad Lab), which was in operation from October 1940 until December 31, 1945, was also created at this time by Vannevar Bush. The purpose of the lab was to conduct the RADAR research for the detection and location of distant targets to gain the high grounds for World War Two. After its closure, this famous lab later became Research Laboratory for Electronics (RLE) that generated many civilian spin-off activities. It is also ironic to note that The Rad Lab gave birth to the famous Building 20 of MIT, which is covered in section 2.3 of this thesis.

1960s and 1970s: Spin-off firms targeting civilian computer industry

The most direct connection between MIT originated wartime programs and the advancement of high-tech industry in Boston was the formation of a computer science capability at MIT, which was quite independent of the old 1950s electronics base. One of the representative companies is the Digital Equipment Corporation, which was founded by Kenneth Olson, whom Jay Forrester sent to IBM to supervise the company's contract manufacturing process. Like DEC, most of the new entrepreneurs obtained their knowledge in research projects linked to MIT or to

other firms generally funded by defense spending. Yet the products of the new companies diversified quite rapidly: they were mainly aimed at the civilian market. It was the invention of the minicomputer and the introduction of computers into office (with the workstation concept developed by Wang) that propelled the new high-tech complex in Greater Boston in the late 1970s.

The interdepartmental and entrepreneurial spirit has its roots, once again in Building 20, the Plywood Palace. RLE was the institute's first interdepartmental research lab funded by a $600,000 annual grant from the Army, Air Force, and Office of Naval Research. The grant was incredibly open-ended, chartering RLE to "do research in electronics." This open-endedness allowed for entrepreneurial activities to prosper. For instance, one day in 1959, Wiesner saw a strange object in Bose's office: a wedge shaped contraption with 22 loudspeakers attached. Five years later, Bose started his own company to market speakers. New-technology companies such as DEC, Bolt, Baranek, and Newman incubated in Building 20 and later took its way to their corporate cultures (Simson 1991)

1980s: Shift from hardware manufacturing to software development

MIT's great expansion into a Federally funded research powerhouse, in the post-war decades, was grounded upon the idea of a comprehensive engineering science that was subdivided into increasingly fine-grained research areas that could be pursued by means of rigorous, in-depth specialization. Such federally funded research projects led MIT to become a very successful research institution, but the time was ripe for change.

The growth of high-tech industry in the 1980s could be summarized into one world: personal computer. Started from a group of electronic enthusiasts in a garage in Silicon Valley, the Homebrew Computer Club mass-commercialized personal computers in the late 1970. Among its members were Bill Gates, Steve Jobs, and Stephen Wozniak. By the early 1980s, personal computers came to be owned and operated by individuals, making a reality of distributed processing. Sales of personal computers rocketed from none in 1975 to 7 million units sold worldwide in 1983 (Forester, 1987).

Castells notes that when the world's computer industry went into a downturn in the 1984-6 period, MIT was able to financially sustain itself due to the Reagan administration buildup of defense funding redirecting Massachusetts' high-tech industry toward military programs. The emphasis of "Star Wars" on software and

artificial intelligence created huge, instant, highly-profitable markets for high-tech firms. He offers somewhat pessimistic forecast of Massachusetts' high-tech industry due to the vulnerability of such excessive dependence on military markets. Nevertheless, contrary to Castells' pessimistic forecast, the exponential spread of the personal computers lighted the new revolution in software development industry. The shift from hardware manufacturing to software development marked the tipping point for urban growth pattern.

Lotus Development Corporation, one of the first and most successful software development companies to establish in Kendall Square is a perfect example. Mitch Kapor, who dropped out of MIT Sloan School and established Lotus in 1982. Professor Bill Aulet, managing Director in the Martin Trust Center for MIT Entrepreneurship at the MIT Sloan School of Management, commented that Lotus was able to locate in Kendall Square because it was a software development companies. Businesses needed not to move out to the suburbs in search for cheap and large land suitable for hardware manufacturing facilities.

MIT's President Jerome Wiesner, who worked in Building 20 for over ten years and was the director of RLE, had also recognized this shift of paradigm and his remedy was to create a new type of intellectual enterprise that would be at the vanguard of the technology that enabled the "digital revolution" and enhanced human expression - the MIT Media Laboratory in 1985 (Mitchell year unknown). The lab signaled an opening of the new era of economic growth based on innovation and entrepreneurship through interdisciplinary collaboration. It has been incubating spin-offs, of which many of them have been based in Kendall Square.

Yet, behind the entrepreneurial scenes, such significant growth of entrepreneurial activity could not have been possible without the passing of Bayh-Dole Act. The Act, which was adopted in 1980, permits a university, small business, or non-profit institution to elect to pursue ownership of an invention in preference to the government. Since its adoption, the notion of technology transfer, the dynamic exchange of knowledge between research organizations and the private sector through patenting and the licensing of those patents to industry, boosted the industrial commercialization of the research conducted at MIT, which in turn gave rise to countless spin-offs and attracted powerful corporations to Kendall Square simultaneously.

1990s: The biotech boom

Perhaps, the industry that benefited most from the technology transfer opportunities from MIT and research institutions was the Biotech and Pharmaceutical industry. According to Andrea Schievella, who handles biotechnology patents as part of a 4 member "biobunch" team at the MIT Technology Licensing Office, biotechnology is hugely important to MIT as 160 (40%) of the university's 400 new invention disclosures each year are in biotech and 20-25 companies are spun out each year (Sable 2007). Consequently, parallel to the upsurge of entrepreneurial activity, Kendall Square came to be the hub of life science.

The genesis of the biotech boost started as early as the 1980s. The first round of investment dollars funded the research laboratories of newly-founded biotechnology companies such as Genzyme, Biogen, and the Whitehead Institute for Biomedical Research. This new and exciting revolution in organic chemistry has become possible because of two main developments in biological science: The first was discovery of so called recombinant DNA techniques, and and the second was finding ways to "sequence" or identify every link in the DNA chain (Cooke 1991).

Alexander M. Klibanov, professor of chemistry at MIT had said in his interview with The Boston Globe in 1994: "There is a revolution in chemistry and molecular genetics that is presenting new research and business opportunities that would have been impossible 20 years ago. MIT, to its credit, has been enlightened in encouraging faculty members like myself and Tony Sinskey to explore opportunities to commercialize their discoveries." Working in collaboration with graduate and post-doctoral students, MIT faculty members in biology, chemical engineering and chemistry filled out the One Kendall Square office complex in Cambridge.

Yet the real biotech boost started in 1990 with the Human Genome Project funded by the US Department of Energy (DOE) and the National Institutes of Health (NIH). This aim of this $3-billion dollar project was to provide a complete and accurate sequence of the 3 billion DNA base pairs that make up the human genome and to find all of the estimated 20,000 to 25,000 human genes. Both MIT and Harvard were highly successful in winning research funding. As a result, Whitehead Institute/MIT Center for Genome Research founded in 1990, and it becomes an international leader in the field of genomics and a flagship of the Human Genome Project. This momentum was accelerated as the Cambridge City Council approves the construction of Biogen's drug manufacturing plant in Kendall Square in 1993.

In 2001, a first draft of the human genome is published, sparking a new era of biomedical research and a new model for science that launched the Broad Institute, a research collaboration in genomic medicine involving faculty, professional staff and students from throughout the MIT and Harvard academic and medical communities that is governed jointly by the two universities.

Since 1995, biotechnology in Cambridge has grown considerably as only 2 of the top 25 employers were biotechnology firms and they employed only 913 people. By 2000, 6 of the top 25 employers were biotechnology firms and the number of people they employed had risen by 450% to 3928. Finally, in 2006, 8 of the top 25 employers were biotechnology companies and the number of people they employed has almost doubled to 7764 people. In little over a decade, biotechnology has emerged as the dominant non- academic employer in the City of Cambridge (City of Cambridge 2003). It is now home to many Cambridge-founded corporations and research centers such as Alkermes, Vertex Pharmaceuticals, and Genzyme, as well as international biotech and pharmaceutical companies including Novartis, Sanofi, and Millenium Pharmaceuticals.

Post 2000s: The resilient mix

Since the turn of the century, the economic activities of Kendall Square has been evolving into a diverse mix of companies, both by size and by industry types. This diverse mix of businesses has rendered the district resilient and self-reinforcing. The companies that are rooted in the area range from one-person startups to giant corporations and the types of businesses stretch over a broad spectrum of different industries from information technology, biotechnology, software developments, to traditional professional services.

In the world of entrepreneurship, new incubator spaces for startups played a significant role in popularizing the startup industry of Kendall Square. The community concept of hatching startups in a single space with shared resources originally kicked off with idealab of Pasadena, California, and made its way to Massachusetts in the late 1990s. One of the first Boston's incubator spaces to be established was the Cambridge Incubator what is now known as the Cambridge Innovation Center (CIC). The original business model of the center was to provide office space, shared business services, as well as seed financing, focusing on the e-commerce companies. Over time, this model evolved into a more flexible version that mainly concentrate on its role as the provider of office space, service, and stimulating interactions among knowledge workers through coordinated events, rather than

managing seed financing and incubating businesses directly. This management model was proven to be very successful. The popularity that the CIC gained over the past decade and its efforts to advertising Kendall Square as the center of Innovation contributed significantly in branding Kendall Square as innovation district.

From the big corporation's perspective, they certainly benefit from locating near the top class knowledge sources such as MIT, the Whitehead Institute, and the Broad Institute. Nevertheless, what is as important, perhaps even more so, is being in the midst of a vibrant startup environment. In his interview with the MIT News in November 23, 2011, Martin Schmidt, MIT's associate provost and professor of electrical engineering, asserted that being in Kendall Square gives large corporations a "front-row seat" to the next wave of acquisitions. According to Schmidt, in the pharmaceutical industry, acquiring a startup's new drug may speed a therapy through the pipeline and out into the world as the pipeline for drug discovery is famously hard to manage.

Consequently the robust ecosystem for tech and biotech innovations has drawn large multinational corporations to locate in Kendall Square, particularly those specializing in the life sciences. In 2002, Novartis leased 764,000 square feet of lab space in Cambridge and invested $750 million to develop, equip, and staff the Novartis Institute of Biomedical Research, the lead research facility and global command center for the company's R&D efforts. Since Novartis moved in, pharmaceutical giants like Sanofi Aventis and Merck have erected research facilities in Cambridge. Genzyme opened up the company's new headquarters in 2003. Biogen Idec, a biotech company co-founded by MIT's Phillip Sharp, moved from Kendall Square to a suburban location seven months ago, and is now returning its headquarters to the square. And MIT and Pfizer broke ground on a new complex that will house the company's Cardiovascular, Metabolic, and Endocrine Disease (CVMED) and Neuroscience research units.

This is not only true for the biotech companies. The information technology giants are also flocking to the area. In 2007, both Microsoft and Google opened up its Kendall Square branch to tap into the area's human capital and innovation culture. Here is a quote from Sara Spalding, senior director of the Microsoft New England Research and Development (NERD) Center in Cambridge.

> *"As a global technology company, we are only successful because of people — the people we hire and the people we partner with. For us, this*

means making connections is fundamental. When we opened the Microsoft New England Research and Development Center (NERD) here in Kendall Square in 2007, we knew that New England was home to an incredible concentration of the best technical and engineering talent in the world."

What we are witnessing in Kendall Square is the development of a new model of high-tech industrial clustering that knits companies of diverse sizes and industries closely together with people: the knowledge workers. In this setting, startups and corporations build a symbiotic relationship. Corporations such as NERD can provide managerial and technical training, host large events and local tech events, and share physical resources, thus encouraging entrepreneurship. Large corporations benefit from the local area by networking with the emerging startups and becoming part of the innovation culture. I name this symbiotic model of high-tech cluster, the innovation district.

3.3. The Three Periods: Industrial Landscape, Office Park, Innovation District

In this section, I turn my attention to tracing the history of the built environment of Kendall Square in order to offer a comprehensive explanation of the forces that transformed the square drastically over the last few decades. Before the 2000s, Kendall Square was described as an office park district. Workers came to work at 9am, worked within their corporate campuses, and then headed home at 5pm. Now, if you walk down the streets of Kendall Square, you see restaurants, coffee shops, bars, outdoor plazas, and open spaces full of people mingling with each other in twos and threes. Every knowledge worker that I talked to who has been around the area for more than a decade recognized and made a comment about this dramatic transformation. Here is a quote from one of my interviewees, who has been an MIT undergraduate and has been around for more than ten years: "It just wasn't a place to be after dark. There was nothing to go to, it was even scary to walk across the area. Now, all the good restaurants are in Kendall Square."

Entrepreneur Pritesh Gandhi, co-founder of a Media Lab spin-off Ambient Devices, has been quoted in his interview with the MIT News saying that the fact that new buildings and restaurants and things are popping up increases the profile of Kendall Square as a cool, hip place to be. So it appears to be, at least from the abundant comments of the entrepreneurs, that the new "cool, hip places" are

increasing the image of Kendall Square and therefore making the district more attractive to knowledge workers. A survey conducted by the Kauffman foundation as part of their report, *Entrepreneurial Impact: The Role of MIT*, revealed that almost all MIT alumni who founded a company said that the most influential factors that influenced the location of their companies were: (1) where the founders lived, (2) network of contacts, (3) quality of life, (4) proximity to major markets, and (5) access to skilled professional workers. Quality of life issues included access to a strong educational system, cultural facilities, open space, and good transportation. The fact that Kendall Square came to be one of the most desirable place for entrepreneurs, IT and biotech companies to locate confirms the relative importance of the urban amenities have on knowledge workers.

Thus, from the preliminary observations of Kendall Square, I made an assumption that the improvement of built environment and the development of high-tech industry have been growing hand in hand. Consequently, I layout the physical development history of the square in this chapter in order to see where the two parallel stories intersect, influence, and enhance each other. By understanding how Kendall Square came into being, I will be able to identify the potentials and limitations of physical environments have had in building an innovation district.

Where is Kendall Square?

The exact spatial boundaries of Kendall Square are yet to be defined. It is certainly not a square, as with many other squares in the Boston area. The place rather conforms to Lynch's description of a district where the observer can go mentally inside of and which have some common character (Lynch, 1960). Even as a district, Kendall Square has no defined center or boundaries. In general, it is considered as areas within five to ten minute walking distance to the MBTA's Kendall T station.

Figure 3-6. Boundary of the city's K2C2 planning study

The City of Cambridge's recent Kendall Square Central Square (K2C2) Planning study have attempted to delineate the boundaries for the planning purpose (Fig.). However, this boundary does not include the anticipated future life-science lab building developments along north side of Binney St. and also do not recognize Technology Square, Draper Laboratory, One Kendall Square, and the Broad Institute, which all have played integral role in advancing the economic development of Kendall Square.

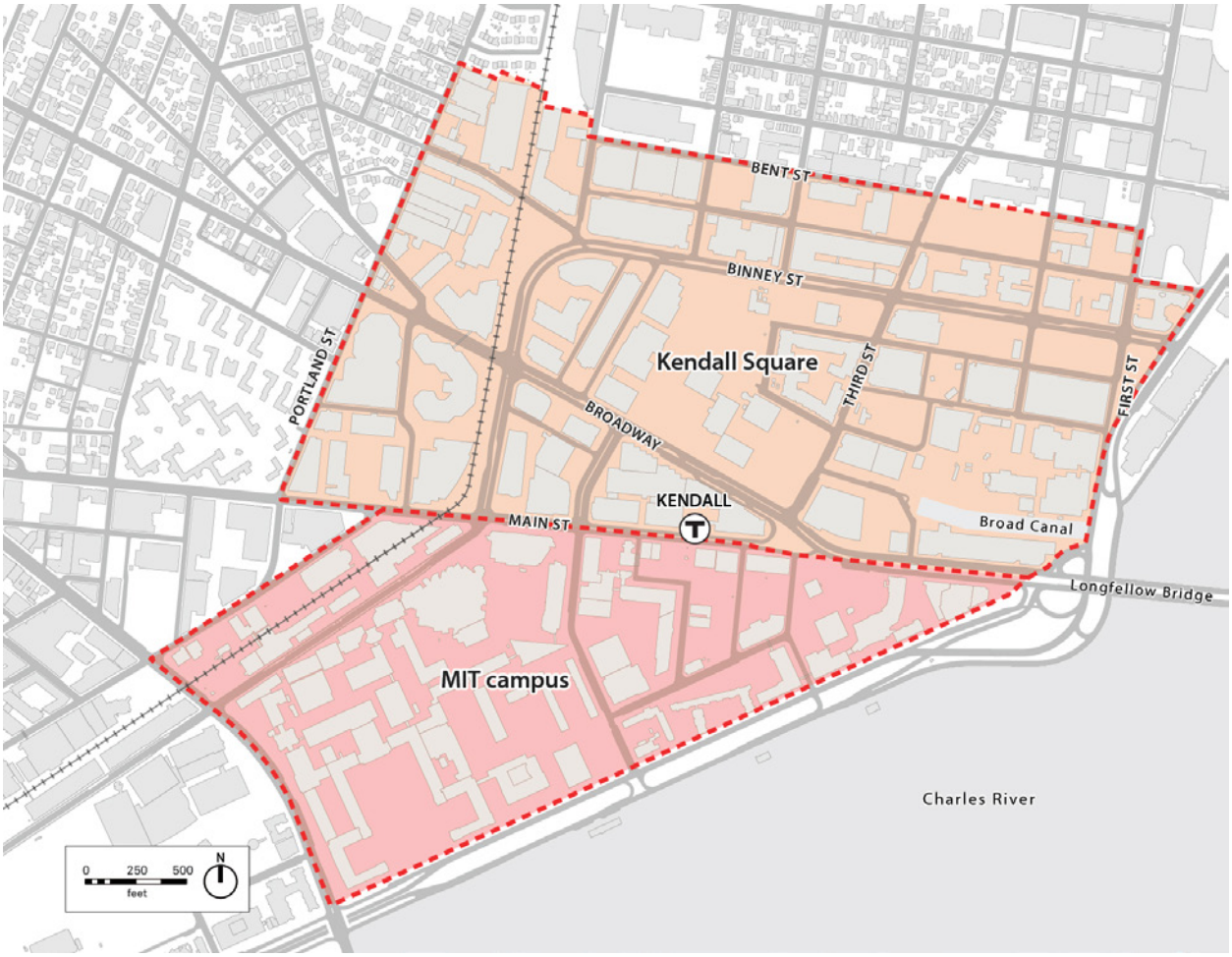


Figure 3-7. Boundary of the study area for this research

Therefore, for the purpose of this thesis, a new boundary of Kendall Square is defined by Portland St to the west, Bent St to the north, First St to the east, and Main St to the South. The west side of MIT campus is included as well, but treated with special attention as the characteristics of an academic campus is very different from other parts of the city. Surprisingly, this newly defined boundary corresponds very well with the existing zip code boundary. Therefore, I conveniently utilized the zip code 02142 as my spatial boundary when I was conducting archival research and surveys.

Industrial Landscape

The intersection of Broadway and Main St was called Dock Square in the 1800s and the area as a whole was called the Lower Port. The Lower Port was surrounded by marshes until the mid 1800s. In 1868, service began on the Grand Junction branch of the Boston & Albany Railroad, which began to attract many manufacturers to the area. In the 1890s the triangle between Broadway, Main St, and rail-

road had been renamed, Kendall Square, after a prominent businessmen who had established a boiler factory on Main St and Broadway intersection. The first subway line came from Park Street to Kendall Square in 1912. This coming of the subway line made the area increasingly attractive for manufacturing. Cambridge experienced 300 percent gain in manufacturing over the course of ten years and most of the increase was located in Kendall Square (Maycock, 1988). In 1916, the Massachusetts Institute of Technology moved to its current location in Cambridge from Back Bay, Boston. After the World War II, the industrial development of Cambridge came to a halt. As industrial buildings were fleeing out, MIT purchased the vacant factories.

Figure 3-8. Kendall Square in 1950 (Cambridge Historical Society)

Office Park in the 1960s - 1990s

From the 1960s, Kendall Square became the subject of postwar urban renewal movement that drastically changed the entire landscape of the area. What initiated the urban renewal movement was the Federal Housing Act of 1949. Title I of the Act, "Slum Clearance and Urban Renewal Program," was aimed at clearing out blighted urban areas in replace of new urban developments. As required by the Program, a Citizen's Advisory Committee was established to identify major economic, physical and social planning issues that the City should address as it planned for its future. In 1955 the redevelopment and renewal functions were transferred to the newly created Cambridge Redevelopment Authority (Simha 2011).

Technology Square was the CRA's first major project in Kendall Square. It was a campus of four buildings for offices and laboratories for science and engineering firms that was developed by a private developer, Cabot, Cabot & Forbes, in association with MIT and the Cambridge Redevelopment Authority (1955-present). Mr. Roger Boothe, Director of Urban Design, admitted that it was a brutal project from an urban design point of view. According to his description, the original design of the campus, which had been reworked in 1999, was on a raised platform, X feet from the ground, completely shutting off the entire campus from the sidewalks. Unfortunate to the Cambridge residents, the Technology Square set a new standard for development in this area. From the 1960s to the early 2000s, Kendall Square was not a pleasant neighborhood to walk in or even to walk through.

Figure 3-9. Kendall Square in the 1970s (source not identified)

Perhaps the most significant urban renewal project that had changed the look of Kendall Square was the grand scheme to locate NASA in Kendall Square. NASA was growing at that time and chose to site its Electronics Research Center in Cambridge. Mr. Robert F. Rowland who later became the Executive Director of the CRA visualized Kendall Square as an ideal place for NASA's research center because of its unique locational advantages, including the rapid transit station, proximity to MIT, direct subway connections to Harvard University and downtown Boston, and easy connection to Logan Airport (Tercyak 2012). So he approached the Cambridge Citizens Advisory Committee with a proposal that Cambridge acquire the necessary land in and around Kendall Square to accommodate the NASA center. The Redevelopment Authority engaged Mr. Rowland to carry the project forward and establish the Kendall Square Urban Renewal Project. The City Council approved the project in the summer of 1965. The Redevelopment Authority under Mr. Rowland's leadership then proceeded to acquire the properties within the project boundaries and to arrange for relocation assistance for the business organizations that had formerly occupied the site. In doing so, approximately 110 businesses were relocated and the Broad Canal was partially filled. In April of 1966, the CRA designated a 29 acre site for NASA.

Nevertheless, in December of 1969, President Richard Nixon withdrew the federal government's' plan to locate the NASA research center, leaving empty 29 acre lot in the middle of the city. The CRA put much effort to develop the cleared land and luckily the Department of Transportation established the National Transportation System Center in one of the parcels in 1970. The center was later named as the Volpe center after the secretary of DOT and former governor of Massachusetts. Development of the remaining 24 acres of land was not an easy task. The CRA tapped into the advisory panel services of the Urban Land Institute (ULI) to review the Kendall Square Urban Renewal Project and suggest ways to move the project in the right direction. Through a Request for Proposal process Boston Properties was chosen as the developer of the site, which was by then named as the Cambridge Center (Tercyak 2012).

The design of Cambridge Center is the hallmark of office park approach of workplaces, which had set the image of Kendall Square for many years. Large blocks with overly wide streets and less attention to the ground level experience altogether generated an extremely unfriendly and uninteresting environment for pedestrians. One of the major open spaces for the project is up four floors from the sidewalk, atop a parking garage. With an office/research & development focus, served by hotel and some retail use, the development has been the subject of criticism ever since its construction for looking like a corporate office campus.

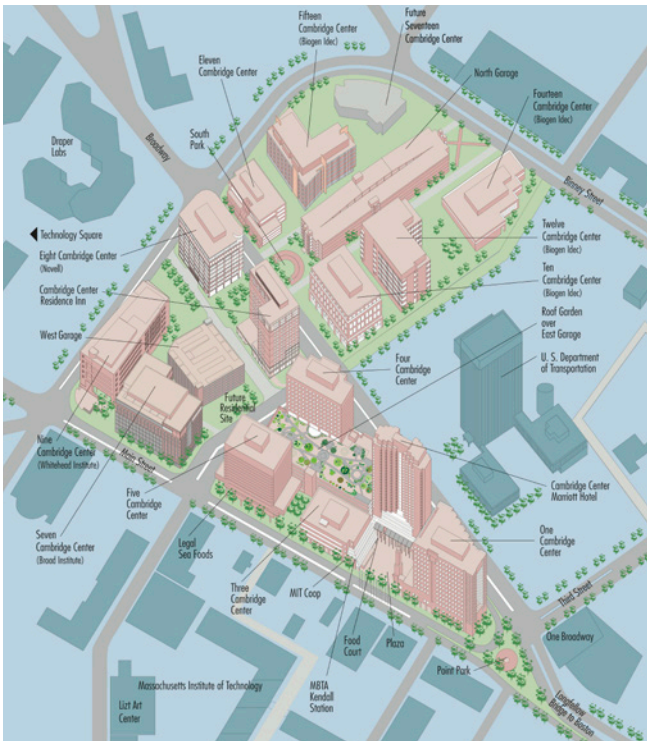


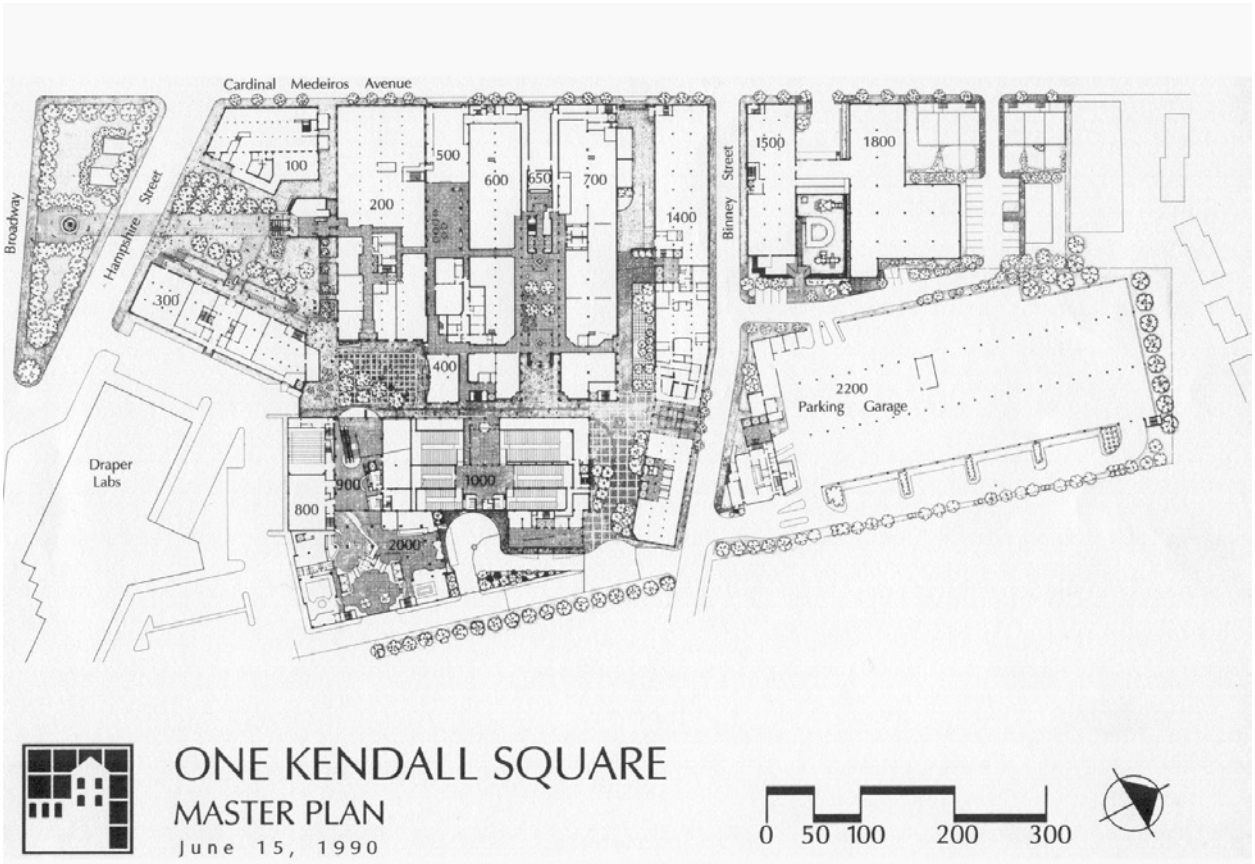
Figure 3-10. Cambridge Center axonometric site plan (Boston Properties)

The PUD zoning that was established closest to Kendall Square guided one of the earliest special permits, the Riverfront Office Park (1982) that provided some ground-floor retail and created the Broad Canal walkway on the south side.

Becoming a Mixed-use Innovation District

Nonetheless, a new bright future of Kendall Square started to materialize in the 1990s. One Kendall Square development, which was initiated in 1989 by two distinguished personnel, signaled a new bright future for Kendall Square. One Kendall Square is a campus of seven factory buildings that were rehabilitated into an office space. David Clem, the developer, and Dan Winny, the architect, had an remarkable foresight when they developed the project together.

> *"Well, the aspiration was really urban design in the first place... We were also very fond of the old buildings and the interesting space in between them, which could be landscaped and developed.*
>
> *[One Kendall Square] was deliberately intended to have mix of uses including retail, restaurant, it was also programmed to have a hotel that didn't get built. It was always intended to have a movie theater so the goal was to great a kind of a high tech village which had mix of uses which will make campus like community for the demographic of Kendall Square, which is very campus oriented.*



(top) Figure 3-11. One Kendall Square site plan (Dan Winny)
(bottom) Figure 3-12. Images of One Kendall Square Development

And even though it was inexpensively developed, it was pretty popular with the market that it was intended to reach. We later realized that this was a quite an interesting development model. You can call it a research driven urban mixed-use project, research driven in economic sense. And we got more interested in looking at new development along the same line as opposed to rehabs. We did several new developments in different cities around the country that were all research centers."

As a result, One Kendall Square has become the beacon of mixed-use office complex development. It has been home to some of the most well-regarded go-to-places such as Cambridge Brewing Company, Friendly Toast, Kendall Square Cinema, Flat Top Johnny's and the Blue Room. A number of The Boston Globe article have recognized this exciting change of the scene since the early 1990s through the mid-1990s when not much else was yet available in the area. Drawn to the hip amenities or to the cheap rents that I do not for sure, but One Kendall Square has certainly been the most iconic development that housed entrepreneurs coming out of MIT.

The success of One Kendall Square naturally made the development a new development model for the area. Other real estate developers started to renovate the old factory buildings into office space for small and large businesses. The existing and newly built developments since then have struggled to accommodate attractive retail spaces on the ground floor and offer pleasant public realm. Considering the original design of the Tech Square and the Cambridge Center, this was a major shift towards a new era of Kendall Square.

Interestingly, the city's planning goals, which represent goal of the Cambridge community as a whole, progressed hand in hand with this new model of building places. The East Cambridge Riverfront Plan and Implementation (1978-2002) and the Citywide Rezoning of 2001 began the process of moving away from the urban renewal approach, particularly by emphasizing the importance of the pedestrian realm, with open space at the level of the sidewalk. The Citywide Rezoning in particular, created Article 19 for Planned Unit Developments (PUD) recognizing the impact of built form to create a livable neighborhood. Under Article 19, all PUD

Figure 3-13. Images of Technology Square and its ground-floor retail

projects have to go through intensive design review process with the Cambridge Planning Board, where the specifics of building and open space design get inspected and reviewed by the experts and Cambridge residents.

The remodeling of two 1960s era projects, One Broadway(?) and Tech Square (1999), were a significant improvement to the district. Both projects carried on by the MIT investment management company, Mitimco, added ground-floor retail to the buildings and created a better connection to the public streets. Tech Square IPOD Special Permit (1999) resulted in major reconfiguration of original building complex, connecting formerly isolated green plaza to Main Street, with ground-floor retail including cafes, copy center, health club, and convenience store. The Special Permit was amended in 2005 to allow construction of two small, but significant additions—one-story pavilions to create space for restaurant and cafe uses at the sidewalk level.

The endeavor to provide attractive environment is realized in a major development at the heart of Kendall Square throughout the 2000s. Once again, originating from the two pioneers David Clem and Dan Winny, Cambridge Research Park, sometimes referred to as Kendall Square, has been a major improvement of the district. It has been masterplanned as a campus of seven different buildings and went through a design competition process for each of the buildings. Genzyme headquarters is located with other biotech offices and two high-end housing towers are there as well. What is notable of this development is the attention given to the development of retail, cultural amenities, and open space, which are all interconnected at the ground floor.

Like One Kendall Square, Cambridge Research Park treats the urban space outside of buildings as one, sequential space as opposed to treating it as leftover spaces. Its retail plan illustrates the effort to disperse small but significant retail spaces throughout the entire area to create series of activities .

On the other side of the Third Street from Cambridge Research Park, a large residential complex was built in 2003, with ground-floor retails. One of the retail tenants, Voltage Cafe, became one of the most popular hangouts for entrepreneurs and venture capitalists according to Scott Kirsner, who went around and asked 74 people asking where they went regularly and were most likely to run into others of their ilk, in Boston, Cambridge, or suburbs.

(top) Figure 3-14. Site plan of Cambridge Research Park/kendall Square (Dan Winny)
(bottom) Figure 3-15. Images of ground-floor retail (left) and public spaces (right) of CRP

3.4. Synthesis

In this chapter, I have covered two versions of the history of Kendall Square: one looking at the economic growth and the other looking at the development of the built environment. Each history point towards the same conclusion that Kendall Square have evolved into a true innovation district over the past decade. In this section, taking a step further from understanding what is an innovation district, I present how Kendall Square evolved into an innovation district and what lessons could be learned from its development process. To do so, I define the causal link of events that integrates the two seemingly irrelevant versions of the same history.

What came first were the entrepreneurs. After the enactment of the Bayh-Dole Act in 1980, pandemic spread of personal computers in the early 1980s, the subsequent boom in software development, and the establishment of the Media Lab in 1985, Kendall Square was swarmed with new startup companies coming out of MIT. The birth of urban legends also helped establishing the entrepreneurial culture in Kendall Square. Professor Bill Aulet, Managing Director in the Martin Trust Center for MIT Entrepreneurship at the MIT Sloan School of Management, recalled Mitch Kapor as the key personnel in making entrepreneurship 'cool:' "Culture is the operationalizing of values. How you operationalize value is through urban legends, through stories that are told. Mitch Kapor was the role model. He became the poster child for the staying in the city. He broke the wall between hackers and business people."

Then came the quality built environment. The entrepreneurial young professionals were not interested in being bounded within a cubicle of suburban office park style buildings. One of the first developments to notice this shift in market was the One Kendall Square development:

> *"We pretty quickly became aware that what a lot of the market was looking for. The market was largely start up companies that were relatively young people who have both scientists and business school graduates. And they weren't interested in the textbook idea of what a research space ought to be. If you look at the textbook, all the bldgs got to be 120 ft wide, it's gotta have concrete floors… there were old bldgs that were made of bricks and wood and had funny shapes and corners. That's what exactly this market actually liked.*

They didn't give a damn that it wasn't meeting the technical standards. So we realized that what really mattered was the environment: a completed environment. And that the ideas, which are the most important thing, the ideas don't come from building that's cubed. They actually happen when people having cup of coffee, taking a lunch break. So more and more we incorporated social space, interaction spaces into the programming of the program."

Here, an important lesson about establishing an innovation district can be highlighted in that that an innovation district cannot be built from scratch. Jane Jacobs (1961, 245) again makes a great point about how innovations grow out of existing urban spaces:

"Only operations that are well-established, high-turnover, standardized or highly subsidized can afford, commonly, to carry the costs of new construction. Chain stores, chain restaurants and banks go into new construction. But neighborhood bars, foreign restaurants and pawn shops go into older buildings.... Old ideas can sometimes use new buildings. New ideas must come from old buildings."

If you apply the analogy of chain stores as corporations and neighborhood bars as startups, you begin to realize that an innovation district, which should be composed of a diverse mix of businesses ranging from startups to corporates, cannot rise from ashes. So an innovation district cannot just be made of brand new buildings. Additionally, it has to start from the bottom up. The small entrepreneurs need to fill in the space, create the buzz, and then the relationship between these firms starts to create a healthy and resilient innovation ecosystem. This lesson learned from Kendall Square seems to conform to the common traits drawn out from the case of Silicon Roundabout and South Lake Union.

The next turning point was in 1990, after launching of the Human Genome Project. As MIT and Harvard was very successful in winning the federal funding, both institutions were extremely advanced in the gene research. The biotech companies were naturally drawn to the area due to the proximity to two institutions. The physical proximity was of great advantage to the big biotech and pharmaceutical companies because of the patent licensing opportunities and the possibility to acquire startups with fresh ideas.

The rapid inflow of the biotech companies brought capital and development opportunities. Capital flows to top talent. And that capital gets invested in building offices and living spaces. Gradually, Kendall Square came to be filled with quality real estate developments with much attention paid to enhancing the public realm. As a result, it became a livable and thriving neighborhood with high concentration of high-tech companies: the innovation district.

To sum up, competition between the developers to house the biotech and pharma companies improved the district as a whole. Michael Owu, director of investment at MITimco, referred to the ground floor additions of Tech Square (i.e., Area Four, Catalyst restaurant) as the 'curb appeals': "real estate is valuable if only when people want to be there. In a commercial building the way you do that is to make sure that ground floor, where people see, is interesting and dynamic." The developers of Kendall Square are competing against each other very fiercely for the next development opportunity. They are aggressively trying to make their project the most attractive to the potential tenants. So they build the most interaction spaces, best restaurants: the coolest places to hangout.

Lastly, the quality built environment is reinforcing the high-tech industry of Kendall Square in twofold. Its first and direct impact is the attraction the knowledge workers. So it becomes an iterative process where more people are attracted to the area because of the built environment and in order to attract even more people, the built environment keeps getting better. What we are witnessing in Kendall Square at the turn of the century is the shifting priorities of the location choice of knowledge-based businesses. High-tech startups depend heavily on the availability of skilled professionals to build reliable, high-quality, innovative products. The start-up companies also locate where these professionals like to live. Such demands of the marketplace and of the tenants that they wish to serve as seen by the developers have transformed the built environment of Kendall Square.

The private developers who developed key real estates in the area admitted that it is extremely arduous and unprofitable to rent retail space. One developer noted that tenants like cafes, bars, and restaurants are not "particularly profitable" and "time consuming." Also the developers can't normally lease them before your project is fully built out. Nevertheless the reason why developers are willing to take on this endeavor comes from a purely economical perspective:

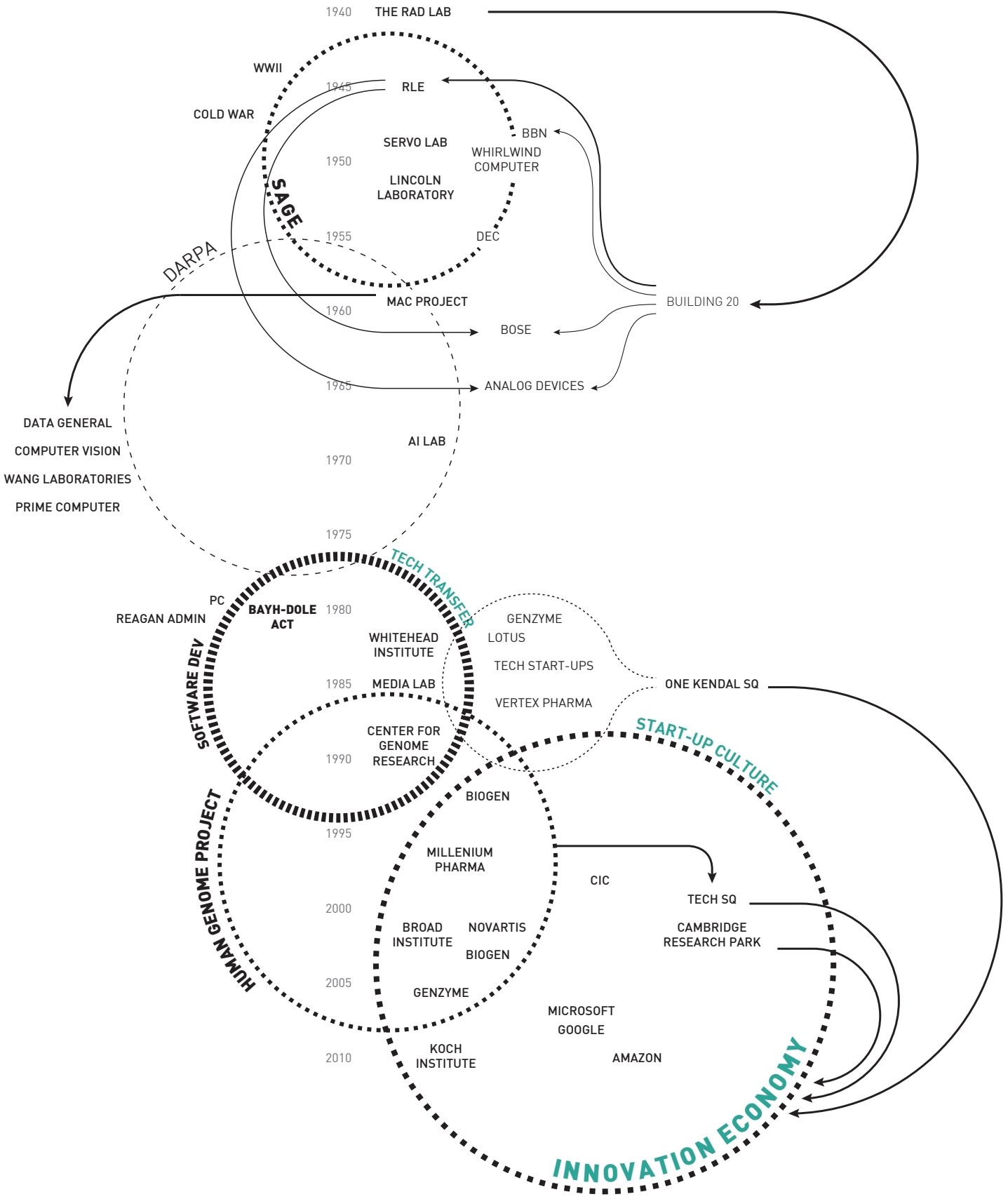
"What has become so important now is the quality of the environment. It started out as cafes and restaurants that improve the quality of life in a workplace and makes it easier for landlords to lease space if they have those facilities. A lot of developers are realizing that it is worth subsidizing those kinds of activities in order to improve the quality of marketability of the space."

The second and indirect impact of the built environment in enforcing the high-tech industry of Kendall Square is by creating new venues for new types of activities. For instance, Voltage Cafe located on Third St, which as one of the first coffee shops to open in the area, is currently the location of weekly office hour that connects local entrepreneurs and Venture Capitalists. Pardis Saffari from the Economic Development Department of the Cambridge Community Development Department believes that places like Voltage Cafe are serving as new venues for entrepreneurial activities. Such events could not have happened in Kendall Square in the 80s and 90s as there just was no venue to hold those events, which demonstrates the role of urban amenities in innovation districts.

This emergence of good urban spaces in Kendall Square indicates a fundamental point about good urban spaces: good new space builds a new constituency (Whyte 1980). The new constituency in the case of Kendall Square was the knowledge workers. They started to activate the good urban spaces by utilizing them in many different ways that contribute to the innovation ecosystem. To name a few, the spaces are used as alternative workplaces, meeting venues, places to socially interact with each other, or as getaways from work. All of these activities enhance the frequency of interaction and collaboration between people and firms.

Good urban spaces are blurring the boundary between workplaces and social spaces. In addition to their fundamental function as offering services, they are facilitating the interaction and innovation between smart people. Borrowing Oldenburg's term (1989), I define these spaces as "Third Places", after home, the first, and workplace, the second. The Third Places are where the next chapter begins. Through analyzing how these places are used by the highly-skilled knowledge workers, the next chapter investigates the role of the Third Places in enhancing the innovation ecosystem of Kendall Square.

Figure 3-16. Diagram synthesizing the process of how Kendall Square came to be an innovation district


1940
THE RAD LAB
WWII
1945
RLE
COLD WAR
SERVO LAB
BBN
WHIRLWIND COMPUTER
1950
LINCOLN LABORATORY
SAGE
1955
DEC
DARPA
MAC PROJECT
1960
BUILDING 20
BOSE
1965
ANALOG DEVICES
DATA GENERAL
COMPUTER VISION
WANG LABORATORIES
PRIME COMPUTER
AI LAB
1970
1975
TECH TRANSFER
PC
REAGAN ADMIN
BAYH-DOLE ACT
1980
GENZYME
LOTUS
WHITEHEAD INSTITUTE
TECH START-UPS
1985
MEDIA LAB
ONE KENDAL SQ
VERTEX PHARMA
SOFTWARE DEV
CENTER FOR GENOME RESEARCH
1990
START-UP CULTURE
BIOGEN
1995
MILLENIUM PHARMA
CIC
TECH SQ
2000
BROAD INSTITUTE
NOVARTIS
CAMBRIDGE RESEARCH PARK
BIOGEN
HUMAN GENOME PROJECT
2005
GENZYME
MICROSOFT
GOOGLE
KOCH INSTITUTE
2010
AMAZON
INNOVATION ECONOMY

Chapter 4.
The Power of Third Places

In the mid-1990s, when the giant corporations dominated the world economy, bureaucratic corporate cultures stifled creativity and innovation by individual workers (Whyte 1956). Contrarily, people of the information society are less bound to the organizational rules of the past. The highly-skilled workers of the twenty-first century now seek for organizations and environments that encourage them be creative. Consequently, workplaces, personal lives, and industries are coming to depend on dynamic interaction between creative people (Florida 2001). This desire for increased social interaction is pushing the boundaries of what has been traditionally regarded as a workplace. In chapter two, I made an argument that the distinction between conventional office spaces and places where other parts of everyday lives have been carried out is disappearing. People are working practically everywhere.

In this thesis, I name the unconventional workplaces as the "Third Places," borrowing the term from Oldenburg's class book, *Great Good Places* (1989). The Third Places, which comes after home, first, and office, second, are informal public gathering spaces like cafes, restaurants and plazas. In the days of Oldenburg, such spaces used to be places for social interaction and close communities. People used to seek comfort through interacting with others in Third Places. Now, in addition to their role as centers of social interaction, Third Places are now being used in many different ways that enhance the economic activities of the postindustrial society. Therefore, my initial assumption was that Third Places are important catalysts for the success of innovation districts by becoming the physical venue for social interaction, interfirm collaboration, idea exchange, and extended office spaces. In order to test my speculation, I have explored how knowledge workers are using the existing Third Places in Kendall Square

Figure 4-1. Marriott hotel lobby around 3PM on Monday

and how the places are influencing the economic activities.

Interestingly enough, a number of my interviews were also conducted at the popular Third Places in Kendall Square at the interviewees' suggestion: Voltage Cafe, Marriott hotel lobby, and Tatte bakery. What I noticed while I was waiting for my interviewees was that there were many people in twos and threes having a business meeting of some sort in Third Places. They were pitching proposals, presenting ideas, making deals at those very public spaces. This one afternoon when I was in the Marriott hotel lobby, there were four different tables making different deals in that space. In Voltage and Tatte, I noticed a high number of people working with their laptops for hours and hours.

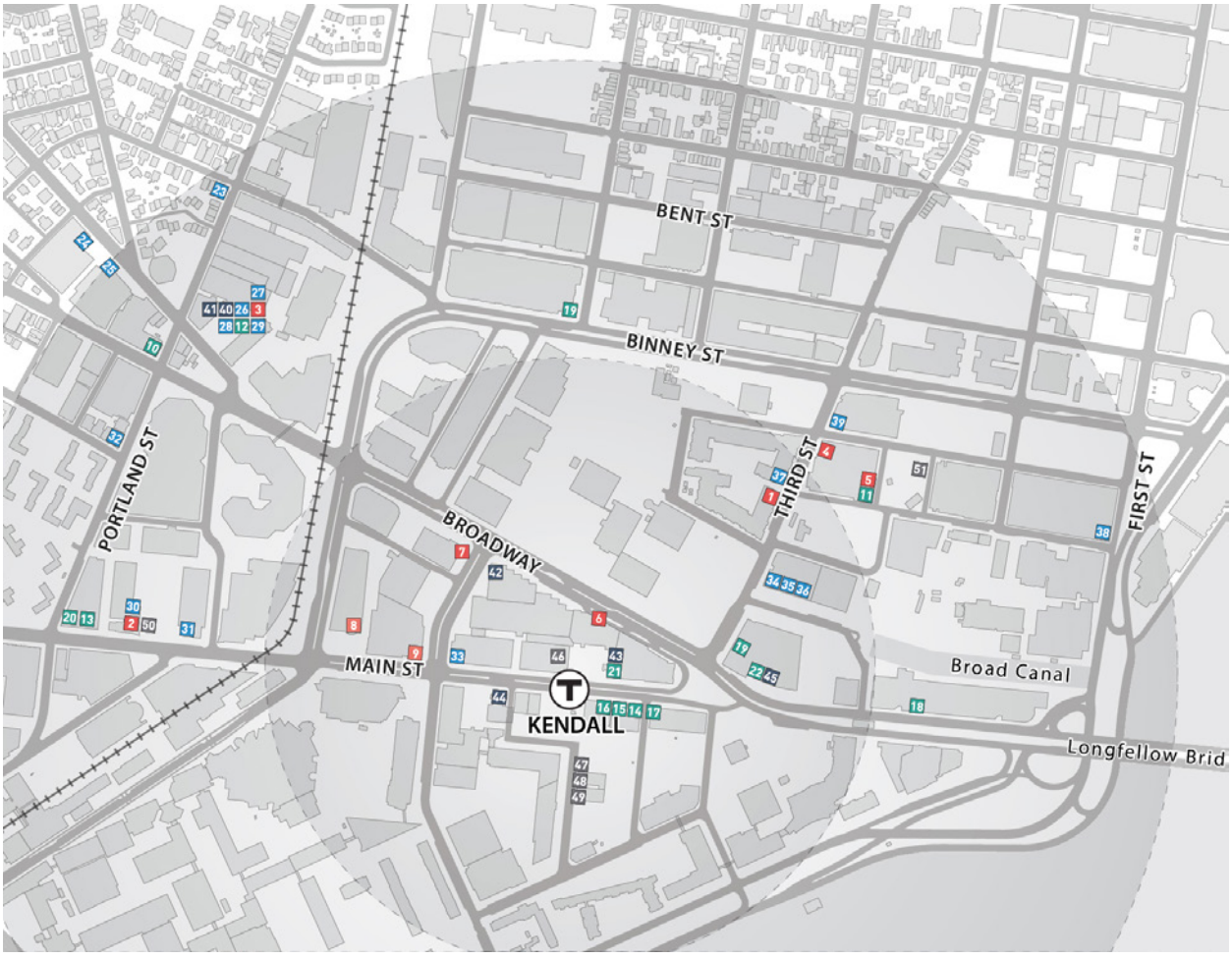
This chapter investigates the urban spaces of Kendall Square through three different methods. First is an observational analysis as a third person. I visited the Third Places in person and observed how the knowledge workers were using the spaces. Once I was inside the places, head counted how many people were talking to each other, working on their laptops or having a meeting. The second method is participant observation of the knowledge workers. I engaged with number of entrepreneurs and attended their networking events to have casual conversations with the knowledge workers of Kendall Square. Their perspectives and anecdotal stories are combined with the onsite observations to support my findings. Lastly, I surveyed the knowledge workers in Kendall Square asking about how they are actually using the Third Places in Kendall Square. The details of the survey design and its results are further explained in the Appendix B. By using various methods, my goal is to triangulate a convincing argument about how the emerging Third Places are enhancing the innovation economy of Kendall Square and further offer some design recommendations about how such places could be designed for future developments.

4.1. Third Places in Kendall Square

As a result of active real estate development market over the last two decades, Kendall Square now features various retail establishments and public spaces. Nevertheless, not all of them can be labeled as Third Places, as their contribution to the innovation ecosystem of the district varies significantly. Therefore, this section first provides an inventory of the existing urban amenities in Kendall Square to understand why some places come to be Third Places and why some don't. I have

identified two major categories of urban amenities: the first is retail space, where you have to buy a cup of coffee or a meal to use the space; and the second is public space, where you have free access to come and go as you like. Next, I present an overall analysis of why some urban spaces are contributing more to the innovation ecosystem of the district and become Third Places by comparing its physical and nonphysical characteristics such as spatial configuration, price range, hours of operation, design, and usage.

Retail Spaces	Public Spaces
cafe cafeteria restaurants bar & pub Food trucks food court cinema gym	building lobby plaza streets and sidewalks open spaces farmer's market Kendall Square Community Ice Skating Charles River Canoe and Kayak



Retail Spaces

There are 9 different categories of retail spaces in Kendall Square. Here is a complete list of establishments.

- **cafe**: Voltage Coffee & Art, Area Four, Beanetown Coffee House, Tatte Bakery, Leisure Station (Bubble tea shop), Starbucks at Marriott Residence Inn, Starbucks at Marriott Hotel
- **cafeteria**: Whitehead Institute cafeteria, Sebastians,
- **take-out shops:** Kendall Kitchen, Aceituna Cafe, Bon Me, Mexicali Burrito, Cosi, Kendall Market & Deli, Rebecca's Cafe, Au Bon Pain, Cafe on Main, Redbones Rib Shack, Zigo, Chipotle
- **restaurants**: Hungry Mother, Atasca Hampshire, Emma's Pizza, The Blue Room, West Bridge, Flat Top Johnny's, Friendly Toast, Quiznos, Area Four, Catalyst, Amerlia's Trattoria, Legal Sea Foods, Za, EVOO, Kika Tapas, Abigail's, Technique, Fuji
- **bar & pub**: Tommy Doyle's Irish pub, Cambridge Brewing Company, Mead Hall, Champions Sports Bar, The Black Sheep Restaurant, Firebrand Saints
- **food trucks**: Clover, Momogoose, Jerusalem Palace Truck, Chang Foods
- **food court:** Cambridge Center food court
- **cinema:** Kendall Square Cinema
- **gym:** Cambridge Athletic Club

Obviously, not all of the listed retail spaces can be Third Places. Talking to the workers in the area and browsing through many newspaper articles that talked about the Kendall Square's retail buzz, I have identified several places that are the most heavily used by the knowledge workers: Voltage coffee, Tatte Bakery, Area Four, Cambridge Brewing Company, and Mead Hall. These places were being used as alternative workplaces, meeting venues, for social interaction, and networking events. Such activities all contribute to the innovation ecosystem of Kendall Square by increasing the chance of idea sharing, by enhancing work productivity, and by serving as social stimuli. Then, the question is: What are the common characteristics of these successful retail spaces?

Figure 4-2. Map of retail spaces in Kendall Square (This map is a recreation of the Kendall Square Retail Map designed by Ambit creative group for Kendall Square Association)

In order to understand why the above five places are the most sought-after, I've gathered information about all of the retail spaces from the crowd-source retail evaluation service, Yelp: (1) price range; (2) connection to the public realm based on outdoor seating visible from the streets; (3) wifi availability; (4) operating hours; and (5) ambience data.

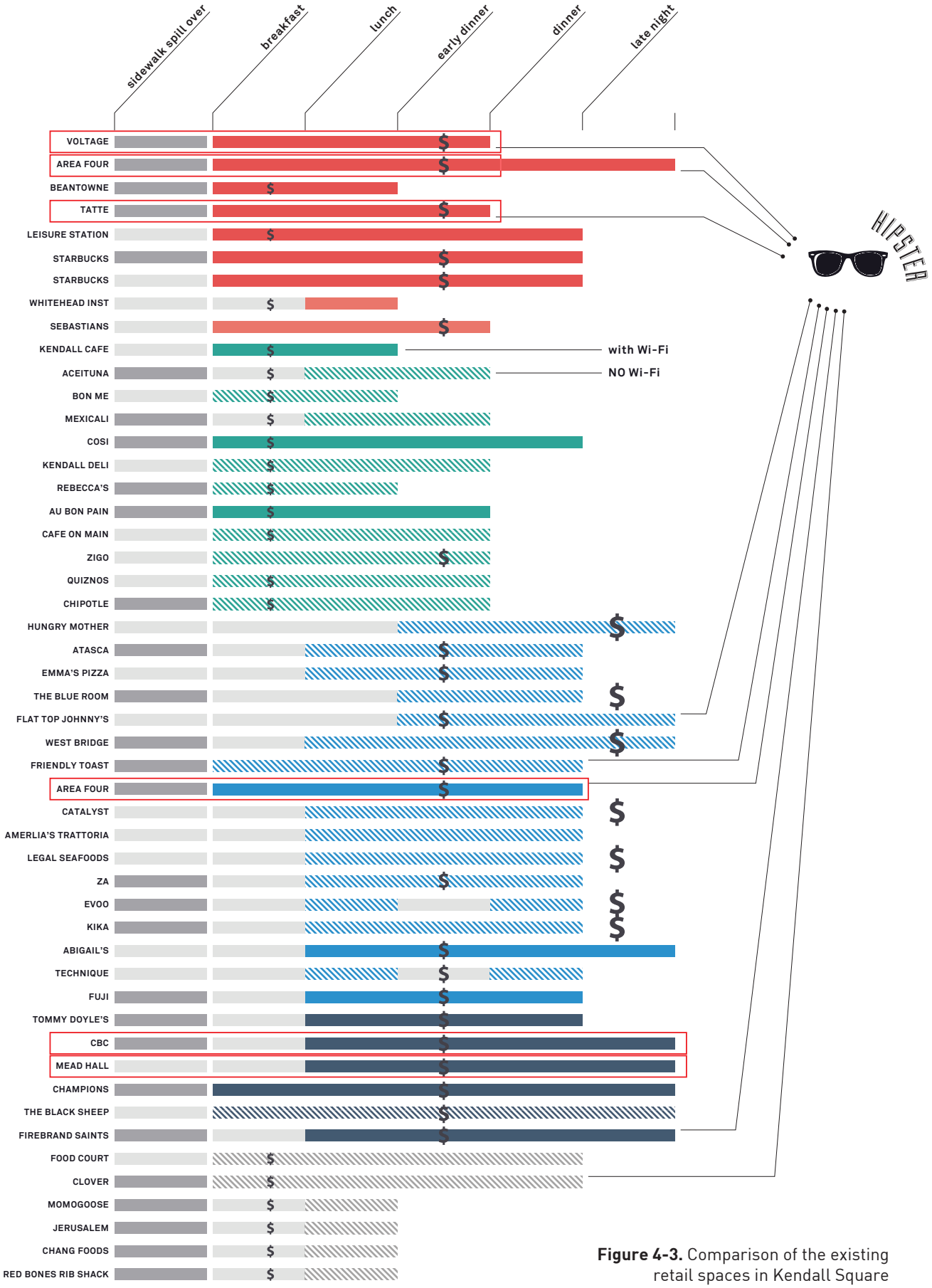


Figure 4-3. Comparison of the existing retail spaces in Kendall Square

The aggregated data reveals that common characteristics of the most-coveted places are: (1) places with free WIFI; (2) places with outdoor seating that engages with the sidewalk; (3) places that are "moderately" priced; (4) places that are open throughout the day; and (5) places with "hipster" ambience. In order to fully understand why certainly places are thriving, I provide further analysis of the spaces of these retail spaces in the next section.

Public Spaces

- **building lobby**: Marriott hotel lobby
- **plaza:** Marriott Plaza, One Kendall Square plaza, Genzyme Plaza streets and sidewalks
- **open spaces:** Point Park, Tech Sq grass lawn, Cambridge Center rooftop garden, Broad Canal Walk
- farmer's market
- Kendall Square Community Ice Skating
- Charles River Canoe and Kayak

Figure 4-4. Map of public spaces in Kendall Square

Although Kendall Square does not have a wealth of good public spaces, there are several different types of public spaces in the area. Again, not all the spaces designated as a plaza or an open space is equally contributing to the innovation economy. The ones that are well-used are: Tech Square grass lawn, One Kendall Square plaza (Fig 4-4, #1), Genzyme plaza (13), Broad Canal Walk (12), and Marriott hotel plaza and lobby (10). Some of the least utilized spaces were plazas and open spaces within the Cambridge Center development complex (3, 5, 6, 7, 8).

(left) Figure 4-5. One Kendall Square's connected public plaza
(right) Figure 4-6. Paley Park in New York

The plazas of One Kendall Square are very actively used because its main plaza is bordered by a number of retail establishments with good reputation that spills out to the public realm. Secondly, the plazas are all connected with each other creating a continuous two-way pedestrian flow: to and from the garage located on the northern part of the site and the main entrance on the southern side. The increased traffic flow makes the plazas look more vibrant and consequently encourages people to visit public spaces more often. Another important factor contributing to the activation of the public plazas is that the entrances to the buildings are all facing toward the connected public realm. All of the above spatial characteristics increase the chance of people unexpectedly bumping into each other.

When I interviewed an employee who works in the complex, the person said he liked the plazas of One Kendall Square because they create a sense of closure and openness at the same time, which he later named them the "nook" spaces. In Whyte's observation of the New York plazas, one of the most beloved plaza was the Paley Park (Fig 4-6), which is an extremely small pocket park tucked under high-rise towers. Nevertheless, New yorkers enjoyed the place because it was intimate and secluded, yet visible from the public streets (1961).

The open spaces in the Cambridge Center development, except for the Marriott hotel plaza, were not working for many reasons. First of all, the most common problem of inactive public spaces is that the spaces are not defined by buildings or other active edges. The strip of designated open space along the Boston & Albany Railroad (Fig 4-4, #3), is confined in between the railroad and a 80 ft-wide road, which naturally makes the space impossible for people to activate it as an open space. The pedestrian walkway (Fig 4-4, #7) that connects Binney St to Broadway along the DOT campus is also not a successful open space as it is bordered by the back of three buildings on one side and a surface parking along the DOT side. These spaces exemplify the importance of defining the edges of public spaces with uses that generate pedestrian flows.

(left) Figure 4-7. An example of unsuccessful green space in Cambridge Center
(right) Figure 4-8. Rooftop garden of Cambridge Center

On the other hand, the two moderately-sized parks along broadway (Fig 4-4, #5,6) are defined by buildings, but were still not actively used. In this case, the design of these two spaces seem to make it difficult for the spaces to be activated. For instance, despite their small sizes, the two plazas are overly-designed with planters, benches and other landscaping elements, which becomes a barrier for people to utilize the space in flexible ways. Additionally, the buildings have low fences. This fences increase the psychological entrance barrier by hinting that this property might be private, although it is not. The fact that surrounding buildings are all office buildings increases the sense of exclusion to a passersby.

The success or failure of Cambridge Center's main open space, the rooftop garden above a parking structure, is debatable. The garden has been both criticized and advocated for over the recent years. In terms of its design, although it is fully landscaped, the landscaping elements does not hamper variety of activities of the users,

because the size of the garden is quite significant. Many workers who are aware of this amenity seem to like the fact that there is a garden like this. Nevertheless, the fact that it is four floors above the ground makes it impossible for vast majority of the public to not even recognize the existence of this amenity. For this reason, the garden is mostly visited by the workers of the adjacent office towers or hotel guests.

Figure 4-8. Marriott hotel plaza

The plaza in front of the Marriott hotel seems to be fairly well utilized especially on a sunny day. Some people were sunbathing on the grass or sitting on the movable chairs, others were eating lunch, having casual conversations, and reading books. I even saw a group of students having a picnic on the grass lawn. The plaza seemed to be working well after its recent renovation, which added removable chairs, many benches, and a raised grass bed in the middle that serves as additional seating area. Also, the recent addition of outdoor dining areas for Chipotle and Champions sports bar greatly improved the image of the plaza. Because the entrance to the Kendall Square T Station is connected to the plaza, the plaza has enjoyed constant pedestrian traffic. Now with a better design of the plaza, the people who have been coming and going from the T stop became constituencies including the occasional tourists visiting MIT. The plaza's least successful feature is the disproportionate ratio of Marriott hotel tower compared to the size of the plaza. The tall tower dominates the overall atmosphere of the plaza (Fig 4-8).

The grass lawn of the Technology Square was working well on sunny days. This building campus is notable as we witnessed the power of ground-floor retail in activating public space. The two signature establishments on the two sides of the lawn: Area Four and Catalyst, were added to the existing buildings 10 years ago. According to Roger Boothe, urban design director of Cambridge Community Devel-

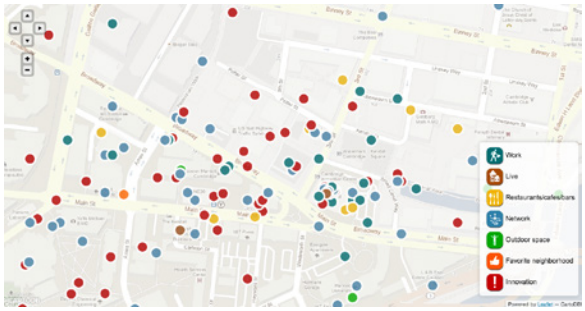
Figure 4-9. Grass lawn of the Technology Square campus

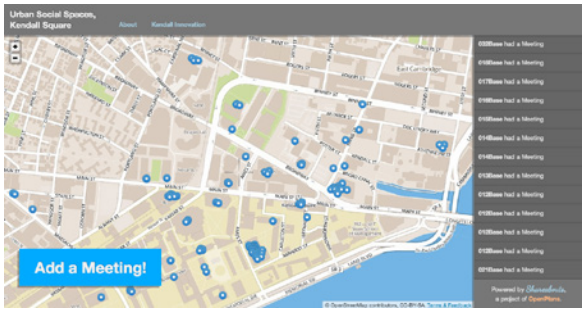
opment Department, when those two restaurants didn't exist, the central lawn wasn't as vibrant as it is now. Only after the addition of ground-floor retail, workers of the buildings and people from outside started to activate the central lawn. The two restaurants, especially Area Four, has become one of the go-to destinations of the neighborhood. Another element that is making the open space vibrant were the coordinated events sponsored by the management company, Alexandria Real Estate. Although their events are targeted for the workers of the tenant businesses, occasional music and activities were good additions to the public realm.

Turning to another major development, Cambridge Research Park, there are two major public spaces in this complex. The first one is the Broad Canal walk and the spacious sidewalk that connects Broad Canal to the Third St, and the second one is the plaza in front of the Genzyme headquarters. The Broad Canal walk opened in 2002, as part of a public benefit given to the community by the developer. Although it is bordered by the Cambridge Gas Company plant on the northern side, The connection to the river and also the Kayak rental spot at the end of the walkway has been regarded as good benefits to the area. The Genzyme plaza, which becomes a skating rink in the winter, was very popular at lunchtime. Despite the fact that surrounding buildings are over 120 ft, the size of the plaza seemed to mitigate the scale of tall and massive buildings. Additionally, the retail establishments that is defining the plaza were also attracting more visitors to the plaza generating more pedestrian traffic.

4.2. How Third Places are Changing the Innovation Ecosystem

There have been a number of attempts to identify where the innovative activities are happening in the district. The Sasaki strategic group has an interactive mapping system where you can identify how knowledge workers are using urban spaces of Kendall Square. The Kendall Innovation group composed of self-interested architects and urban planners have also created an interactive map that asks knowledge workers to identify where they held meetings. Nevertheless, such attempts to pinpoint the places of innovation does offer an insight of how the spaces actually look like nor how and why the workers are actually using the spaces.





(top) Figure 4-10. An attempt to map where various activities of knowledge workers (Sasaki Associates)
(bottom) Figure 4-11. An attempt to map where meetings are held in Kendall Square area (Kendall Innovation Group)

So I went to the most-sought-after retail and public spaces in Kendall Square and started to observe *how* the knowledge workers are actually using those spaces. My case selection for observation was based on ease of accessibility. Since it is not easy to sit and observe people in the retail spaces such as restaurants and bars, I have limited my analysis to the cafe spaces for retail. Public space analysis includes Marriott hotel lobby and plaza, Technology Sq, and Genzyme plaza. In addition to the onsite observation, I have conducted a survey asking how the workers are using the Third Places in Kendall Square. The survey analysis will pair up with my onsite observations to generate a convincing argument about how Third Places are contributing to the innovation economy of Kendall Square.

The survey result revealed that the knowledge workers of Kendall Square are visiting retail Third Place fairly frequently. If you take out the people who "never" or "rarely" visit the Third Places, we can see that 85% of the total respondents are visiting the places at least once per week at lunchtimes. 56% of the respondents are visiting the places at least once per week during work hours. And 48% of the respondents are visiting the places at least once per week after work.

The breakdown of the different times of the day revealed some interesting findings about how the spaces are being used. Not surprisingly, the places were used most heavily at lunchtime, but the high percentage of people who are visiting Third

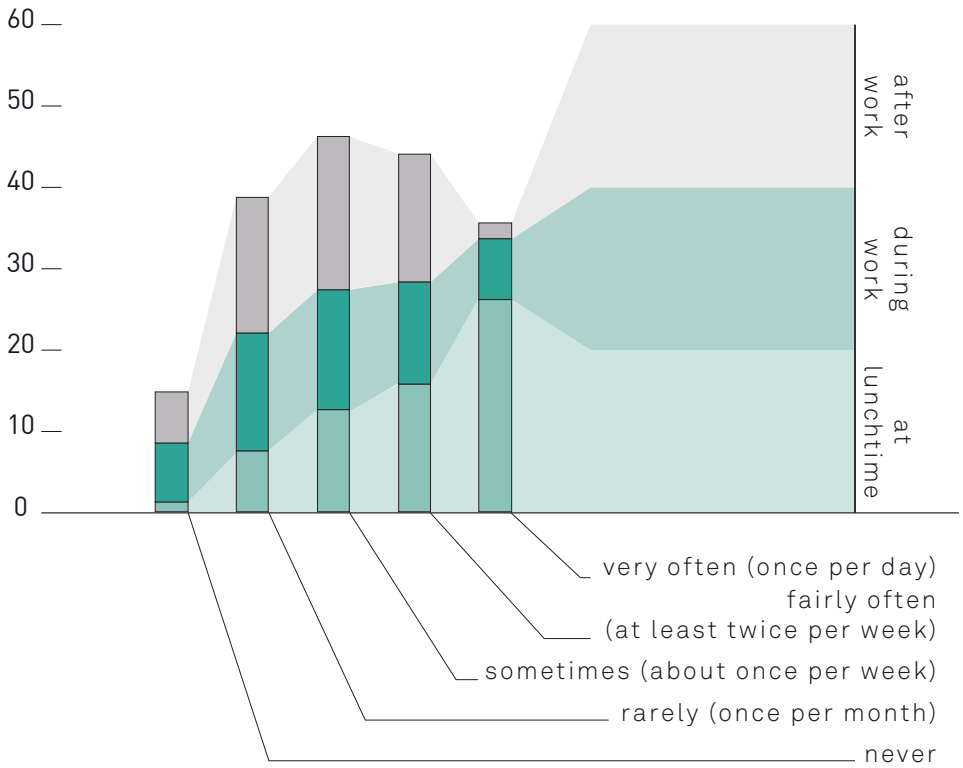


Figure 4-12. Frequency of visits to retail Third Places

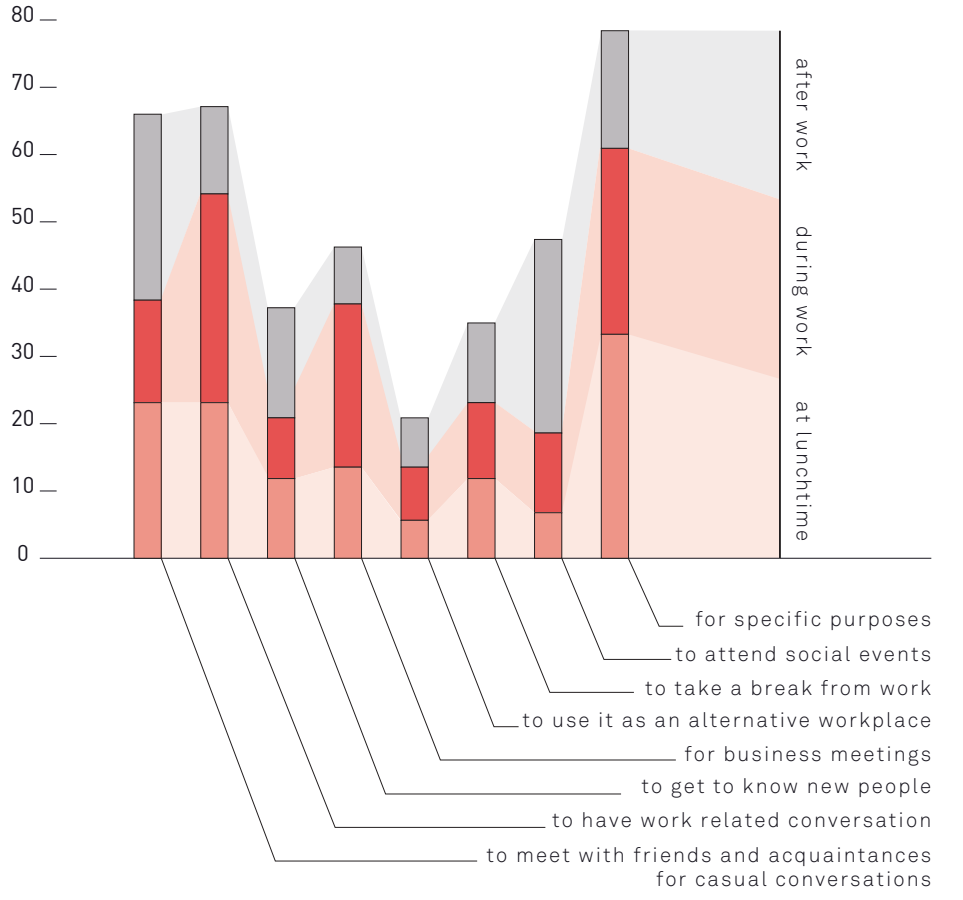


Figure 4-13. Purpose of visits to retail Third Places

Places during work hours and after work could be an indicator that the knowledge workers are not going to Third Places *just* for food and drinks.

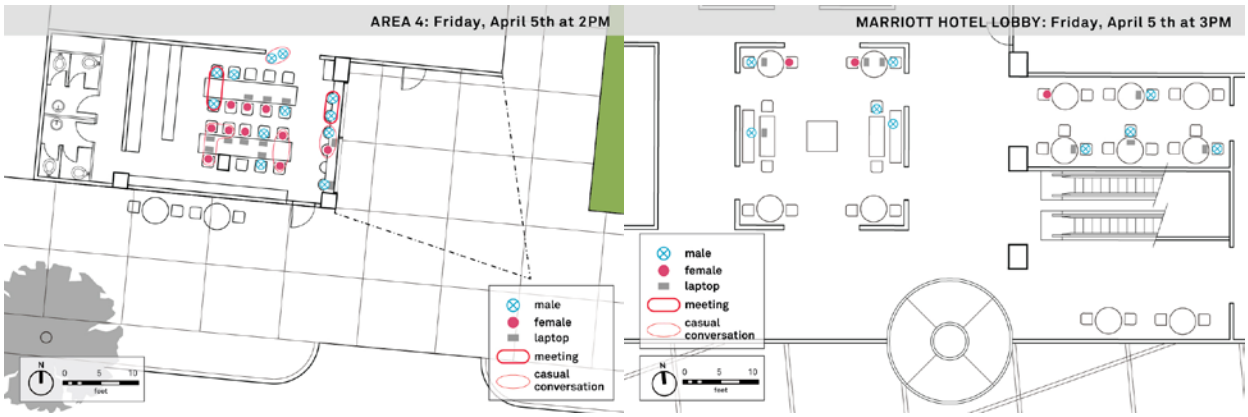
Hence, I asked a follow-up question asking whether or not they were going to these Third Places for reasons other than just for food and drinks and 43 (61%) among 70 respondents answered "yes." By asking about the purpose of their visits, I learned that many workers were visiting the places for casual conversations and work-related conversations at all times of the day. Most of the work hour visits were for business meetings and work-related conversations and after work visits were mainly to attend social events and for casual conversations. For those who use the space as an alternative workplace, the respondents were mostly startup and small business employees/employers.

When I was out in the venues, I was able to confirm the fact that many workers are utilizing the Third Places as business meeting location or to have work-related conversations. The four places that I visited: Area 4 (cafe), Marriott hotel lobby, Tatte Bakery and Voltage Coffee, had an average of two meeting tables every time I was at the place. The meetings or some sort of business-related conversations, with papers and pens or ipads, were in twos and threes and they stayed at the same spot for approximately an hour long. One instance, I was eavesdropping a table behind me in the Marriott hotel and the meeting was between a real estate developer, trying to lease out their property to a biotech company. He was emphasizing how Kendall Square was perfect for the growth of the business because there are so many smart people around and that the innovation culture is here. I was very tempted to turn around and share my thesis findings but decided not to disrupt my research setting and also disturb their important meeting. Regardless, I was very surprised by the their decision to have the meeting in such an open and public area.

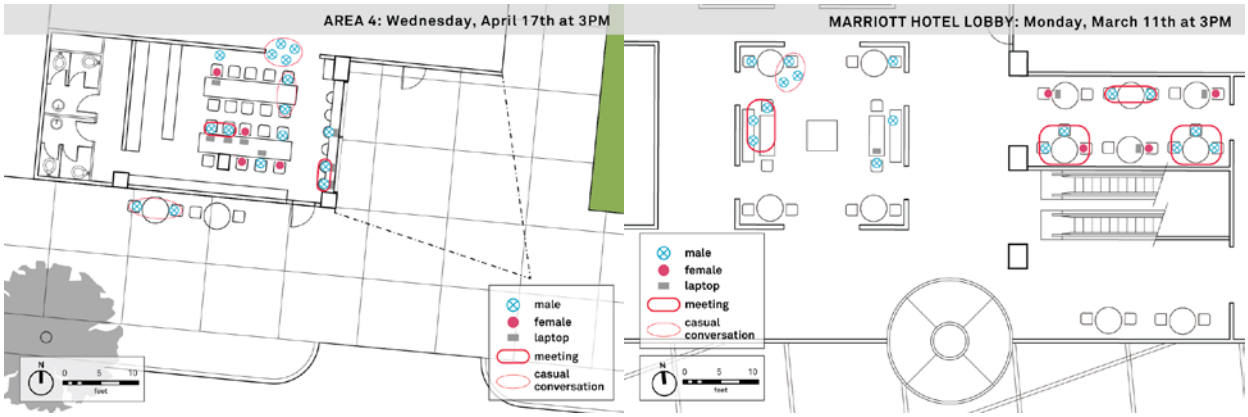
Aside from the serious business meetings, there were also a lot of career or work-related conversations going on in those places. Despite that some of the meetings were more formal than the others and others were almost like a casual conversation between two friends, I could differentiate these meetings with casual conversations because this type of activity always involved some sort of physical material e.g., notebooks, pens, laptops, iPads. These groups also stayed for approximately one hour or so.

The common characteristic of work-related meetings was that they tend to be held during the morning work hours than any other time of the day. During the lunch-

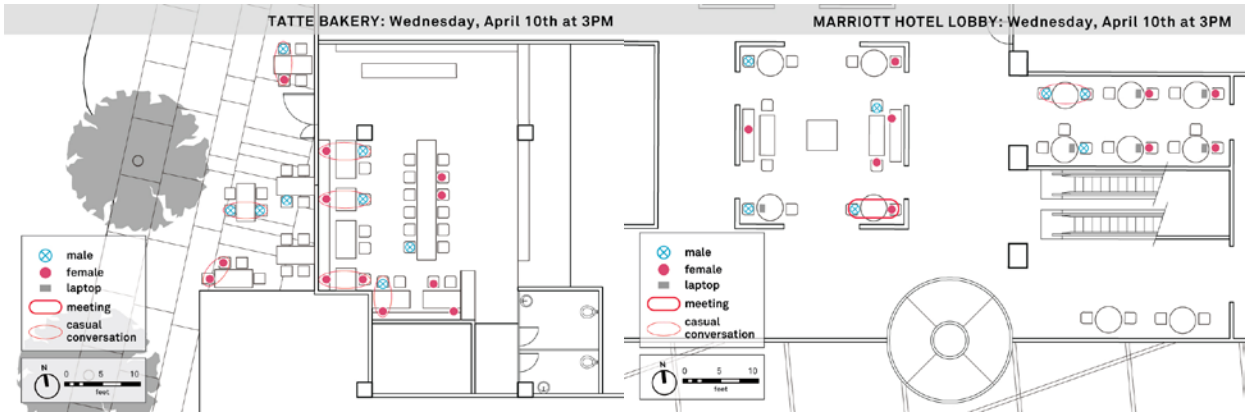
Figure 4-14. Onsite observation map


AREA 4: Friday, April 5th at 2PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet

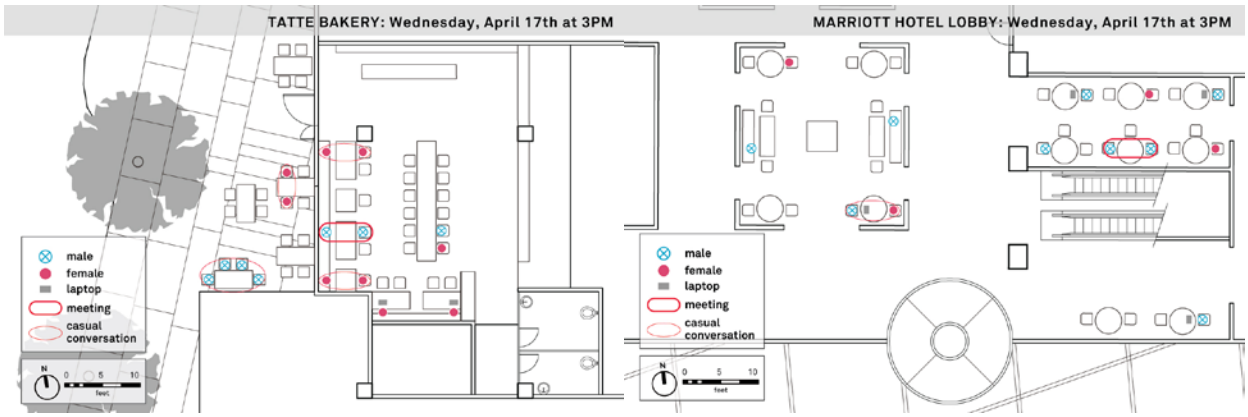
MARRIOTT HOTEL LOBBY: Friday, April 5 th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet


AREA 4: Wednesday, April 17th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet

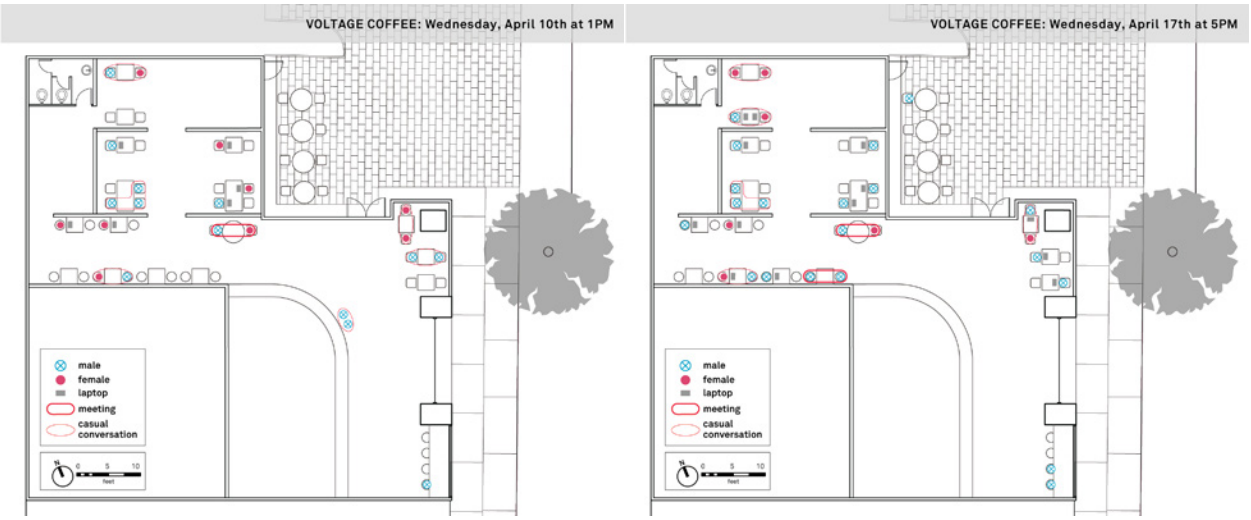
MARRIOTT HOTEL LOBBY: Monday, March 11th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet


TATTE BAKERY: Wednesday, April 10th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet

MARRIOTT HOTEL LOBBY: Wednesday, April 10th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet


TATTE BAKERY: Wednesday, April 17th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet

MARRIOTT HOTEL LOBBY: Wednesday, April 17th at 3PM
male
female
laptop
meeting
casual conversation
N
0 5 10
feet



time, the establishments were all swarmed with people, making it impossible for in depth conversations. During the afternoon, the places had more casual conversations and "catching-up" activities between friends rather than meetings. After work, all three retail spaces closed down and the hotel lobby was too calm for any sort of activities other than the use of hotel guests.

Another prominent activity that characterized these places were people working on their laptops, alone or in groups. In all four places there were at least three people with their computers open and all of these places offered free wifi service for an hour, except Marriott hotel where it was unlimited wifi service. There were a lot of people alone with laptops open in Marriott lobby. They seemed to be doing so because they were waiting for someone or attending a conference. The Starbucks in the hotel was also a convenient amenity for those working. In Voltage and Area

Four, there also was high number of people working with their laptops. Area Four had more student presence and the constituency of Voltage were young professionals. Voltage had many more people working in groups rather than alone and this seemed to be the consequence of size of the place. The tables in Voltage were laid out very spaciously leaving ample room for occupying the floor space with bags, bike helmets, and outers, whereas Area Four was very condensed and small in size, which makes it hard for groups to find spots that could accommodate all of them together.

In three retail spaces, casual conversation was another major type of activity in the space and Marriott lobby wasn't the choice for catch up conversations. There were at least two or more groups talking casually in the retail spaces every time I visited

them, although, afternoon had more groups in casual conversations compared to other times of the day. These groups tended to stay there for twenty to forty minutes. Tatte bakery had the most number of casual conversation groups but they seemed to be people who rather live in the area than those who work. The resident population stayed for much longer period of time.

All three retail spaces had outdoor seating available, with two to five tables on the outside and the outdoor seating appeared to be a desired place to sit for casual conversations rather than serious meetings. Also it seemed like the presence of outdoor seatings was drawing attention of the passersby. Additionally, all three places had outdoor seating not directly spilling out to the sidewalk, but in an indented spaces: the *nooks*. Area Four had both types: outdoor seating for the restaurant was within a shaded nook; and seating for cafe was exposed to the sidewalk, which made it less desirable place to sit.

As I was aware that the Voltage coffee shop was a venue for weekly networking event that connects venture capitalists and startups, I visited the place on a Thursday morning and there was at least thirty people inside the coffee shop, who were all trying to connect with each other by sharing their backgrounds and business ideas.

Another noticeable activity of the three retail spaces was the people taking out food and drinks. All of the three places were packed with people in line around lunchtime until at least 2pm. One very interesting phenomena I've noticed was people accidentally running into acquaintances when they were waiting in line. As I sat in Tatte bakery around 4pm, a woman walked in and ran into an acquaintance of hers who was also waiting in line to order. They started to break into conversation about how their work is going and ended with a remark that they will catch-up again sometimes soon. Despite the fact that not many people actually do follow-up with the such brief encounters, such serendipitous certainly seemed to reinvigorate the weak ties between knowledge workers. So I took the notion of chance encounters further and tested to see if this is really happening often in Kendall Square. We hear hypothetical stories of a biologist and a chemical engineer bumping into each other and sharing ideas that led to a groundbreaking research, but often the stories are anonymous and therefore reduces the credibility.

When the workers were asked whether or not they have experienced chance encounters at all, 59 (84%) among 70 respondents said that they have. Of those 59

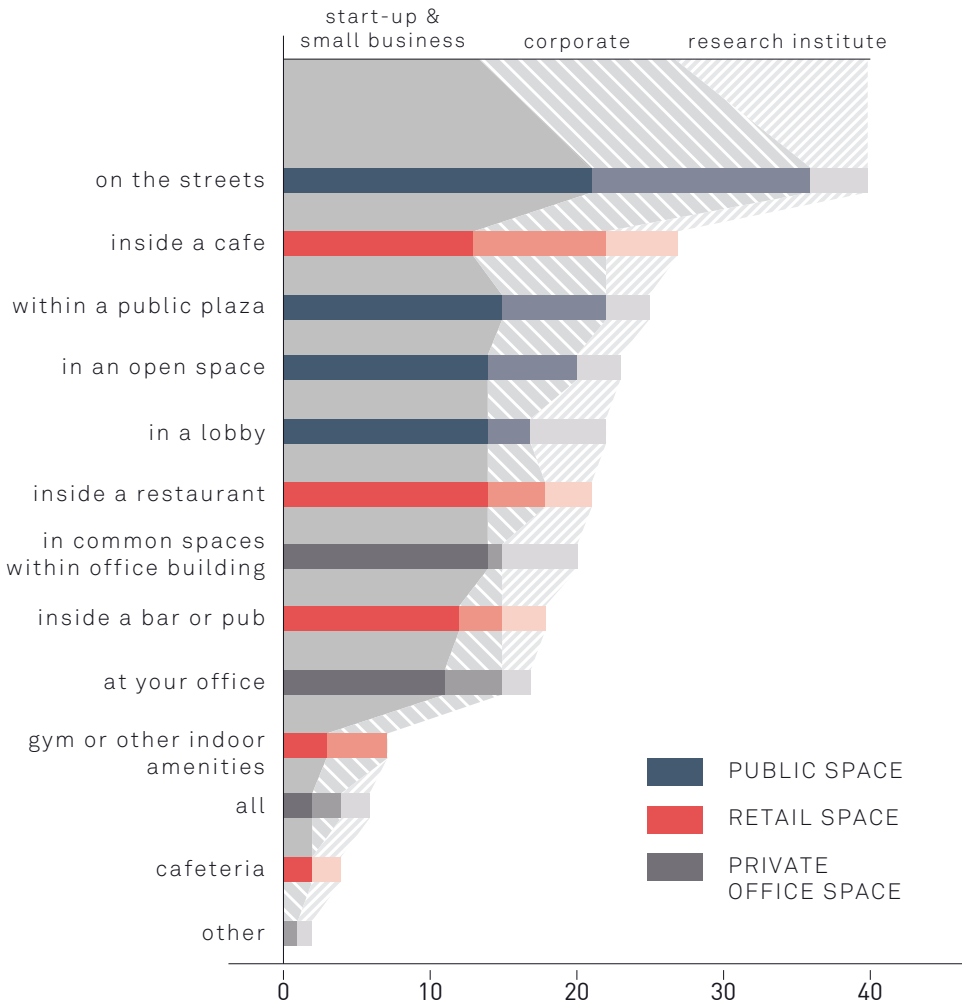


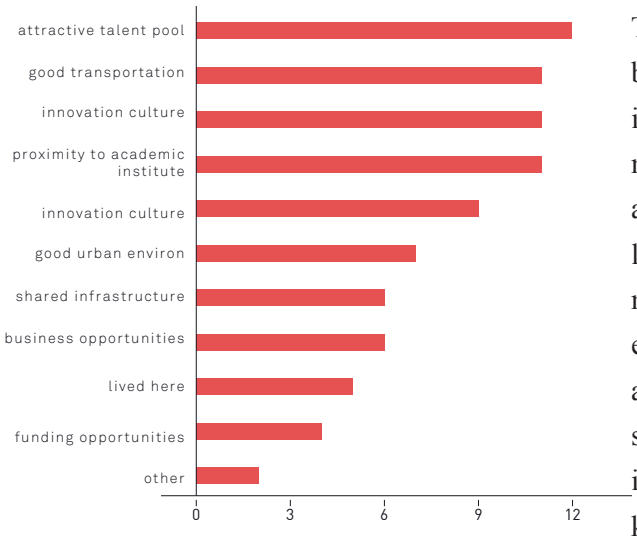
Figure 4-15. Chance encounter locations

people who experienced the chance encounters, 37 (66%) people said that they consider such encounters as helpful conversations in advancing their business/research.

When they were again asked where such conversations took place, the 76% (44 people) answered that the conversations take place on the streets. Cafes (50%, 29 people) also seemed to venues for chance encounters as I have witnessed in Tatte bakery. Public plazas, open spaces, building lobbies, restaurant, common space within office buildings, their own office, and bar or a pub were popular places for chance encounters. Two people mentioned the T station and MIT campus as other venues for encounters. With exception of the higher chances of experiencing chance encounters on the streets, at first glance, the survey result seems to point towards a conclusion that the chance encounters are basically happening everywhere. Nevertheless if you break the result down by retail and public spaces, the data reveals that much of the encounters are happening in the public realm rather than inside retail spaces or within private office buildings.

Furthermore, if you break the data down by different worker groups: startup and small businesses; corporate; and research institute, it can be learned that startups and small businesses are the most active to experience chance encounters compared to the corporate and research institute workers.

Numerous surveys and studies have been trying to find out the elements that influence the location choices of knowledge workers. I was also curious about this question because I wanted to know the relative importance of the built environment in effecting the location choice of knowledge workers. Therefore I asked the same question in my survey but created subgroups for the question: the employers and the employees. This is to capture the corporate employees who work in the area as well. As I have demonstrated in chapter three, corporates also play a key role in enhancing the innovative activities within a district as much as the startups by bringing in capital, resources, and reputation. Often, the location studies of the knowledge workers are done only from the perspective of startups and I believe by obtaining answers from the corporate companies as well would reveal in depth information.



(top) Figure 4-16. Factors that influence location choices of employees
(bottom) Figure 4-17. Factors that influence location choices of businesses

significant factor was the "Accessibility to Good Transportation" by 56% (29 people) and "Good Urban Environment" by 54% (28 people). This is an evidence that favors the importance of urban environment in choosing where to locate. 48% (25 people) also said that they chose their job because they were living here. Again, this indicates that the notion of mobility of the young professionals needs to be tested. Other important factors were "Innovation Culture and Community," "Proximity to Academic and Research Institutions," "Attractive Talent Pool." These indicators are pointing towards the fact that many knowledge workers are opened to the possibility of creating their own business at some point in the future.

For the employers, which were the startups, “Attractive Talent Pool” was the most selected answer although it wasn’t a dominant one. This supports the importance of human capital in the innovation economy. “Innovation Culture and Community,” “Accessibility to Good Transportation,” “Proximity to Academic and Research Institutions,” and “Good Urban Environment,” “Shared Infrastructure,” and “Business Opportunities” were also very influential.

The importance of the built environment was again tested with a question asking about the relative importance the workers consider regarding retail and cultural amenities, and public spaces. On the scale from 1 (not important at all) to 100 (very important), the workers had rated the importance of urban amenities as 70 and of public spaces as 62.5. This reveals that well-designed built environment could be a positive factor in influencing the location choice of knowledge workers. It is also important to note that although workers value retail and cultural amenities more than public space, most of the chance encounters are happening in the public realm. Therefore the value of public spaces would not be fully captured when the location choices of individual workers are only put to investigation.

4.3. Synthesis

As a result of my investigation, I have found out that Third Places are a direct benefit to the innovative activities of a place for five main reasons. First, they serve as a meeting venue for companies of all sizes. Second, they are the places to share ideas. Third, they serve as social and cultural stimuli by providing places to meet up for friends and acquaintances and also to take a break from work. Fourth, they become the alternative workplaces for those who work in startups and small businesses. For those knowledge workers who desire to escape from their offices or those who don't have a proper office space, the cafes and restaurants are becoming popular choices to work with their laptops using free wifi service in spacious seatings. Lastly, they serve as a venue for networking events, which increases the number of weak ties. Weak ties play a role in effecting social cohesion, especially within professional and technical specialties (Granovetter 1973). Therefore the availability of new venues that creates weak ties contribute to a stronger sense of innovation community in Kendall Square.

Aside from the direct impact that Third Places have on the enhancement of innovation district, they also play a critical role indirectly by: increasing the chance of serendipitous conversations among the workers and by attracting more knowledge workers to the area. Knowledge workers responded that they are likely to experience chance encounters on the public realm of the area, which means that well-designed public Third Places such as plazas, opens spaces, and sidewalks are a great benefit to the district as a whole. Additionally, the workers are cognizant of the urban environment that they are working in and they seemed to value the qualities of good urban spaces. Therefore, creating a good urban environment will attract companies who wish to hire the skilled workers, which will in turn attract the knowledge workers.

Chapter 5.
The Future of Innovation Districts

This thesis originated from witnessing the drastic changes that Kendall Square, Cambridge, have gone through. During my short period of two years observation, Kendall Square evolved from a place of nowhere to a buzzing urban neighborhood where businesses want to locate and where people hang out in bars and restaurants after work. Many people that I've spoken to, who have been around the area for a much longer period of time, reaffirmed my observation. MIT graduates, city officials, long-time Cambridge residents have said that the area used to be a place where they would avoid after dark and now that it has become the place-to-be for entrepreneurs in the region.

Along with such vitalization of the neighborhood, Kendall Square is also becoming a place that people are referring to as an "innovation district." The idea stems out of the Boston Consulting Group's 2010 presentation to the Cambridge City Council when they've emphasized the value of Kendall Square as the place of unprecedented density of well-educated young professionals and introduced how these knowledge workers like urban living lifestyle they have in Kendall Square. Later in 2012, the name was popularized when Goody Clancy Associates was working as the consultant for the City of Cambridge's planning study, K2C2. The rationale for calling Kendall Square as an innovation district was that the place have become an urban neighborhood that has extremely high density of well-educated young professionals and that these young professionals are actively sharing ideas with each other leading to groundbreaking inventions or innovations.

From an urban planner's perspective, I was curious to know what impact the improvement of the *built environment* have had on the *economic growth* of the neighborhood and vice versa. Since Kendall Square experienced positive changes to both the built environment and the economic growth over the last fifteen years, my initial goal was to identify any correlationship that might exist between the two. Furthermore, I aimed to study the successful/unsuccessful spaces of Kendall Square to offer guidance about how to design the physical spaces of innovation

districts that would stimulate innovative activities and eventually contribute to the economic development of a place.

From a broader perspective, the creation of urban high-tech clusters seemed to have become a popular tool for the American policymakers to promote economic growth of cities. Since Kendall Square is regarded as one of the thriving urban high-tech cluster, I wanted draw out lessons from analyzing Kendall Square as a case study. By understanding how Kendall Square came to its being and what are the characteristics that have made it successful, my goal was to present physical and non-physical policy recommendations for future attempts to create/foster urban high-tech clusters with special emphasis given to the built environment. Accordingly, the central question of this thesis was: *What form does high-tech clusters take in an urban setting? What are the spatial qualities and characteristics that constitute such clusters?*

The thesis tries to answer these questions through two data analysis methods: first by process-tracing the development history of Kendall Square, both physical and economical; and second by using environment-behavior research approach to observe how urban spaces are being used and contributing to the innovative activities of the district. My goal was to glean some general policy recommendations about building innovation districts from the process-tracing method and then obtain specific tips about the elements that create a thriving innovation district from the environment-behavior research.

In the previous chapters, I have argued: how and why urban high-tech clusters, which I name the innovation districts, are important; what is an innovation district and how it comes into its being, by investigating Kendall Square as a case study; and how urban spaces within an innovation district is enhancing the innovation economy of the district as a whole. In this final chapter, I revisit the questions asked at the beginning and synthesize the lessons learned from my analysis, which distills down to four main categories: (1) development process of innovation districts; (2) impact of the built environment on economic growth; (3) Non-physical characteristics of an innovation district; and (4) physical characteristics of an innovation district.

Development process of innovation districts

Kendall Square was able to evolve into an innovation district because of the pioneering individuals who began to cluster in the area spontaneously. They were

able to do this, because there was cheap, funky factory buildings in the area that was readily available for their startup companies. In this sense, it is not reasonable to build an innovation district from scratch but rather start within an existing city area since the first entrepreneurs often cannot afford to stay in a newly developed real estate. Jane Jacobs also asserted this simple truth of how innovations can only grow from old urban spaces: "Old ideas can sometimes use new buildings. New ideas must come from old buildings (1961, 245)." Therefore, I emphasize that building good physical environment should not be the groundbreaker of innovation districts but rather serve as the catalyst that amplifies the innovative energy that is already existent in a place.

A series of reports from the Brookings Institute on Regional Innovation Clusters also stresses the importance of the *spontaneousness* of cluster-building. The recommendations of the report underlines that policymakers should "*not* try to create clusters" and rather recommends to recognize and nurture "those clusters that establish themselves." The reports goes on further and recommends that the private sector should lead the clustering and the government should act in minimally intrusive manner, primarily to support, connect, fill gaps, and remove obstacles.

I also find similar market-driven strategy to be more successful in making innovation districts. Innovation districts are best built when private developers gradually fill in the area because incremental private developments are much more responsive to the shifting needs of the market. For instance, although One Kendall Square originally was planned for computer-related tech companies, the campus became a place for biotech startups because "that was just the way market went." The developers of the project flexibly adjusted their business model to meet the market demand.

Incremental private development scenario is also compatible for building innovation districts within established urban areas, because the constraints of infill developments such as lack of land, existing buildings, and the neighborhood, are challenging and therefore need tailored solutions for each condition. I have also found that homogeneity of design is uninspiring and unattractive to the knowledge workers in advancing their ideas. Therefore, a district will naturally obtain its diversity through this incremental process. Additionally, I recommend that individual private developments should not be too big in size and the amount of development so as to dominate the characteristics of the entire district.

How urban spaces are enhancing the innovative activities

The improved urban spaces of Kendall Square is proven to be extremely beneficial in stimulating innovative activities. I have found that in Kendall Square, innovative activities, the sharing of ideas, interfirm collaboration, and social interaction, were happening mostly outside the conventional office buildings. Consequently, well-designed urban spaces is an important catalyst for the growth of the high-tech industry and entrepreneurial activities. I label these good urban spaces as Third Places.

In order for Third Places to thrive and therefore enhance the district, I strongly suggest that districts be developed within 10 minute walking distance from subway stations or other major public transit stations and that the entire district should be tightly networked together with pedestrian-friendly walking environment from the public transportation access. The 10 minute walking distance equals to an approximate size of less than 500 acres.

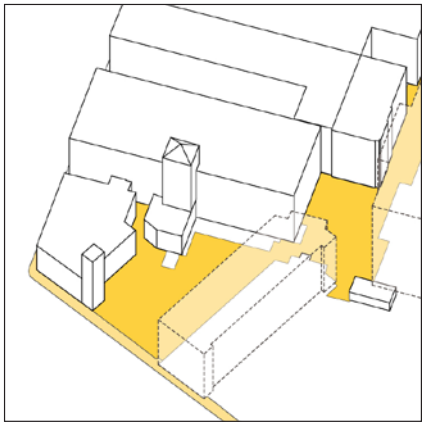
In Kendall Square, the Third Places have been influential to the growth of innovation ecosystem in two different ways: intentional use and unintended side effect. The breadth of intentional use included: business meetings; work-related conversations; casual conversations; cultural stimulus; alternative workplace; and networking purposes. These activities collectively have positive influence to the innovation economy of Kendall Square, as they increase social interaction between the knowledge workers and offer a new type of venue for innovative idea sharing.

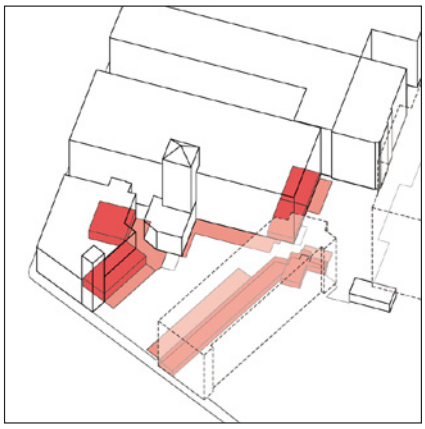
The unintended side effect of good urban spaces included: the chance encounters and improving the profile of the district and consequently attracting more people to the place. My observation and the survey results collectively support the finding that Third Places are where the chance encounters were happening in Kendall Square. Increased chance encounter enhances the weak ties between knowledge workers and leads to better chance of innovation. Third Places also seem to be uplifting the image of a district as a whole, which is making the neighborhood more desirable to knowledge-intensive companies. Companies believe that their potential employees value good urban environment. Therefore, they attempt to offer the desired lifestyle of the people who they wish to attract. Such companies in turn, attract even more knowledge workers, which increases the innovation capacity of a place. To sum up, I argue that urban spaces of innovation districts are critical to the success of the districts.

Non-physical characteristics of Innovation Districts

An important lesson that I've learned from studying different spaces of Kendall Square was that the existence of ground-floor retail makes a huge difference in activating the streets and enlivening the district. The ground-floor additions to Technology Square, One Broadway building and along the Third Street significantly increased the pedestrian experience and the level of activity. The appropriate percentage of retail within a single development seems to be around 5 to 7 percent of the total development amount. According to Dan Winny Architect's 2006 report on retail planning at the Kendall Square Project (Cambridge Research Park), One Kendall Square has approximately 6% of retail, Technology Square has 4%, and University Park in Cambridge Port has 2.5% of retail space, and therefore, proposes a 5 to 6% of retail space for Kendall Square Project. Both One Kendall Square and Kendall Square Project have been successful in creating a vibrant pedestrian environment in and around the development.

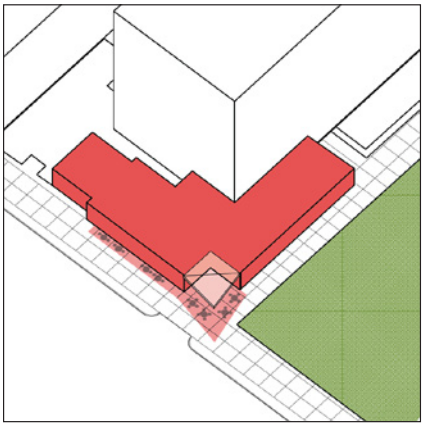
Another important element of a vibrant innovation district was the appropriate mix of residential and commercial uses. The development history of Kendall Square illustrates that housing has been extremely beneficial in activating the district by increased pedestrian traffic and activity after work hours. Therefore, it is important that a district maintains its right ratio of residential and commercial uses. Nevertheless, commercial development is often worth much more money to the real estate developers. So, if it becomes challenging to maintain the right mix due to market-driven decisions of private developers, I recommend that local governments to intervene and keep the balance.





Physical characteristics of Innovation Districts

Most importantly, I argue that the physical environment that is outside buildings, the urban space that is connecting individual buildings, are the most important element in the success of innovation districts. And that well designed Third Places, retail and public, are a catalyst for innovation. Here, I offer some specific design principles about how to create good urban spaces that will stimulate social interaction, chance encounters, and interfirm collaboration by improving the public realm of innovation districts.

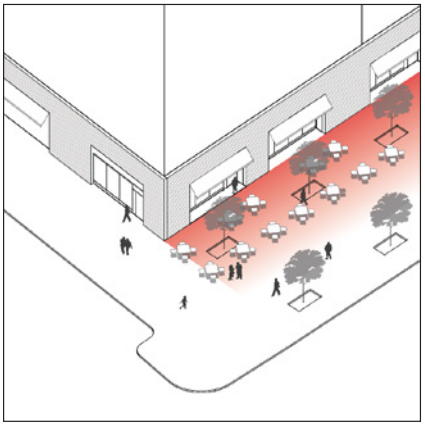


One, innovation districts should have connected public realm.

Comparing different public spaces in Kendall Square, I find that open spaces and plazas that are interconnected with each other and connected with public streets within a visible distance are the most thriving type of public space design.

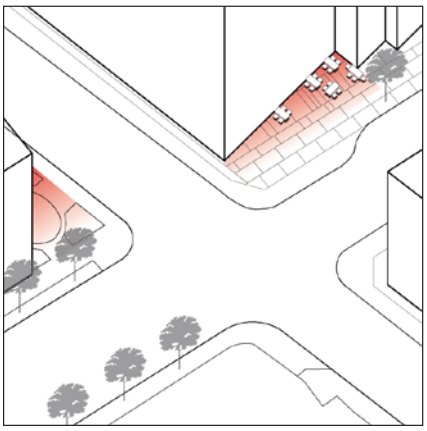
Two, retail spaces should be concentrated to create a critical mass.

Retail spaces that are adjacent to each other or within a short distance offer eating and drinking options to the workers in the area and therefore create focal point for concentrated pedestrian activity.



Three, retail space should define the public realm.

The renovation of the Tech Square in Kendall Square demonstrated the power of retail space that defines and invigorates public realm. Public spaces that are either undefined or defined by undesirable uses such as back of buildings become underutilized by not being able to attract people to those places.



Four, ground floor of buildings should spill over to the public realm.

Ground floor uses that interact with the sidewalk space, e.g. outdoor dining areas, operable windows, have found to be very successful in improving image of a district compared to the uses that are not interacting with the sidewalk space.

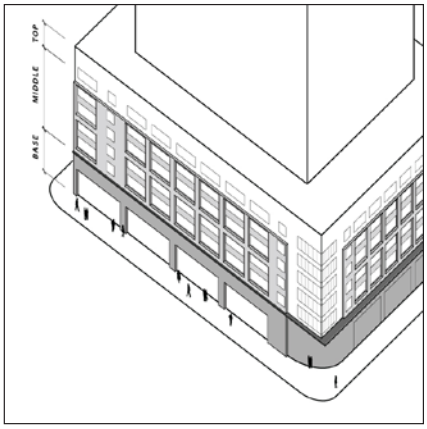
Five, urban "nooks" are appealing to the knowledge workers.

My interviews and onsite observations revealed that urban nooks become spaces where the workers like to hang around. These secluded yet public spaces are important asset in making the district look interesting and generating foot traffic.

Lastly, I would like to share some of the aspirational design principles that I believe could contribute to building a vibrant and successful innovation district.

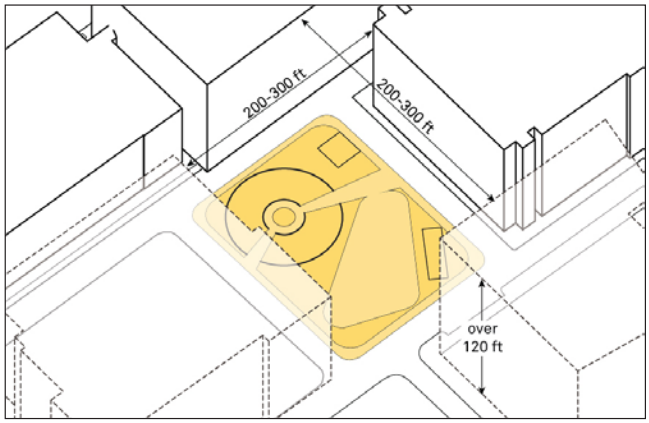
One, building design should be diverse.

One of the most obvious lesson from the Cambridge Center development was the negative comments about the homogeneous brick buildings of the development. Although it may be not an easy task to artificially create diversity, it is important to keep this in mind. Utilizing old building structures and balancing the old and the new is an effective way of creating diversity.



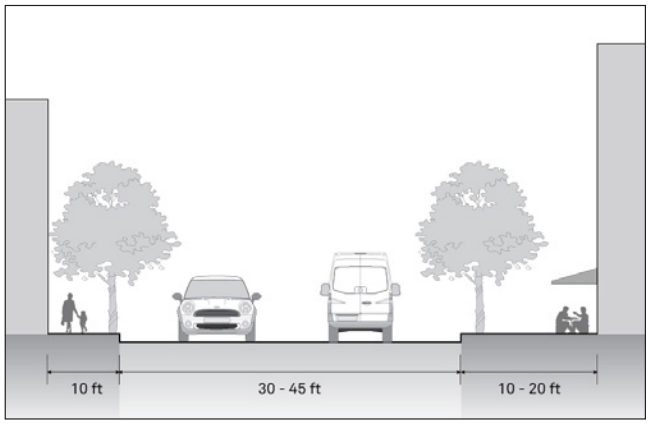
Two, plazas that are defined by buildings should be proportionate to the height and scale of adjacent buildings.

Plazas that are too small or too big compared to the scale of adjacent buildings tend to be hard to activate. Appropriate proportion of the plaza is that it should be at least as wide as the height of surrounding buildings. Given the current density and built form of Kendall Square, building that are five to six stories are most commonplace for the buildings that abut public plazas.



Eight, streets should not be overly wide.

Overly wide streets create a sense that the neighborhood is not populated enough. Kendall Square have been struggling to recover from its mistake of making the streets too wide at the time of urban renewal. Road with should be within 30 to 45 feet and sidewalk should be 10 to 20 feet, if outdoor dining activities are to be accommodated. Where sidewalk spillover is not anticipated, sidewalk width of approximately 10 ft is appropriate.



Appendix

Appendix A. Interviews

I have conducted twelve semi-structured interviews with city officials, real estate developers, and entrepreneurs in Kendall Square. Although interview questions were tailored for each interviewees depending on their expertise, the basic categories and some sample questions are provided below. Aside from the semi-structured interviews, much of my insight about how Third Places in Kendall Square are actually used by the knowledge workers come from the casual conversations I had with entrepreneurs I met at networking events. I attended four different networking events: two of them were weekly Thursday night events at the Venture Cafe in Cambridge Innovation Center, one of them was part of the Cambridge Science Festival, and the other one was a follow-up meetup for a previous networking event.

For city officials

1. Could you provide a brief history of the development of Kendall Square? Given the drastic changes of Kendall Square, when would you say was the turning point for the area? What triggered such transformation?
2. How would you describe the economic activities of Kendall Square? Is it any different from the past?
3. What are some successful/unsuccessful urban spaces in Kendall Square? Could you provide detailed explanations of why such places work/not work?
4. What are the changing demands that you experience from the developers of the area? What do you do to support/discourage such demand?
5. What are the changing demands of the businesses that want to locate in the area?

For real estate developers

1. Could you tell me a brief historical background of the development of [name of a specific development projects in Kendall Square]?
2. What was your motivation in designing this project? Which features jump to you the most when you are describing it?
3. What influenced your decision to include ground-floor retail in this development complex?
4. What makes this development different from other developments in Kendall Square? What are the similarities?
5. What do you emphasize the most when you are targeting high-tech businesses?
6. Which are the most important physical design features for high-tech businesses? Is it any different from common office building design?
7. How would you describe the market demand of Kendall Square? How has that changed over time?

8. What do you think is the appropriate mix of uses for commercial developments in Kendall Square (housing / office / retail / open space)?

For entrepreneurs

1. How long have you been working in Kendall Square? How do you like/not like the place?
2. What is your definition of an innovation ecosystem? What are the elements that stimulate innovation? Some examples include:
    - talented people
    - thick labor markets that range from a single-person start-ups to international corporate firms
    - capital investments
    - manufacturing capabilities
    - creative community that shares ideas
    - social and cultural venues that are open to public
3. How do you think innovative ideas get generated?
4. How often do you visit retail stores in Kendall Square? What were the purpose of your visits?
5. What are some of your favorite places to visit? And why do you like these places?
6. What do you think about the cafe, restaurant, entertainment venues and bars in Kendall Square? What about the public spaces?
7. Do you interact much with others who work in the area? Does this include new people as well as acquaintances? Do you purposefully share ideas with people from other firms?
8. Where do you get to meet new people? Where do you meet acquaintances?
9. Have you ever experienced serendipitous conversations with others who work in the area?

List of Interviewees

Community Development Department, City of Cambridge,

Roger Boothe, Director of Urban Design
Iram Farooq, Project Planner
Jeff Roberts, Project Planner
Pardis Saffari, Project Planner
Chris Balser, Project Planner

Real Estate Developers of Kendall Square

Dan Winny, Dan Winny Architects
Bob Flack, Twining Properties
Mike Owu, MIT Investment Management Company

Entrepreneurs in Kendall Square

Andrew Singleton, Event Coordinator, Venture Cafe

Jesse Baerkhan, President, CityRetail

Sebastian Castro, Co-founder, Leaf

Kwan Hong Lee, Redstar Ventures

Bill Aulet, managing Director, Martin Trust Center for MIT Entrepreneurship at the MIT Sloan School of Management

Appendix B. Survey

In designing the survey, previous survey attempts were greatly helpful. The City of Cambridge had conducted two surveys: first one was to understand the retail usage and demand in and around Kendall Square and the second was targeted to entrepreneurs to obtain a better understanding of the current entrepreneurial activities in Kendall Square. The retail survey, Kendall Square Customer Intercept Survey 2011, surveyed 650 people who were visiting Kendall Square, whether it was for work, to visit retail businesses, or because they lived around the area. It was interesting to see that out of 640 respondents 75% of the people were working in the area, which represents high population of people who come to Kendall Square for work. Another interesting finding was that the respondents liked restaurants and cafes in Kendall Square but desired more of a "24-hour feel" around the neighborhood. The city's Innovation Survey in 2013 was informative especially in designing my survey questions to understand the characteristics of current businesses in Kendall Square.

I have also looked in the survey results conducted by the New England Venture Capital Association (NEVCA). The major takeaway from the NEVCA's survey was that entrepreneurs cited access to talent, overall lifestyle and livability, and access to interaction with other entrepreneurs as the primary factor in influencing their location choice. Therefore, I included the above options as choices for question six and seven of my survey too. Additionally, Andrew Singleton, event coordinator of the Venture Cafe in the Cambridge Innovation Center, offered insights about the characteristics of the startups and entrepreneurial activities in Kendall Square, which influenced my survey design.

Nonetheless, despite their desire to understand the entrepreneurial activities in the area, the city's innovation survey and NEVCA survey only targeted entrepreneurs and have not included employees from research institutes or corporates. As I believe such actors are an important part of the mix of innovation ecosystem, I decided to target employees in major research institutions and corporates as well.

I collected total of 83 completed survey responses: 29% of the respondents from startup companies, 20% from corporates, 12% from small businesses, 12% from academic institutions, 13% from research institutes, and 4% from non-profit organizations. Nevertheless, to get a better profile of the innovation ecosystem of Kendall Square, I filtered out respondents who identified themselves as employees of an "academic institute," as this group included jobs that were not directly related to the high-tech sector or entrepreneurship.

Major method of collecting survey responses was through the MIT Alumni Association. I reached out to the MIT alumni who have been working around Kendall Square area. I also visited the Venture Cafe, three times during their thursday night events where entrepreneurs gather for networking and potential capital investment opportunities. Lastly, I used some of my personal contacts who were employees of the startup companies located in Kendall Square.

Thank you for your participation. The survey is consisted of 20 questions in total and will take about 3 minutes to complete.

1.What is your age range?

- ☐ 15 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 or more

2.What is your gender?

- ☐ Male
- ☐ Female

3.What is your home zip code? _____

4.Do you work in Kendall Square?

- ☐ Yes
- ☐ No

5.How would you describe yourself?

- ☐ Employee
- ☐ Employer

6. **(For employees)**

What were the most significant factors when you were choosing where to work? (check all that apply)

- ☐ Good Job Offer
- ☐ Thick Job Market
- ☐ Proximity to Academic and Research Institutions
- ☐ Shared Infrastructure and Incubator Space
- ☐ Attractive Talent Pool
- ☐ Live here
- ☐ Innovation Culture and Community
- ☐ Accessibility to Good Transportation
- ☐ Funding Opportunities
- ☐ Business Opportunities
- ☐ Good Urban Environment (e.g. variety of eating and drinking options, cultural amenities, good walking environment etc.)
- ☐ Other (please specify) _____

7.**(For employers)**

What were the most significant factors when you were choosing where to locate your business? (check all that apply)

- ☐ Proximity to Academic and Research Institutions
- ☐ Shared Infrastructure and Incubator Space
- ☐ Attractive Talent Pool
- ☐ Live here
- ☐ Innovation Culture and Community
- ☐ Accessibility to Good Transportation
- ☐ Funding Opportunities
- ☐ Business Opportunities
- ☐ Good Urban Environment (e.g. variety of eating and drinking options, cultural amenities, good walking environment etc.)
- ☐ Other (please specify) _____

8.Which of the following best describes your company?

- ☐ startup
- ☐ corporate
- ☐ other _____

9.How long has your company been in business for?

- ☐ 1 to 5 years
- ☐ 6 to 10 years
- ☐ 11 to 20 years
- ☐ 20 years or more

10.How many employees are there in your company?

- ☐ 1
- ☐ 2 to 5
- ☐ 6 to 10
- ☐ 11 to 20
- ☐ 21 to 50
- ☐ 51 to 100
- ☐ 100 or more people

11.Which of the following sector can your company be classified as? (multiple choices are possible)

- ☐ Pharmaceutical and Medical Manufacturing
- ☐ Scientific Research and Development Services
- ☐ Management, Scientific, and Technical Consulting Services
- ☐ Data Processing, Hosting, and Related Services
- ☐ Computer Systems Design and Related Services
- ☐ Software Publishers
- ☐ On-Line Information Services
- ☐ Architectural, Engineering, and Related Services
- ☐ Educational Support Services
- ☐ Computer and Office Machine Repair and Maintenance
- ☐ Other (please specify) _____

12.How often do you visit cafes, restaurants, bars and other social/cultural venues in Kendall Square?

	very often (once per day)	fairly often (at least twice per week)	sometimes (about once per week)	rarely (once per month)	never
at lunchtime					
during work hours					
after work					

13.Do you go to such places for purposes other than just to get food and drinks?

☐ Yes ☐ No

14.If yes, what was the purpose of your visit?

	at lunchtime	during work hours	after work
to meet with friends and acquaintances for casual conversations			
to have work-related conversations			
to get to know new people			
for business meetings			
to use it as an alternative workplace (e.g., work on laptop)			
to take a break from work / for entertainment purpose			
to meet with friends and acquaintances for casual conversations			
to have work-related conversations			
to get to know new people			
Other (please specify)			

15.How important are the indoor go-to-places such as cafes and restaurants for your everyday work-life?

very important	Somewhat important	not important at all	no opinion

16.How important are the outdoor spaces such as plazas and open spaces for your everyday work-life?

very important	Somewhat important	not important at all	no opinion

17.Do you purposefully interact with people from other companies and institutions located in Kendall Square (e.g., networking events, acquaintances meetups)?

	yes	no
with new people		
with acquaintances		

18.Have you ever experienced unexpected interactions (e.g., running into acquaintances, breaking into random conversations) with others working in Kendall Square?
Unexpected interactions do not include networking events and prearranged meetups.

¬ Yes ¬ No

19.If yes, do you find such serendipitous conversations helpful in advancing your business/research?

¬ Yes ¬ No ¬ Don't know

20.Where does the serendipitous conversation take place? (check all that apply) ¬ inside a cafe
¬inside a cafeteria
¬inside a restaurant
¬inside a bar or a pub
¬inside a gym or other indoor amenities
¬ on the streets
¬within a public plaza
¬in an open space
¬inside a building lobby
¬in common spaces of an office building
¬ Other (please specify) _____

21.Please leave your email address, if you are open for open for follow-up questions or conversations _____

Thank you for your cooperation. Your answers are extremely important in furthering my research. Please contact Minjee Kim at minjeek@mit.edu if there are any additional questions or comments.

Survey Results

(The results presented here excludes responses from the employees of an academic institute)

Q1. What is your age range?

15 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 or more	total
0	24	24	13	4	4	69
0%	35%	35%	20%	5%	5%	

Q2. What is your gender?

Male	Female	total
48	21	69
70%	30%	

Q3. What is your home zip code?

01339	1	01921	1	02138	2	02421	1
01581	1	01982	1	02139	11	02445	1
01583	1	02030	1	02140	1	02467	1
01720	1	02043	1	02141	3	02474	1
01742	1	02111	1	02142	4	02476	3
01748	1	02114	4	02143	2	03051	1
01778	1	02129	1	02144	3	03060	1
01803	1	02130	1	02145	1	03076	1
01810	1	02134	1	02155	2	010014	1
01890	1	02135	1	02420	2	033004	1

Q4. Do you work in Kendall Square?

Yes	No	total
67	3	70
96%	4%	

Q5. How would you describe yourself?

Employee	Employer	total
51	19	70
73%	27%	

Q6. What were the most significant factors when you were choosing where to locate your business? (check all that apply)

Total respondents: 19	
Proximity to Academic and Research Institutions	13
Shared Infrastructure and Incubator Space	7
Attractive Talent Pool	14
Have been living here	6
Innovation Culture and Community	12
Accessibility to Good Transportation	12
Funding Opportunities	4
Business Opportunities	6
Good Urban Environment (e.g. variety of eating and drinking options, cultural amenities, good walking environment etc)	10
Other (please specify)	2

Q7. What were the most significant factors when you were choosing where to work? (check all that apply)

Total respondents: 52	
Good Job Offer	47
Thick Job Market	7
Proximity to Academic and Research Institutions	18
Shared Infrastructure and Incubator Space	5
Attractive Talent Pool	14
Live here	25
Innovation Culture and Community	23
Accessibility to Good Transportation	29
Funding Opportunities	4
Business Opportunities	8
Good Urban Environment (e.g. variety of eating and drinking options, cultural amenities, good walking environment etc)	28
Other (please specify)	3

Q8. Which of the following best describes your company?

Startup	Corporate	Small Businesses	Research Institute	total
24	25	10	11	70
34%	36%	14%	16%	

Q9. How long has your company been in business?

1 to 5 years	6 to 10 years	11 to 20 years	20 years or more	total
31	8	18	13	70
44%	11%	26%	19%	

Q10. How many employees are there in your company?

1	2 to 5	6 to 10	11 to 20	21 to 50	51 to 100	100 or more
0	8	4	5	8	5	40
0%	11.5%	6%	7%	11.5%	7%	57%

Q11. Which of the following sector can your company be classified as? (multiple choices are possible)

Pharmaceutical and Medical Manufacturing	15
Scientific Research and Development Services	19
Management, Scientific, and Technical Consulting Services	4
Data Processing, Hosting, and Related Services	10
Computer Systems Design and Related Services	10
Software Publishers	4
On-Line Information Services	9
Architectural, Engineering, and Related Services	2
Educational Support Services	0
Computer and Office Machine Repair and Maintenance	0
Other (please specify)	17

Other responses included: e-commerce (2), Light Design and Manufacturing (1), Membership Association (1), Real Estate Development and Advisory (1), Venture Capital (1), Incubator space provider (1), Business Process Outsourcing (1), Cybersecurity (1), Semiconductors (1), Marketing Analytics (1), Consumer and Small Business Technology (1), Online Marketing (1).

Q12. How often do you visit cafes, restaurants, bars and other social/cultural venues in Kendall Square?

	Very Often (once per day)	Fairly Often (at least once per week)	Sometimes (about once per week)	Rarely (once per month)	Never	total
at lunchtime	27	18	12	11	1	69
during work	7	13	15	19	8	62
after work	2	15	21	21	6	65

Q13. Do you go to such places for purposes other than just to get food and drinks?

Yes	No	total
43	27	70
61%	39%	

Q14. What was the purpose of your visit? (Check all that apply)

Total respondents: 42	at lunchtime	during work hours	after work	total respondents
to meet with friends and acquaintances for casual conversations	22	14	26	36
to have work-related conversations	23	31	12	35
to get to know new people	10	8	14	21
for business meetings	14	25	8	29
to use it as an alternative workplace (e.g., work on laptop)	5	7	6	14
to take a break from work / for entertainment purpose	11	12	11	20
to attend a social event	6	10	28	31
for specific purposes (get coffee, food, etc)	32	27	17	35
Other (please specify)				1

Q15. How important are the indoor go-to-places such as cafes and restaurants for your everyday work-life?

Very important	Somewhat important	not important at all	no opinion	total
25	31	10	2	68

Q16. How important are the outdoor spaces such as plazas and open spaces for your everyday work-life?

Very important	Somewhat important	not important at all	no opinion	total
20	33	17	0	70

Q17. Do you purposefully interact with people from other companies and institutions located in Kendall Square (e.g., networking events, acquaintances meetups)?

	Yes	No	total
with new people	33	36	69
with acquaintances	55	15	70

Q18. Have you ever experienced unexpected interactions (e.g., running into acquaintances, breaking into random conversations) with others working in Kendall Square? Unexpected interactions do not include networking events and prearranged meetups.

Yes	No	total
59	11	70
84%	16%	

Q19. Do you find such serendipitous conversations helpful in advancing your business/research?

Yes	No	Don't Know	total
39	12	8	59
66%	20%	14%	

Q20. Where does the serendipitous conversation take place? (check all that apply)

Total respondents: 58	
inside a cafe	29
inside a cafeteria	4
inside a restaurant	23
inside a bar or a pub	19
inside a gym or other indoor amenities	7
on the streets	44
within a public plaza	27
in an open space	25
inside a building lobby	25
in common spaces of an office building	24
inside your workplace	19
all	6
Other (please specify)	2

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