THE DIGITAL DIVIDE IN SAN FRANCISCO

Productivity and competitiveness are, by and large, a function of knowledge generation and information processing; firms and territories are organized in networks of production, management and distribution; the core economic activities are global - that is, they have the capacity to work as a unit in real time, or chosen time, on a planetary scale. (Castells 2001: 52)

ANDRE CHAN

DEPARTMENT OF CITY AND REGIONAL PLANNING

UNIVERSITY OF CALIFORNIA, BERKELEY

FEBRUARY 2, 2007

Acknowledgement

I would like to thank the various friends and colleagues who contributed towards completion of this report. Katherine Daniel and Emilio Martinez de Velasco collaborated on the initial statistical research and compilation, and together we developed more questions and theories than we thought possible about the linkages between technology, innovation, and economic development. I hope this report answers some of those questions we left open. Ted Egan read early drafts of this report, and I thank him for his insights. Vicki Elmer read later drafts of this report, and provided more sparkling ideas than I could possibly include in this report. Finally, my heartfelt thanks go to Professor Karen Chapple, who provided me with the gentle yet monumental nudge towards laying out a blueprint for City policy that links digital divide and digital inclusion programs with workforce development programs; Karen's guidance not only to set me on the right course, but also directed me towards the finish line. This report would not have been completed without her editorial suggestions, advice, and support.

Executive Summary

The digital divide is defined as the access – or lack thereof – to technology at home (U.S. Dept of Commerce October 2003). Recent studies have shown the digital divide can be identified and measured according to seven at-risk socio-economic groups: Race, Gender, Age, Educational Attainment, Income, Disability and Employment Status (Selhofer and Hüsing 2002, European Commission 2003, Hüsing 2004, Fox/Pew Internet, 2005). The following report analyzes the first four groups, based on readily available data.

An analysis of digital divide indicators for San Francisco and comparison cities indicates there is a substantial digital divide in San Francisco, and that it is more acute in San Francisco than in comparison cities. Data from the 2003 U.S. Current Population Survey indicates that one-third of the residents in San Francisco do not have access to a computer or the Internet at home. While the total population of San Francisco ranks in the middle of comparison city rankings, all of the at-risk socio-economic groups in San Francisco are below average, lagging at or near the bottom of the comparison city rankings in terms of absolute percentage with access to technology at home. Educational attainment exhibits the largest and most consistent gap of all at-risk socio-economic groups in San Francisco and across all comparison cities, and is most acute in San Francisco for people who completed high school but did not attend college. San Francisco exhibits the largest gender gap for women, the largest age gap for seniors, and a substantial race gap for non-whites (including Hispanics).

Data obtained from the California Board of Education for the school year 2004-2005 indicates that San Francisco ranks last in computers per 100 students among California cities. San Francisco ranks 7th out of the 9 Bay Area counties, and below the state average. San Francisco ranks last in classrooms with Internet per 100 students both in the Bay Area and among California cities, and below the state average.

In 2004, San Francisco announced plans to offer universal wireless internet access to all residents in the City. This effort will help close the digital divide gap for wireless access and for Internet access, but only for those people who already own a computer with a wireless antenna. San Francisco should focus substantial additional effort towards increasing home ownership of computers, and as a substitute for those who cannot afford one, increasing computers in the classroom and other community institutions.

Interviews conducted with community leaders and community technology center staff members indicate that providing Internet access and computer hardware devices is an insufficient program design for economic development. An effective program must provide skills training and ongoing support in the use, application, repair, and upgrade of both hardware and software to provide a more certain path up the job ladder. The multi-cultural and multi-ethnic composition of San Francisco also necessitates providing and stimulating development of locally relevant content and services in multiple languages.

San Francisco's recently published Draft Digital Inclusion Framework incorporates these recommendations into four program focus areas which require prioritization and funding:

- Access
- Hardware
- Skills Training and Support
- Content and Services

The Draft Digital Inclusion Framework leverages the existence and expertise of the local community technology centers and other non-profit groups to implement and coordinate the proposed programs. However, the Framework, in its Draft format, does not specify prioritization or funding sources for the proposed programs. Most importantly, the framework does not establish explicit linkages to workforce development programs established by the Mayor's Office of Workforce and Economic Development, the Private Industry Council, the Workforce Investment Board of San Francisco, or the Information Technology Consortium. The highest value of the long-term economic benefits to San Francisco's under-served communities will be most effectively realized if an explicit goal of the Digital Inclusion Framework is to establish a career cluster pathways strategy that promotes upward job mobility to higher-wage jobs by providing exposure to technology for local community residents; providing adequate funding for digital inclusion programs; and fostering strong public-private-institutional relationships.

Explicit linkages to workforce development programs can provide additional federal and state funds through workforce investment boards that may not otherwise be available for more general community technology center programs. Explicit coordination with groups such as the Information Technology Consortium can establish the public-private-institutional partnerships between neighborhood non-profit groups, academic colleges and universities, and private corporations that the non-profit groups might not be able to establish on their own. The City of San Francisco is currently engaged in developing its first, official Economic Strategy, and the cluster analysis from the Economic Strategy should include and inform the explicit linkages between digital inclusion and workforce development, and form a primary foundation for the City's Economic Strategy.

On January 5, 2007 the City reached a 4-year renewable Final Agreement with EarthLink to design, build, operate, and maintain a wireless network providing free access to all San Francisco residents at a throughput of 300 kilobits per second. The City also granted EarthLink the right to offer a higher-speed premium service to subscribers, with the City receiving 4% of gross revenues from subscriber fees in exchange for the rights-of-way access. On January 9, 2007 Supervisor Jake McGoldrick submitted for consideration a resolution urging the City to consider a municipally-owned wireless network. On January 29, 2007 the City released a feasibility study for a municipally-owned fiber-to-the-home network, which would serve as the backbone upon which the City would build a hybrid fiber/wireless network providing free wireless network access to all City residents.

The City appears to be taking a balanced approach by considering all of its possible alternatives in provisioning broadband Internet access for all San Francisco residents. However, the Supervisors and commissioners who will vote on each alternative should

consider the larger perspective of addressing the digital divide in San Francisco in as expedient a manner as possible. The lower costs, rapid deployment time, and mobility features of wireless networks, combined with the severe digital divide that one-third of San Francisco residents already suffer, indicate that San Francisco may best be served by pursuing the wireless initiative with EarthLink. The final agreement with EarthLink has no direct up-front cost to the City, with promise of some revenue on the back-end through subscriber fee access. Moreover, the agreement can be terminated in 4 years, particularly if the useful life of the wireless network expires at that time. If a long-term strategy indicates that a municipally-owned fiber/wireless hybrid network is economically feasible and technically superior to the wireless-only network, then San Francisco should pursue that alternative – at that future point in time.

Table of Contents

List of Tables

List of Figures

Introduction

> *Productivity and competitiveness are, by and large, a function of knowledge generation and information processing; firms and territories are organized in networks of production, management and distribution; the core economic activities are global - that is, they have the capacity to work as a unit in real time, or chosen time, on a planetary scale. (Castells 2001: 52)*

Purpose of the Report

This report attempts to quantify the current state of the digital divide in San Francisco, in comparison to other cities in America with whom San Francisco competes economically to attract, retain, and develop an educated, skilled workforce and a dynamic, innovative business climate. This report stresses the short-term and long-term economic impact of programs that address the digital divide and explores the City's role in developing digital infrastructure and digital literacy. This report analyzes how these elements can be effectively intertwined into local economic development planning as fundamental components of workforce development. This report then explores the social and economic barriers that local residents may encounter preventing them from crossing to the "other side" of the digital divide. This report then suggests ways that these barriers may be more effectively addressed through the existing social networks of community technology centers in local neighborhoods, with support from the City. This report concludes by suggesting how the long-term economic impact of these programs may be magnified through linkages with workforce development programs, to broaden the impact beyond the social equity of access to information, but towards development of a locally-trained skilled workforce, providing upward job mobility to higher-wage jobs for local residents.

Structure of this Report

This report is separated into 6 main chapters:

"The Digital Divide and Economic Development" provides background on the concept of economic development, and how the evolution of technology and innovation has both infused economic development, and recently become a primary engine of growth for economic development.

"Measuring the Digital Divide" provides statistics on key indicators for the digital divide.

"Community Responses to the Digital Divide: San Francisco's Community Technology Centers" explores the responses of the non-profit community in San Francisco to address the digital divide in their own neighborhoods. A brief history of the community technology movement is provided, outlining its transition from general social equity goals in information access towards vital job training in knowledge worker skills acquisition.

"San Francisco's Digital Inclusion Framework" explores San Francisco's draft published framework for addressing the digital divide, including the proposed Universal Wireless Access program, which would provide free broadband Internet access to all San Francisco residents. The Digital Inclusion Framework relies heavily on the participation of community technology centers. A risk assessment is provided to craft a set of recommended priorities and actions.

"The Other Side of the Digital Divide" provides statistics on key indicators of technology and innovation that measure the overall competitiveness of the City of San Francisco in terms of its current capacity for technology and innovation in the knowledge economy. These indicators also serve as proxies to measure the depth of competition for jobs that poorly skilled or poorly educated residents may find in the knowledge worker marketplace.

"Recommendations: Linking Digital Inclusion with Upward Job Mobility" provides a summary of findings and offers recommendations towards a City economic development strategy that addresses the short-term socio-economic equity issues of information access, but also proposes a long-term set of policies that establishes linkages between workforce development programs and digital inclusion programs, suggesting some examples of career pathways appropriate for San Francisco's institutional strengths, that may provide greater opportunities for upward job mobility for a larger segment of the San Francisco population.

The Digital Divide and Economic Development

Technology and Innovation

Jane Jacobs wrote that "economic life develops by the grace of innovating" (Jacobs 1984: 39). Technology stimulates economic development when entrepreneurs have "better information about commercial opportunities and innovation possibilities" (Malizia and Feser 1999: 176). Investing in technology infrastructure to bridge the digital divide, when combined with access tools, training, and relevant local content, can address fundamental components of the education and workforce development gaps in society, stimulating local economic development by enabling more people to advance from the working class to the entrepreneurial class.

> *We now live in a society in which the production, acquisition, and flow of knowledge drive the economy and in which global information networks represent key infrastructure… Technology can bring education to people living far from good schools. It can promote organizing efforts in disadvantaged communities. And it can connect people to a wide range of opportunities. The community technology movement – a grassroots social movement that employs IT to empower historically disadvantaged individuals and communities – demonstrates the potential of IT to serve as a tool for social change. (Servon 2002: 1)*

Technology can also stimulate local economic development by increasing the innovation capacity of local companies to both compete and cooperate in the global marketplace (Grossman and Hart 1986: 691-719). As technology has diffused into the production system through the era of flexible specialization, better access to information reduces cost and profit risk, and increases productivity (Sabel: 1989). In the global production system emerging around the knowledge-based economy in the United States, a city's economic strength depends on the amount of technology and innovation capacity it can mobilize to create new products and add value to existing modes of production (Tassey 1995). The high value added to the economic foundations of the city by technology and innovation capacity manifests in spillover effects into other industries, driving up productivity, wages, and business expansions (National Science Board 1998 and Nadiri 1993).

Clusters

The emergence of technology and innovation as a recognized and critical foundation of economic development has converged around the strategy of cluster development, first presented by Michael Porter in 1990. Porter describes clusters as

> *Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate. (Porter 1998: 197-198)*

The key facet of clusters for economic development planning is the recognition that companies in different industries may still be related and interconnected, and may cooperate as well as compete. These cooperative relationships require real-time connections that are supplied through technology. Better-capitalized firms with access to technology, or located in municipalities that provide better technology infrastructure, are in better position relative to competitors to succeed in the global marketplace.

Creative Cities

A more recent concept in local economic development planning is the "Creative City", a conceit first proposed by Richard Florida, which focuses local economic development strategies on the three "T's", i.e. creating a "tolerant" city with a strong "technology" base, that is attractive to working "talent", who comprise the "Creative Class". Florida relegates the balance of the population into either the "Working Class" or the "Service Class". Florida describes the Creative Class thus:

> *The economic need for creativity has registered itself in the rise of a new class…the Creative Class. Some 38 million Americans, 30 percent of all employed people, belong to this new class…the core of the Creative Class to include people in science and engineering, architecture and design, education, arts, music and entertainment, whose economic function is to create new ideas, new technology, and/or new creative content. Around the core, the Creative Class also includes a broader group of creative professionals in business and finance, law, health care, and related fields. These people engage in complex problem solving that involves a great deal of independent judgment and requires high levels of education and human capital... The Creative Class consists of people who add economic value through their creativity. (Florida 2001: 8)*

Florida describes the Working Class as

> *33 million workers, or a quarter of the U.S. workforce. It consists of people in production, operations, transportation and materials moving, and repair and maintenance and construction work. (Florida 2001: 74)*

Florida describes the Service Class as

> *55.2 million workers or 43 percent of the U.S. workforce, making it the largest group of all. It includes workers in lower-wage, lower-autonomy service occupations such as health care, food preparation, personal care, clerical work and other lower-end office work. Alongside the decline of the Working Class, the past century has seen a tremendous rise in the Service Class, from 5 million workers in 1900 to its current total of more than 10 times that amount. (Florida 2001: 74)*

Florida's approach to economic development has been embraced by many local economic development agencies, with goals of transforming their city into a Creative City, such as "Creative Memphis" or "Creative Austin", for example. There are significant criticisms of Florida's conclusions and professional approach, especially in

that his "Creative Class" is really just a nomenclature substitute for the "Educated Class," and analytical research has shown that educational attainment, not creativity "per se", accounts for the economic development impacts that Florida found (Lopoo 2006).

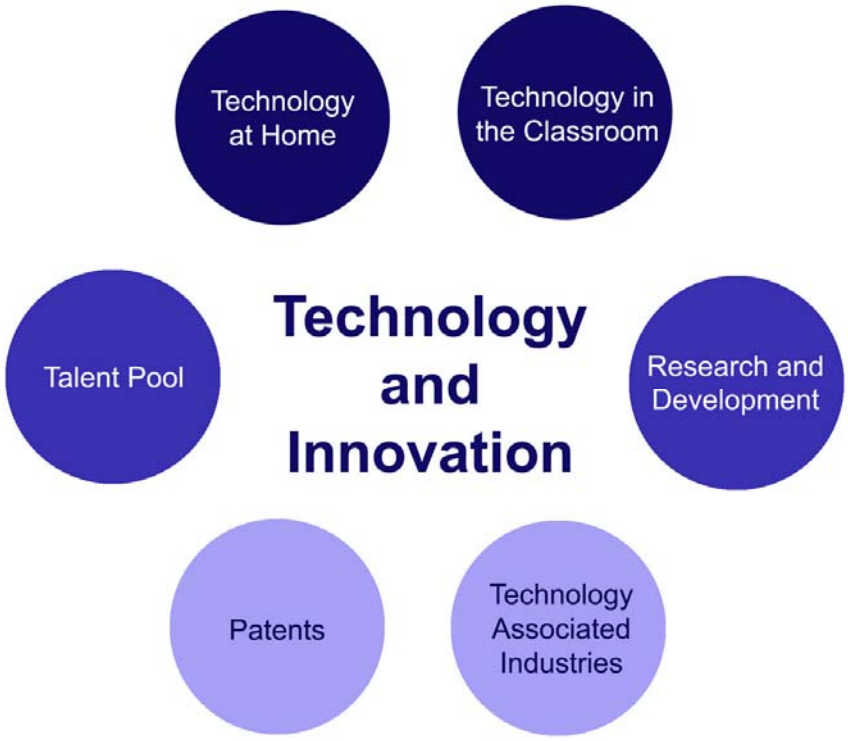
However, the basic class model of society Florida offers is worth exploring in relation to the digital divide. Investment in technology infrastructure, access tools, relevant content, and skills training can improve educational and workforce development opportunities at home for the Working Class and Service Class, supplementing local capacity supporting their entry into the higher-wage Creative Class, as well as improve entrepreneurial development opportunities for members of all classes.

Measuring the Digital Divide

TECHNOLOGY AND INNOVATION

Technology and innovation is a foundation for economic development in the city. The foundation is comprised of multiple components that contribute to the collective innovative capacity of the city. The digital divide is one component of technology and innovation – measured by Technology at Home and Technology in the Classroom. The "other side" of the digital divide is measured by the Talent Pool, Research and Development, Patents, and Technology-Associated Industries and Jobs, and is explored in more detail in the next chapter.

Figure 1: Technology, Innovation, and Economic Development



Source: Chan, Daniel, and de Velasco, 2006

The digital divide is a fundamental component, or more specifically an obstacle, to development of technology and innovation. Exposure to technology at all ages, and particularly for those people with lower education levels, can enhance the upward mobility of local residents into the higher-wage talent pool of knowledge workers (Chapple 2006). The next few sections of this chapter focus on the current state of the digital divide in San Francisco, and the City's efforts to address the underlying factors of digital infrastructure and illiteracy. In later chapters, the "other side" of the digital divide,

the other elements of technology and innovation illustrated above that drive economic development, is explored to provide a comprehensive economic and workforce development ***process***, beyond the City's Digital Inclusion Framework, that incorporates primary and secondary education, digital infrastructure and literacy programs, community development, and career pathway development, specific to San Francisco's unique residential population.

Access to Technology at Home

The digital divide is defined as the access – or lack thereof – to technology at home (U.S. Dept of Commerce October 2003). A global economy requires access to information technology at home as well as the workplace to maintain consistent maximum and efficient productivity and global competitive advantage. Digital divide indicators measure the percentage of access to information technology at home in the form of access to a computer, and access to the Internet.

Recent studies for the European Commission Joint Research Centre (Hüsing 2004) and similar studies (European Commission 2003) analyzed the digital divide by measuring the percentage of access to technology at home to create a Digital Divide Index (DDIX). The most important observation from these and similar studies (Pew Internet, 2005) is the digital divide can be identified and measured according to seven at-risk socio-economic groups: Race, Gender, Age, Educational Attainment, Income, Disability, and Employment Status (Selhofer and Hüsing 2002). This study analyzes the first four groups, based on readily available data.

School Enrollment and Computers and Internet in the Classroom

An input component, or investment indicator, towards bridging the digital divide, particularly for the lowest strata of educational attainment, is investment in computers and Internet access in the school classroom. Early access to technology during the formative educational years fosters a compound educational benefit towards advancement within the knowledge economy, particularly for those residents who cannot afford to purchase a home computer.

Benchmarking San Francisco

This study quantifies the digital divide in San Francisco, in relation to comparison cities, using the following indicators:

Table 1: Digital Divide Indicators by Indicator Type

Indicator Type	Indicator
Investment	Computers in the classroom per 100 students
Investment	Classrooms with Internet per 100 students
Performance	Percentage of residents with access to a computer at home
Performance	Percentage of residents with access to the Internet at home

Investment indicators measure the city's contribution towards bridging the digital divide. Performance indicators measure the current outcomes of how San Francisco is succeeding in bridging the digital divide.

At-Risk Socio-Economic Groups

An analysis of digital divide indicators for San Francisco and comparison cities, using data from the 2003 U.S. Current Population Survey, indicates that one-third of the residents in San Francisco do not have access to a computer or the Internet at home. While the total population of San Francisco ranks in the middle of comparison city rankings, all of the at-risk socio-economic groups in San Francisco are below average, lagging at or near the bottom of the comparison city rankings in terms of absolute percentage with access to technology at home. Educational attainment exhibits the largest and most consistent gap of all at-risk socio-economic groups in San Francisco and across all comparison cities, and is most acute in San Francisco for people who completed high school but did not attend college. San Francisco exhibits the largest gender gap for women,[1] the largest age gap for seniors, and a substantial race gap for non-whites (including Hispanics).

Table 2: Percentage of Total Population and At-Risk Socio-Economic Groups with Access to a Computer at Home

		Race		Education		Gender		Age
County	Total Population	Whites	Non-Whites	Did Not Finish High School	Completed High School (No College)	Male	Female	Senior Age 55+
Los Angeles	66	79	59	49	59	68	65	51
New York	65	78	54	38	43	67	63	55
San Diego	69	82	55	43	59	68	71	60
San Francisco	64	77	57	52	32	71	58	38
Santa Clara	82	80	83	79	60	82	83	71
Washington, DC	59	81	51	30	41	58	60	47

Note: Non-Whites includes Hispanics

Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI=95%, Margin of Error=7.6%

The picture of the digital divide is equivalently stark when examining the percentage of population that has access to the Internet at home. The severe digital divide persists in San Francisco for the population that has completed high school but did not attend college. Interestingly, the racial divide for Internet access disappears in San Diego. Further examination of local policy and public-private marketing efforts in San Diego for Internet access is recommended.

[1] The statistical gap by gender is outside the margin of error.

Table 3: Percentage of Total Population and At-Risk Socio-Economic Groups with Access to the Internet at Home

		Race		Education		Gender		Age
County	Total Population	Whites	Non-Whites	Did Not Finish High School	Completed High School (No College)	Male	Female	Senior Age 55+
Los Angeles	56	75	47	34	50	58	54	46
New York	61	74	51	31	40	65	58	52
San Diego	62	62	63	35	52	61	63	57
San Francisco	65	72	56	45	32	70	60	45
Santa Clara	69	65	75	63	52	70	68	63
Washington, DC	53	72	44	22	32	52	53	42

Note: Non-Whites includes Hispanics

Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI=95%, Margin of Error=7.6%

Public Schools

Further analysis of the digital divide in regard to the lowest strata of educational attainment explores school enrollment data and the ratio of Computers per 100 students and the ratio of Classrooms with Internet per 100 students. Data from the California Board of Education is presented for the State of California, and for the core county of several cities in California: San Francisco, San Diego, Santa Clara/San Jose, and Los Angeles.

San Francisco ranks last in Computers per 100 students among California cities, 7th out of the 9 Bay Area counties, and below the state average. San Francisco ranks last in Classrooms with Internet per 100 students both in the Bay Area and among California cities, and below the state average.

Table 4: School Enrollment and Computers and Internet in the Classroom (School Year 2004-2005)

	School (State or County)	Enrollment	Computers	Classrooms with Internet	Computers per 100 Students	Classrooms with Internet per 100 Students
	California	6,318,729	1,319,023	310,496	20.9	4.9
Core County	**Santa Clara**	253,065	63,015	13,702	24.9	5.4
	Sacramento	238,385	50,228	12,267	21.1	5.1
	San Diego	498,186	110,487	24,604	22.2	4.9
	Los Angeles	1,733,855	358,234	74,403	20.7	4.3
	San Francisco	58,735	11,748	2,394	20.0	4.1
Bay Area	**San Mateo**	88,273	21,306	7,670	24.1	8.7
	Marin	28,429	7,417	1,686	26.1	5.9
	Alameda	215,801	46,641	11,839	21.6	5.5
	Santa Clara	253,065	63,015	13,702	24.9	5.4
	Contra Costa	166,024	32,832	8,989	19.8	5.4
	Sonoma	72,295	14,503	3,873	20.1	5.4
	Napa	19,654	4,418	924	22.5	4.7
	Solano	71,489	13,941	3,011	19.5	4.2
	San Francisco	58,735	11,748	2,394	20.0	4.1

Source: California Board of Education

The significance of Classrooms with Internet per 100 Students is that it indicates the City's capacity for simultaneous instruction settings utilizing the Internet. For example, for every 100 students, San Mateo has the capacity for more than twice as many concurrent classroom instruction settings (8.7) than San Francisco (4.1).

The comparison rankings for technology in the classroom are shown graphically on the following page, with San Francisco highlighted in red, and the averages for the State of California highlighted in green.

Figure 2: Computers in the Classroom per 100 Students

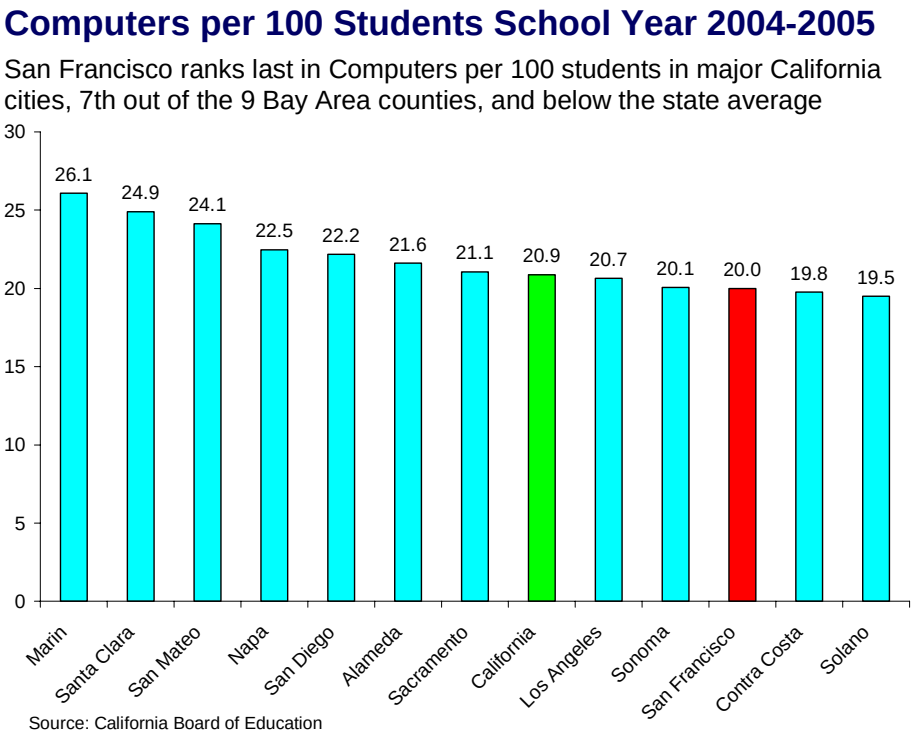
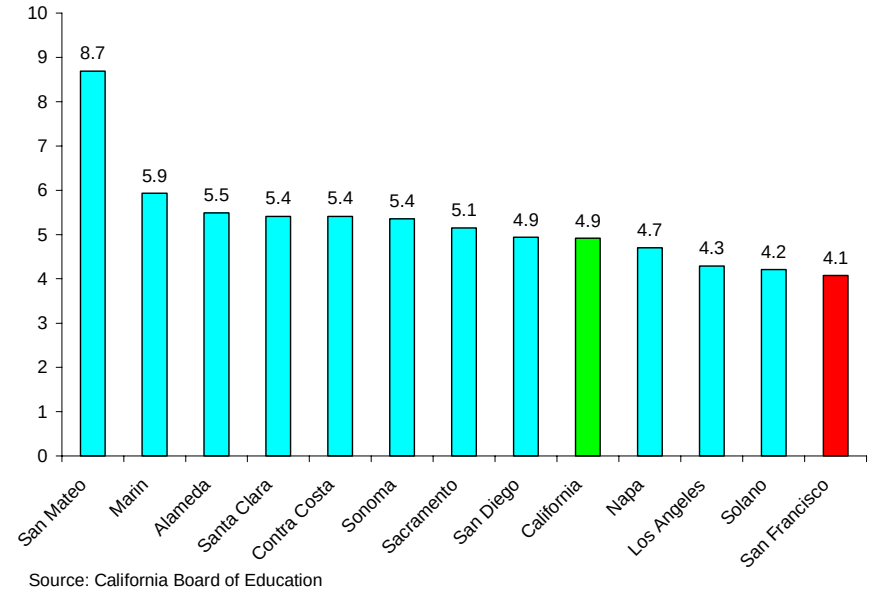


Figure 3: Classrooms with Internet per 100 Students



Comparison Charts

The sections in the Appendix present a detailed graphical breakdown and walk-through of each at-risk socio-economic group and its share of access to computer and Internet technology at home.

Community Responses to the Digital Divide: Community Technology Centers

Playing to Win

The digital divide was recognized more than two decades ago as a social inequity born out of an economic inequity. Local government is ill-equipped to directly address these inequities in an immediate fashion, so community leaders took the lead in establishing community technology centers where local residents could access computers and, later, the Internet. Community Technology Centers (CTCs) are place-based community development organizations, providing access to a variety of technologies and technology-related services. They serve the dual purposes of combating the digital divide by providing access to technology and the Internet, while also combating the persistent social issues caused by the economic divides associated with poverty and race. The expanding role of CTC's in local economic development is a more recent phenomenon:

> *During this first phase of the movement, community technology pioneers were concerned about democracy and equal access to information, but did not explicitly address poverty and civil rights issues. In the beginning, the community technology movement is not nearly as diverse as it is today. (Servon 2001: 50)*

The establishment of the first low-income neighborhood CTC is attributed to Antonia Stone, who founded Playing2Win in Harlem, New York, in 1980 in the basement of a public housing building, initially focused on promoting educational use of technology to prison inmates and ex-offenders. In 1983, the mission of Playing2Win was expanded, and the operation was moved into a storefront building on 111th Street and 5th Avenue to provide the first public access to computers in low-income, inner-city neighborhood. In 1990, Ms. Stone collaborated with the Educational Development Center to receive a grant from the National Science Foundation, and in 1992-93 Ms. Stone established the Playing2Win Network, which in 1995 became known as CTCNet.

CTCNet

CTCNet is a national network of community technology centers and other non-profits, which according CTCNet's mission statement are

> *united in their commitment to provide resources and education to under-served communities…and founded on the recognition that in an increasingly technologically dominated society, people who are economically disadvantaged will be left further behind if they are not provided access to and training on information tools. (CTCNet Mission Statement 2006)*

CTCNet has grown substantially over the years:

> *In 1995, after receiving a five-year grant from the National Science Foundation, CTCNet expanded first into a regional network of 55 affiliates and then into a national network of more than 600 affiliates with more than 4,000 locations, including settlement houses, after-school programs, church programs, adult literacy programs, and alternative schools. (Sargent 2005)*

Beacon Initiative

The New York City Department of Youth and Community Development established its first Beacon Initiative in 1991, to establish "beacons": school-based community centers offering after-school programs, for children, youth, and families in the afternoon, evenings, and weekends. The programs offered by each beacon center may vary, but the core program focus areas include:

- Academic Enhancement
- Career Awareness/School to Work Transition
- Life Skills
- Community Building
- Recreation

By 1997, the Beacon Initiative expanded to include 41 beacon centers in 32 school districts through New York City. In 1998, the City of New York funded a rapid expansion of the Beacon Initiative, and by 2006 there were 80 beacon centers operating throughout the City's schools, with a minimum requirement for each beacon center to be open 42 hours per week, and 6 days per week, with typical operating hours of 3pm to 7pm. Observing New York's success with the program, Oakland, Savannah, Denver, Minneapolis, and San Francisco are among the cities who have adopted the model.

The San Francisco Beacon Initiative is a public-private partnership that has established community technology centers hosted in the City's public schools. Eight beacon centers have been established in the City, serving over 7,000 youth and adults every year. The program focus areas for the San Francisco Beacon Initiative are education, career development, arts and recreation, leadership, and health (sfbeacon.org 2006).

- **Education:** Programs range from tutoring and homework help to writing projects and other academic offerings.

- **Career Development:** Students can sharpen their computer skills in state-of-the art computer labs, and develop a range of other career paths.

- **Arts and Recreation:** Centers offer a variety of team sports (basketball, volleyball and football) mixed with hip hop, mural painting, poetry and theatre.

- **Leadership:** Young people are encouraged to play a leadership role in planning activities and spearheading discussions.

- **Health:** Centers offer a range of health programs, including providing information about publicly funded health coverage options for youth.

Interviews were conducted with some San Francisco Beacon Centers, which are detailed later in this chapter.

Information Technology Consortium

The Information Technology Consortium (ITC) is a project of the Workforce Investment San Francisco (WISF) Board. The WISF Board directs and oversees the operations of the Private Industry Council of San Francisco (PIC). The WISF Board was created in response to the federal Workforce Investment Act (WIA) of 1998, which superseded the Job Training Partnership Act (JTPA) of 1982. The JTPA legislation created a federally-administered set of job-training programs for youth and unskilled adults. The WIA legislation re-directed the federal funds to the states, who then administered the funds to local Workforce Investment Boards (WIBs) who could administer the funds more efficiently to local groups with ties to the communities they serve who could actually deliver the training.

The ITC has established a workforce training program for 800 nurses to receive informatics training and English as a second language training. The Information Technology Training Program is a public-private partnership running from 2004-2007, with City College of San Francisco actually delivering the training (itc-sf.org 2006). The program's collaborative design methods leverage the industry expertise of Laguna Honda Hospital to design the customized training, with City College's educational and institutional expertise to deliver the customized training (Bole 2005).

CTC Challenges

CTCs also face substantial challenges, concentrated in the areas of funding, staffing, and coordination and cooperation among CTC's (Servon 2002: 70-76).

- Funding
    - Lack of sustainable funding
    - The funding community must be educated about IT
- Staff
    - Technical assistance is difficult to support
    - Many CTCs cannot meet the demand for services
- Coordination and cooperation
    - Community technology efforts would benefit from greater integration

Funding is always a concern for any organization in any field, whether incorporated as a for-profit or non-profit entity. Technical assistance and fulfilling demand are dependent

on sufficient funding to hire the workers necessary to staff these requirements. Therefore, it is little surprise that funding is a pervasive hindrance to the effectiveness of CTCs. Servon highlights coordination and cooperation among CTCs as a significant, and overlooked, obstacle, that multiple CTCs may each be "re-inventing the wheel" in redundant program design and delivery. However, CTCs do compete for limited grants and other forms of funding, so a mechanism must be developed to enable CTCs to cooperate in the service delivery arena, even while they compete in the funding application arena.

Interviews with CTCs in San Francisco

To explore the current state of the digital divide in San Francisco, and the expanding role of CTC's in addressing the digital divide, interviews were conducted with four leaders of community technology centers. The scope of each interview centered on three main broad topics, but each interview candidate was allowed to steer the conversation towards their own concerns. Those three topics are:

1. What are the specific target groups for your organization, how do you outreach to them, and how/why do these people find you?
2. What are the challenges people face in obtaining technology in their home and developing technical skills?
3. What are the challenges people face after completing technical skills training, when attempting to (re-)enter the workforce with their new skills?

Each interview resulted in a common set of themes and concerns.

- **Income / Funds** were reported as the primary impediment to home computer purchase
- **Native Language** was consistently reported as a significant impediment to technology skills acquisition and access to specific **content and services**
- **Educational Attainment** was reported as the largest impediment with finding employment, after completing training
- **Space** in the home (for a desk and chair, and computer peripheral equipment such as monitor, printer, modem, etc.) reported as a rarely mentioned impediment, particularly for residents living in a single-room occupancy (SRO) unit
- Follow-up **Training and Support** resources consistently reported as a major impediment towards continued computer usage

Notes from the interviews are included in Appendix B.

The overall outcome of the interviews suggests that there are social as well as economic barriers to overcome in addressing the digital divide. These sociological issues include several areas of personal doubts for local residents which are an initial impediment towards adoption of technology at home, including:

- owning sufficient household space to permanently store a computer

- lack of short-term confidence to set up and utilize a computer and Internet
- the lack of relevant, native language content online
- lack of long-term confidence in the ability to profit from the investment

These sociological issues cannot be directly addressed by government intervention, because aside from lack of household space, these problems are rooted more in the lack of a local, trusted social network for support, encouragement, and advice about how to make effective use of the ***personal investment*** in a computer. Personal investment extends beyond just the initial cash outlay for computer hardware, or the recurring monthly fees for Internet access. Personal investment includes the time spent acquiring the basic workforce development skills necessary to use common office productivity, email, and web browsing software. Personal investment includes the additional time spent finding web sites that offer relevant content in the user's native language. Most importantly, most overlooked, and most difficult to quantify, personal investment also includes the emotional investment to overcome uncertainty about how, where, or why to engage in any of the activities listed above.

These obstacles to personal investment can be addressed most effectively through local social networks. These social networks may be formally established community technology centers. These social networks may be less explicitly technology-focused, such as public schools, community colleges, churches, and temples. These social networks may also be informal networks formed out of the community or the family itself. Castells suggests that the rise of a "mobile youth culture", flash mobs, and other peer-to-peer networks may portend a new mobile, social networking society where the definition of a CTC may become the community itself (Castells, et al. 2006), especially when supported by a freely-accessible Internet infrastructure, as proposed in San Francisco's Digital Inclusion Framework, which is the topic of the next chapter in this report.

San Francisco's Digital Inclusion Framework

Universal Wireless Access

In his State of the City speech on October 21, 2004, Mayor Gavin Newsom announced a bold initiative to address the digital divide by calling for the City to provide free wireless Internet access to every San Francisco resident. After a lengthy research process by City officials, on August 16, 2005, the City announced a new initiative, ***TechConnect***, with a mission to provide the tools, access, and training necessary in an effort to bridge the digital divide in San Francisco.

> *Following the model of "Project Connect," TechConnect will connect all San Franciscans to the social, educational, informational and economic opportunities available online by creating public/private partnerships to provide technology equipment to those residents who can least afford it; by providing tools to help users make sense of the incredible array of information found on the internet; and by providing training support to teach residents how to use and maintain the equipment necessary to access the wealth of opportunity available online. (Newsom 2004)*

The announcement began a 45-day Request for Comment / Information period, allowing the public an opportunity to participate in the design of the TechConnect program. A formal Request for Proposals (RFP) was published by the City of San Francisco on December 22, 2005 for vendors and service providers to deploy a "universal, affordable wireless broadband network" with a "free level of service (Basic Access Service)" (City and County of San Francisco 2005: 1-3). Proposal responses were submitted by six vendors by the deadline date of February 21, 2006. On April 5, 2006, the City announced that Google/Earthlink's partnership proposal had been selected, allowing the City and the vendor to enter "final negotiations" to reach agreement on the final terms of service (DTIS 2006). These negotiations commenced on May 26, 2006 and culminated with a Final Agreement with EarthLink on January 5, 2007 on the terms and conditions to build, operate, and maintain the wireless network. The next step is to submit the San Francisco Wireless Network Final Agreement for approval to the Board of Supervisors, Public Utilities Commission (PUC), Local Agency Formation Commission (LAFCO), and other City and regional agencies with authority to approve or reject the agreement. The key terms of the Final Agreement are outlined later in this chapter.

Digital Inclusion Task Force

On April 26, 2005 Project TechConnect announced the formation of a 15-member Task Force on Digital Inclusion. The Task Force is primarily composed of representatives from Community Technology Centers, supplemented by experts in social venture capital markets. The members of the Task Force are

London Breed, African American Cultural Center
Anni Chung, Self Help for the Elderly
Marcus Clarke, Bayview Business Resource Center
Laura Efurd, Community Technology Foundation of California
Eli Horn, Visitacion Valley Community Beacon Center
NaNoshka Johnson, EventRegistration.com
Sydney Levy, Media Alliance
Sasha Magee, Funnel Foundation
Michael McCarthy, Consultant
Michael Meniktas, The Meniktas Group, Merrill Lynch
Silvana Rainey, Adaptive Technology Services
Anthony Townsend, Institute for the Future
Julie Trell, Salesforce.com Foundation
Valerie Tulier, Latino Steering Committee
Julie Yick, Women's Initiative for Self Employment.

Draft Digital Inclusion Framework

On October 18, 2006, San Francisco published its initial Draft version of a Digital Inclusion Framework. The document includes a set of Visions, Strategies and Programs. The Vision Statement names the following priorities:

> *The City's goal is to bridge San Francisco's digital divide within all of its socio-economically diverse communities, thereby:*
> - *Enabling all San Franciscans to use the Internet to access jobs, education, healthcare, and government services.*
> - *Enabling all residents to use digital technologies to better able express their viewpoints and participate in civic and community affairs.*
> - *Enabling all residents to participate more fully in the global information economy and society.*
>
> *- (DTIS 2006c: 2)*

The Strategies focus on access, hardware, training and support, and relevant, local content.

> *The city's digital inclusion programs will focus its most underserved neighborhoods as well as its most disadvantaged residents: low-income residents, limited English speaking and disabled populations.*
>
> - *Free and affordable wireless Internet access throughout all of San Francisco.*
> - *Strategies to address computer ownership include low or no interest loan hardware purchase programs and leveraging existing nonprofit organizations and businesses that refurbish and distribute used hardware.*
> - *Building technology skills will be accomplished by partnering with organizations that currently provide community based technology training and support and by creating an online directory of technology training services.*
> - *Strategies to increase the amount of relevant, language-appropriate Internet content and online services include creation of a multi-lingual web*

> *portal, promotion of community based web sites, content development training programs, and supporting partnerships between vendors, nonprofits and schools.*
>
> *The City will leverage existing government, educational, nonprofit and private resources and programs to execute its digital inclusion strategy. The City does not seek to reinvent existing digital inclusion programs; rather seeks to empower underserved residents by connecting them with available resources.*
>
> *- (DTIS 2006c: 2)*

The City's Draft Digital Inclusion Framework includes a summary of some proposed digital inclusion programs as an Appendix.

> *The following are some of Digital Inclusion Programs the City is considering to promote internet and computer access, training, support, content and applications for San Francisco's underserved communities:*
>
> - *Discount Internet Access for Community Technology Trainers and Support Providers*
> - *Computer and Hardware Purchase Program*
> - *Community Based Support and Training Centers*
> - *Digital Inclusion Grants Program*
> - *Technology Resources Online Directory*
> - *Volunteer Events and Computer Fairs*
>
> *- (DTIS 2006c: 2)*

As suggested in earlier chapters, these programs are, by definition and intent, limited to "digital inclusion" – but what is the purpose of digital inclusion? If the program is intended to address social issues regarding equity of access to information, then the framework generally meets these criteria. If the program is also intended to provide short-term economic benefits to the local economy, then the framework also meets these criteria, as explored in the following section, "Short-Term Local Economic Benefits of Universal Wireless Access." However, a larger policy statement is required that explicitly links the Digital Inclusion Framework to the City's workforce development programs, or an opportunity to realize the full benefits of the City's investment in digital inclusion may be missed. These opportunities and benefits are explored in the final two chapters of this report.

Municipal Wi-Fi Business Models

Cities have experimented with all varieties of municipal wireless Internet business models. Some smaller cities have experimented with localized free networks, such as New York City's Bryant Park. Some larger cities, such as Philadelphia, have begun proof-of-concept designs in localized neighborhoods. In most cases, the city neither owns nor operates the network. The city contracts with a local exchange carrier to build, operate, and maintain the network. In return for the right-of-way to construct the network, the vendor usually pays a fee to the city, and may also provide the city's local government agencies with free service, particularly first call emergency responders such as police, fire, and hospitals.

For large city-wide networks, the enormous size, complexity, and cost to build, operate, and maintain the wireless network necessitates some recovery of these costs through subscriber access fees from local residential population and business establishments. San Francisco's proposed Universal Wireless Access program is, therefore, unique, in that all local residents and businesses will have access to a free level of wireless broadband Internet service, while the operating vendor assumes some risk by operating as both a wholesaler to competitive local exchange carrier, and also contracting with the City to offer a higher-speed "Premium Service" to subscribers at a market-rate fee.

The various types of municipal Wi-Fi business models, are nicely summarized by Bar and Park (2006), based on a matrix of who owns the network, and who operates the network.

Table 5: Municipal Wi-Fi Business Models

Who owns? / Who operates?	*City*	*One private actor*	*Multiple others*
City	Public utility	Hosted services	Public overlay
One Private actor	Wholesale	Franchise	Private overlay
Multiple others	Wholesale open platform	Common carrier	Organic mesh

Source: Bar and Park 2006

San Francisco's Final Agreement with EarthLink stipulates initially a franchise agreement, with mandates for competitive local exchange carriers to purchase access to the network at wholesale market rates, resulting in a common carrier arrangement.

On January 9, 2007, Supervisor Jake McGoldrick, along with Supervisors Tom Ammiano and Ross Mirkarimi, introduced a resolution urging the City of San Francisco to consider the alternative of a municipally-owned wireless network. The resolution will be taken under consideration of the Budget and Finance Committee of the Board of Supervisors on February 7, 2007, which, if passed by committee, will be taken under consideration by the full Board at a later date.

In the following sections, the key terms of the Wireless Network Final Agreement with EarthLink are explored and analyzed. In succeeding sections, the key arguments of the resolution in favor of a municipally-owned wireless network (and the counter-arguments to the common carrier agreement with EarthLink) are explored and analyzed. The full text of the proposed resolution is provided in Appendix B.

Key Terms of the San Francisco Wireless Network Final Agreement

After nine months of negotiation of specific terms and conditions with EarthLink, the winner of the initial RFP process announced in April 2006, the City of San Francisco reached a final agreement on January 5, 2007 for the construction, operation, and maintenance of the wireless broadband Internet network. The final agreement must still be ratified by certain local and regional agencies with oversight of municipal services: the Public Utilities Commission (PUC) and the Local Agency Formation Commission (LAFCO). The final agreement must then be ratified by the Board of Supervisors.

The initial key terms and conditions of the San Francisco Wireless Network Final Agreement with EarthLink are organized around the following major topics:

- Public Rights-of-Way
- Fees
- Duration
- Proof-of-Concept
- Open Wholesale Access for Competitive Local Exchange Carriers
- Free Basic Service
- Premium Service
- Competition
- Digital Inclusion Products
- Disadvantaged Business Enterprise Set-Aside Goal

Public Rights-of-Way

San Francisco's agreement with EarthLink provides a basic, non-exclusive authorization to occupy and use the Public Rights-of-Way in San Francisco.

- The City authorizes EarthLink "to occupy and use the Public Rights-of-Way to construct, install, repair, maintain, and operate its Network and Communications Equipment". (2.1 Right of Way Authorization)
- The right-of-way authorizations are non-exclusive. (2.9 Non-Exclusive)

One of the most valuable, and often controversial, aspects of municipal wireless networks has been the assignment of the public rights-of-way to private corporations, ostensibly in exchange for services provided for the public's benefit. The race for private corporations to be first-to-market in the ownership of the municipal wireless networks has led to some public opposition, with concerns that it will lead to a natural monopoly (Lehr, Sibu, and Gillett 2004). Moreover, free-market economists express concerns that a local government may stifle local competition and innovation if it establishes a municipal network. However, longitudinal studies in the telecommunications market have shown that municipal networks do not materially interfere with market competition.

> *Municipal providers tend to serve markets that CLECs do not. We also find that the presence of a municipal provider in a market does not*

> *affect the probability that a CLEC also serves that market (Hauge, Jamison, and Gentry 2005).*

The intended goal of the Universal Wireless Access program is to provide and available broadband Internet connection to all residents and business, and in particular through a broad Digital Inclusion Framework, to provide the means to access those available connections. Thus, the City's free wireless network should not interfere with the open competition of CLECs in the marketplace, as the primary goal of the program is to address the one-third of San Francisco's population that is not currently being served by the "open" marketplace.

Currently Under-Served Neighborhoods

However, there is one major concern with the Public Rights-of-Way clause of the Final Agreement. The requirements for geographical availability of the network are reduced "in the event that a material number of Unsuitable Poles substantially impairs EarthLink's ability to satisfy coverage requirements…the City and Earthlink shall agree upon modified coverage requirements based on the available poles that are not Unsuitable Poles" (3.2 Availability). This clause may effectively absolve the City and EarthLink of providing service to neighborhoods that may already be under-served by the wired networks provided by CLECs due to a "material number of Unsuitable Poles". A truly "Universal" wireless access program would address these under-served neighborhoods not with an escape clause, but rather with a promise to provide coverage, and construction of "suitable poles, if such poles are indeed necessary to provide universal wireless access.

Fees

San Francisco's agreement with EarthLink includes a public rights-of-way fee structure that is tied to revenues received through subscriber access to the network. In the final agreement, EarthLink agrees to pay the City 5% of "Gross Access Revenues" from any "Premium Service" that EarthLink sells to subscribers (4.1 ROW Fee).

Economic Valuation of the Public Rights-of-Way

The value of access to the public rights-of-way is difficult to quantify, but the value is generally recognized, and codified as a defining principle of the American Public Works Association (APWA).

> *Municipal Governments are entitled to receive revenues over and above direct costs associated with rights-of-way as compensation from corporations using public (municipal) property for profit, as federal and provincial Governments do today (APWA 1998).*

An economic model for the estimation of the fair market value of the public rights-of-way has been provided by the American Public Works Association (APWA 1998).

$$\boldsymbol{R} = L * l * w * r * a * u$$

where

$\boldsymbol{R}$ = Value of the Right-of-Way

L = Land Value of right-of-way by unit area
l = length of area occupied
w = width of area occupied
r = rate of return
a = factor to recognize degree of alienation of area
u = use factor

- Land Value is determined to be the market value of the private lands adjoining the right-of-way.
- Length of Area Occupied is the length of street occupied by wires, ducts, or cables.
- Width of Area Occupied is the width alienated for other purposes, i.e. the width of the duct/wire/cable plus half the minimum clearance required on either side of the duct/wire/cable, which is space that would otherwise be assigned to another utility. For cities without a minimum clearance requirement, the suggested minimum clearance is 2 meters.
- Rate of Return is the annual rate of return that the municipality expects to receive on the market value of its property, and is commonly estimated to be no less than 10%
- Factor to Recognize Degree of Alienization recognizes that periodic use of the surface area of a private property is required in order to access the subterranean utility equipment installed beneath the surface, and that such periodic use reduces the value of the land. A common factor used is 50% of the full market value of the land.
- Use Factor is not commonly used in telecommunications projects, but is an umbrella factor that can incorporate factors related to specific use of the land
    - Sharing Factor recognizes that if specific ducts along a right-of-way can be shared among various service providers, then a modified rate can be applied to encourage sharing a conserve use of the street space
    - Essential Service Factor recognizes that essential public utilities, such as water service, may be a lower rate than non-essential, for-profit entities, such as cable service. The Universal Wireless Access program is a mixed-use service, and therefore the rights-of-way fees are assigned only to the for-profit premium access service subscriber fees.
    - Exclusive Rights Factor assigns a higher rate to for-profit entities that hold an exclusive right to the duct or right-of-way
    - Depth and Disruption Factor assigns a higher rate to utilities installed at a shallow depth, i.e. 1.5 meters or less, because these utilities tend to need maintenance and repair more often, resulting in service and access disruption. Conversely, deeper utilities would pay a lower rate.

- Hazard Factor recognizes that utilities that expose a life-threatening risk such as electricity and gas will pay a higher rate.

Until EarthLink provides technical specifications of a design, build, operate, and maintain plan for the wireless network, it is difficult to estimate the value of the public rights-of-way granted by the City. This exercise is left for future study.

Duration

The duration of the agreement is 4 years, with 3 successive automatic renewal periods of 4 years each, provided neither party changes any other terms or conditions of the agreement, with a transition period of 18 months in case of termination of the agreement by either party (7.2 Term). Early discussions in the negotiation process reportedly included discussions of contract duration of 7 to 10 years or more, but

Proof-of-Concept

The proof-of-concept acceptance criteria for the wireless network "may include, based on the mutual agreement of the Parties: outdoor coverage, indoor coverage up to a height of forty (40) feet, Network performance/throughput, Network availability, reliability, and prioritized service for municipal use." (5.1.3 POC Acceptance Criteria)

Open Wholesale Access for Competitive Exchange Carriers

The agreement stipulates open access to the network for other competitive local exchange carriers (CLECs). EarthLink is required to "offer to any Service Providers wholesale access to any Access Service of the Network that EarthLink offers to the public (except for Digital Inclusion products, Occasional Use products, and Basic Service) on nondiscriminatory terms and conditions." (9.1.1 Wholesale Access Required)

The agreement further stipulates that competition and open wholesale access must exist with at least three (3) other Service Providers, with explicit provision and definition of default by EarthLink. "In addition to the Open Access provisions in Section 9.1 of this Agreement, the Assignee agrees as follows with respect to any Premium Service that the Assignee offers to the public: (a) Assignee shall make such services available on a wholesale basis to other service providers on nondiscriminatory terms and conditions; (b) Assignee shall enter into contracts with at least three (3) Service Providers for the provision by Service Providers of one or more services over the Network, and, at any given time, at least three (3) Service Providers shall be offering to the public one or more services over the Network; and (c) Failure by Assignee to meet these requirements shall constitute a Termination Default, as specified in Section 14.5 of this Agreement." (1.6 Definitions)

Free Basic Service

The end-user requirements for accessing the free Basic Service are minimal but not specifically defined. "EarthLink shall require that users of the Basic Service be directed to a Capture Portal, which shall be branded by the provider of the Basic Service, where such users shall be presented with options to register and login that require minimal information from the user." (10.4.2 Basic Service Login)

On an annual basis on the anniversary of the agreement, the minimum speed of the free Basic Service will be reviewed and adjusted to be at least 15% of the "advertised speed of the Best Selling Wireless Broadband Product." (11.1.5 Basic Service Speed Adjustment)

Premium Service

The City requires that EarthLink provide at least one higher-speed access product with a minimum average symmetric throughput of one (1) Mbps, with no limit on the cost of such service. (11.1.1 Premium Service)

Digital Inclusion Products

The City has incorporated elements of its Digital Inclusion Framework into the Wireless Agreement by requiring provision of a Digital Inclusion Product. "EarthLink and the City will mutually agree upon a program tailored to the specific needs and existing programs of the City that is designed to expand access to the Network, featuring an Access Service with a minimum average symmetric throughput of one (1) Mbps, priced at the discounted rate of twelve dollars and ninety-five cents ($12.95) per account per month, or at a price mutually agreed upon by the Parties. EarthLink will make available three thousand and two hundred (3,200) Digital Inclusion Products to the City." (11.1.2 Digital Inclusion Product)

EarthLink must also provide the equipment necessary to connect to the Network, with a maximum cost of $100, and with no specification about whether the City or the subscriber must bear the cost of the equipment.

Disadvantaged Business Enterprise Set-Aside Goal

The agreement establishes a set-aside subcontracting goal of 15% for disadvantaged business enterprises of the sums actually paid by EarthLink for installation, operation, and maintenance services in San Francisco. (19.1 DBE Goal)

Short-Term Local Economic Benefits of Universal Wireless Access

The centerpiece of the universal wireless access program is free wireless broadband Internet access for all residents and businesses in the City. Focusing on the residential aspect of the program, the program could have a substantial positive effect on the local economy.

Currently, Comcast Corporation, headquartered in Philadelphia, Pennsylvania holds the cable franchise in San Francisco, and AT&T, headquartered in New York City, holds the telephone franchise in San Francisco. Essentially, these two corporations receive almost all of the high-speed DSL subscription revenue from San Francisco residents, and the money "leaks out" of the San Francisco local economy. If even a small portion of these residential subscribers switch to the City's free wireless Internet offering, then those residents may spend some of their recovered and saved subscription costs within the City's economy at local businesses. Because local neighborhood-serving businesses are likely to be run by local residents, these local entrepreneurs may in turn re-spend their sales income at other local businesses. This pattern of money re-cycling within the local economy is known as the local multiplier effects, which can represent a value greater than the initial amount spent (Johnson and Man 2001: 23).

A simple cost-benefit analysis can quantify the possible economic benefit to the local economy, ***V***.

The estimated monthly value, ***V***, to the local economy can be represented according to the following formula:

$$\boldsymbol{V} = [(b * \mathrm{H} * c) + (u * \mathrm{H} * d)] * a * s$$

where

H = number of households in San Francisco
b = U.S. broadband penetration rate
u = S.F. imputed dial-up penetration rate
c = consumer broadband DSL cost per household
d = consumer dial-up cost per household
a = adoption rate of current broadband DSL subscribers to Basic Service
s = rate of savings spent within local economy

The statistics to plug into the given formula are derived from the following sources:

- According to a March 2006 Pew/Internet survey, 42% of American households currently subscribe to high-speed Internet service (Horrigan 2006). This is a more conservative estimate than the 64% Internet-at-home rate (the difference is likely dial-up Internet customers)
- According to the U.S. Census Bureau's 2005 American Community Survey, San Francisco has
    - 322,389 households
    - 141,327 family households
    - 51,482 family households with children under age 18
- At a 42% household penetration rate, San Francisco has approximately 135,000 broadband Internet subscribers

- At a 64% total Internet-at-home rate, we can impute a 22% dial-up Internet penetration rate, further imputing that San Francisco has approximately 70,000 dial-up subscribers, and just over 200,000 total Internet subscribers
- Current consumer DSL cost: $50 per household per month
- Current consumer dial-up cost: $20 per household per month
- Estimated adoption rate of Basic Service by current Internet-at-home broadband DSL subscribers: 20%
- Estimated adoption rate of Basic Service by current Internet-at-home broadband DSL subscribers: 20%
- Estimated rate of savings spent within local economy: 20%
- Estimated value to local economy: $325,000 per month

Because the universal wireless access program is planned as a franchise arrangement with no fixed cost to the City – aside from the right-of-way grants – these benefits have no cost to the City to offset them; however, it is conceivable that residents who adopt the free wireless access may spend more time online, which could result in more online shopping, diminishing revenue for local neighborhood retailers and consequently the City's sales tax revenue.

Conversely, this cost-benefit analysis does not factor in the economic benefits resulting from the local small businesses and start-ups that may take advantage of converting to the free wireless broadband Internet network, in addition to residential households. Moreover, the long-term economic benefits to the City of establishing a business technology climate where all un-connected residents and businesses have the opportunity to access the Internet are likely to be substantially greater.

A more complete economic model would incorporate a (presumably) negative component for local sales lost to online merchants, as well as a positive component for local businesses that adopt the free wireless access service. That exercise is left for future study.

Resolution Urging Consideration of a Municipally-Owned Wireless Network

The resolution argues that a municipally-owned network, built on the thirty-five (35) miles of existing underground fiber infrastructure currently owned and operated by the City, mostly used to operate traffic signals and emergency services, but otherwise underutilized, could provide the backbone for a hybrid fiber/wireless network that would be superior in service quality, speed, and reliability than the purely Wi-Fi network agreement under consideration with EarthLink. Moreover, the resolution argues about the special needs of currently under-served neighborhoods in regard to broadband Internet services, and the inadequacy of the service level of the final agreement with EarthLink:

> *WHEREAS, Areas of the City and County of San Francisco primarily in the south-east sectors are "redlined" and have neither DSL nor cable modem connectivity for Internet access; and,*

> *WHEREAS, A shared connection speed of 300 kilobits per second (300kb/s) barely meets the Federal Communications Commission definition of broadband, and is considered inadequate for many Internet applications; and,*
>
> *WHEREAS, Silicon Valley, Mountain View and other communities have been offered free wireless fidelity (known as, WiFi) access at 1,000 kilobits per second (1,000 kb/s); and,*
>
> *WHEREAS, WiFi has a reasonable life expectancy of less than five years, and less than two years with regards to general technological innovation; and,*
>
> *WHEREAS, The information technology (IT) industry and community lauds fiber optic connectivity as far exceeding the reliability and stability over WiFi exceeding any technological advances for at least a decade; and,*
>
> *WHEREAS, Nearly two years ago, San Francisco, in partnership with City College of San Francisco, finished the installation and owns over 35 miles of fiber optic network (with more than 220 strands) that has created a solid backbone for ultra-high-speed access that can carry Internet bandwidth speeds which has been reported at exceeding 100,000,000 kilobits per second (100,000,000 kb/s) = 100,000 megabits per second (100,000 mb/s) = 100 gigabits per second (100 gb/s) per fiber pair; and,*
>
> *WHEREAS, Creating, now, a WiFi network connected to the city-owned fiber network backbone would essentially bring a far better solution to every resident with the vision of a fiber optic connection right into the home or premises in the near future as the continued "undergrounding" of electrical and other cables in addition to the sewer renovation projects would provide ample access to neighborhoods;*
>
> *- (McGoldrick, Mirkarimi, and Ammiano 2007: 1-2)*

The resolution stipulates that the City provide a free wireless network option using multiple modalities – fiber, wireless, etc. – with a public governance system overseen by a revived "Telecommunications Commission with a mix of appointments by the Mayor and Supervisors, plus expand its scope to include broadband Internet access" (McGoldrick, Mirkarimi, and Ammiano 2007: 4). In addition, the resolution identifies a feasibility study for a municipally-owned broadband network that was "finally commenced" by DTIS on August 15, 2006 and stipulates that this feasibility study be immediately released.

> *RESOLVED, That the City and County of San Francisco demands that the feasibility study on installing City-owned broadband facilities adopted on October 5, 2004 and commenced on August 15, 2006 be released immediately*
>
> *- (McGoldrick, Mirkarimi, and Ammiano 2007: 1-2)*

The resolution has been submitted for consideration, and at the time of this writing has not been voted or acted upon, although it is scheduled to be debated at the Budget and Finance Committee hearing on February 7, 2007. The full text of the proposed resolution is provided in Appendix B. However, in anticipation of this hearing, DTIS released the current draft of the feasibility study on January 29, 2007.

The contents of the feasibility study could provide a basis of comparison of a true cost-benefit analysis between competing, or complementary, alternatives. However, the analysis is complex and not entirely symmetrical as the feasibility study focuses on the feasibility of a municipally-owned **wired** broadband fiber-to-the-home (FTTH) network.

Further analysis of the alternatives of a municipally-owned mixed fiber/wireless network versus the franchise/common-carrier agreement with EarthLink is left for future study. However, a preliminary analysis of the FTTH feasibility study indicates that deployment of the wireless network has considerable benefits. The capital costs and timeframe for provisioning wireless access to all residents is considerably less than provisioning every home with fiber access, due to the underground rights-of-way construction and physical access to every residence required with deploying FTTH. Also, the CTC report notes the key advantage of wireless networks that fiber networks cannot duplicate or replace:

> *The key advantage of wireless cannot be mirrored by fiber; wireless offers mobility and connectivity during movement. As has been noted, one can't build fiber to the ambulance, to the bus or to every laptop in a public park.*
> *- (CTC 2007: 22)*

However, on the flip-side there are comparative advantages to provisioning fiber access over wireless network access. The useful life of the physical assets of FTTH is far longer than wireless networks, as the wireless radios "will likely have to be replaced in three to five years as technology changes and components age" (CTC 2007: 22). Also, "fiber optics offer theoretically infinite bandwidth (also known as throughput, speed, capacity) while wireless offers far lower speeds that, though impressive, cannot support some of the ultra-high speed applications made possible by fiber (CTC 2007: 22).

In summary, the City appears to be taking a balanced approach by considering all of its possible alternatives in provisioning broadband Internet access for all San Francisco residents. However, the Supervisors and commissioners who will vote on each alternative should consider the larger perspective of addressing the digital divide in San Francisco in as expedient a manner as possible. The lower costs and rapid deployment time of wireless networks, combined with the severe digital divide that one-third of San Francisco residents already suffer, indicate that San Francisco may best be served by pursuing the wireless initiative with EarthLink. The final agreement with EarthLink has no direct up-front cost to the City, with promise of some revenue on the back-end through subscriber fee access. Moreover, the agreement can be terminated in 4 years, particularly if the useful life of the wireless network expires at that time. If a long-term strategy indicates that a municipally-owned fiber/wireless hybrid network is economically feasible and technically superior to the wireless-only network, then San Francisco should pursue that alternative – at that future point in time.

The short-term local economic development benefits of universal wireless access have been explored in preceding sections of this chapter. The long-term benefits of the application of the full digital inclusion framework towards a comprehensive workforce development strategy are the subject of the following chapters.

Upward Job Mobility: The Other Side of the Digital Divide

There are two primary benefits to the City adopting a comprehensive digital inclusion strategy:

- Increased educational opportunities for youth to later compete with the in-migrant highly-educated workforce in San Francisco
- Increased supplemental educational and skills acquisition for adults along a career ladder to attain higher-wage jobs

Essentially, these two benefits are similar and complementary; they merely represent different stages along the educational-skills-career ladder. The digital inclusion framework should look beyond social equity issues in information access, and attempt to support residents at each of the critical stages that contribute towards a resident's ability not only to advance their wage-earning power, but also to compete with the existing highly-skilled, highly-educated workforce in San Francisco, with particular focus and understanding of the areas of opportunity and competition in the marketplace for jobs.

This chapter will begin by trying to characterize the strength and competitiveness of the workforce and business climate on the "other side" of the digital divide. These indicators are generally two-pronged – they indicate areas of opportunity for upward job mobility, but they also indicate areas where competition in the workplace for jobs is likely to be higher.

- **Graduate Students by Field of Study**: This indicator measures the number of graduate students in the city, relative to other cities, and the particular fields of study with the most graduate students. This statistics indicates both the areas of opportunities for educational advancement, but also the areas of competition in the workplace with the most highly-educated workers

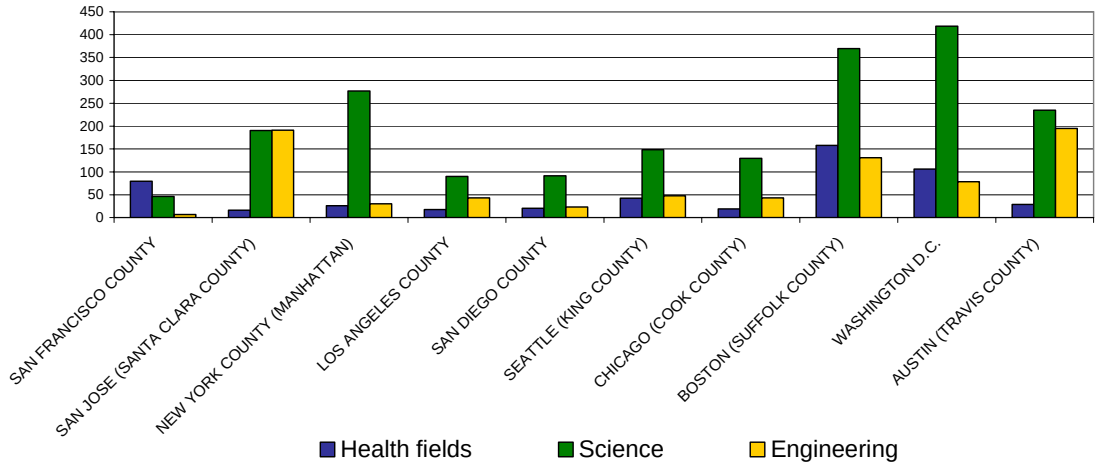
- **Academic Research and Development by Field**: This indicator measures the amount of funds flowing into the city, relative to other cities, and the particular fields that are receiving the most funds. The identification by field indicates a supporting institutional structure that may be leveraged in implementing workforce development strategies related to digital inclusion

- **Technology-Related Industries**: This indicator measures the proportion of firms in the city that can be characterized as "knowledge firms", and also the proportion of jobs in the city that can be identified as "knowledge jobs". These statistics indicate how competitive San Francisco rates relative to other cities in its current innovative industries and workforce, and therefore how abundant and competitive the marketplace for jobs might be in the overall knowledge economy

Talent Pool of Graduate Students

Studies have shown that higher levels of educational attainment correlate highly with higher wages. Bridging the digital divide can enhance educational opportunities for primary and secondary school students that can improve their ability to qualify for higher education. The number of graduate students in technology-related fields measures the size of the talent pool to support local companies in innovation, but it also measures the size of the transitory student population that competes with local residents for professional internships and other entry-level opportunities. San Francisco is strongest in graduate students in health-related fields, followed closely by science-related fields. San Francisco is not competitive in engineering fields. In comparison to other cities, San Francisco has a small number of graduate students per 100,000 residents.

Figure 4: Number of Graduate Students by Field of Study per 100,000 Residents, FY 2003



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2003 (compiled in Chan, Daniel, and de Velasco, 2006).

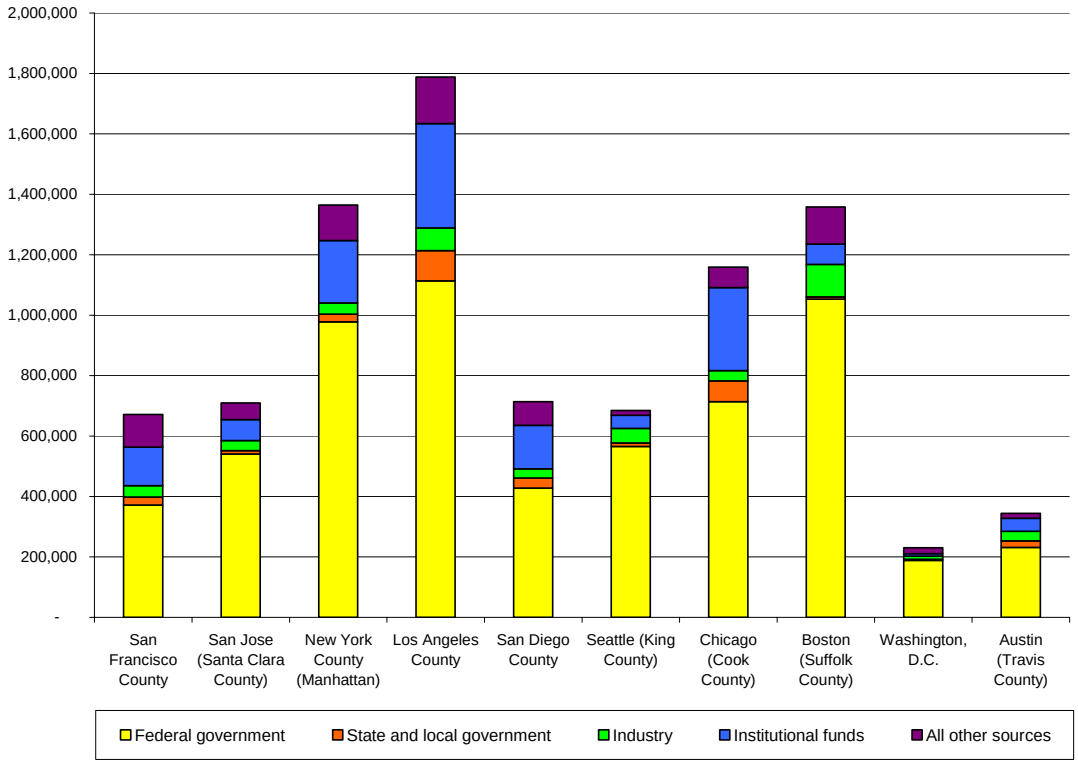
San Francisco's graduate school system is strongest in the health fields, which does not preclude the inference that San Francisco may also be strong in engineering and math fields. R&D in these latter two fields may be concentrated in other universities in the region, University of California Berkeley and Stanford University, as well as in the private industry itself, in nearby Silicon Valley. However, what the data does suggest is that the opportunities for City programs to promote upward job mobility, integrated with local institutions located within the City, may be strongest in the health field. The strength of academic R&D in the health field suggest that there may be opportunities to develop jobs related to the health field, offering lower wages than the highest scientific research occupations but offering easier entry levels, i.e. requiring lower education and

skills levels. The next section evaluates the overall level of funding for academic research and development, to determine if the general field of academic R&D is competitive enough in San Francisco to offer the institutional support towards a career ladder strategy.

Academic Research and Development

Contributions to research and development programs at academic institutions measure the capacity of local institutions of higher learning to educate and train knowledge workers (Tournatzky, Waugman, and Gray 2002). These academic research and development programs employ the highest-educated workers who produce new patentable technology and innovation. San Francisco received just over $600,000,000 in academic research and development funds in 2003, which was just slightly below San Jose (Santa Clara County), San Diego, and Seattle, but higher than Boston (Suffolk County), Washington, D.C., and Austin.

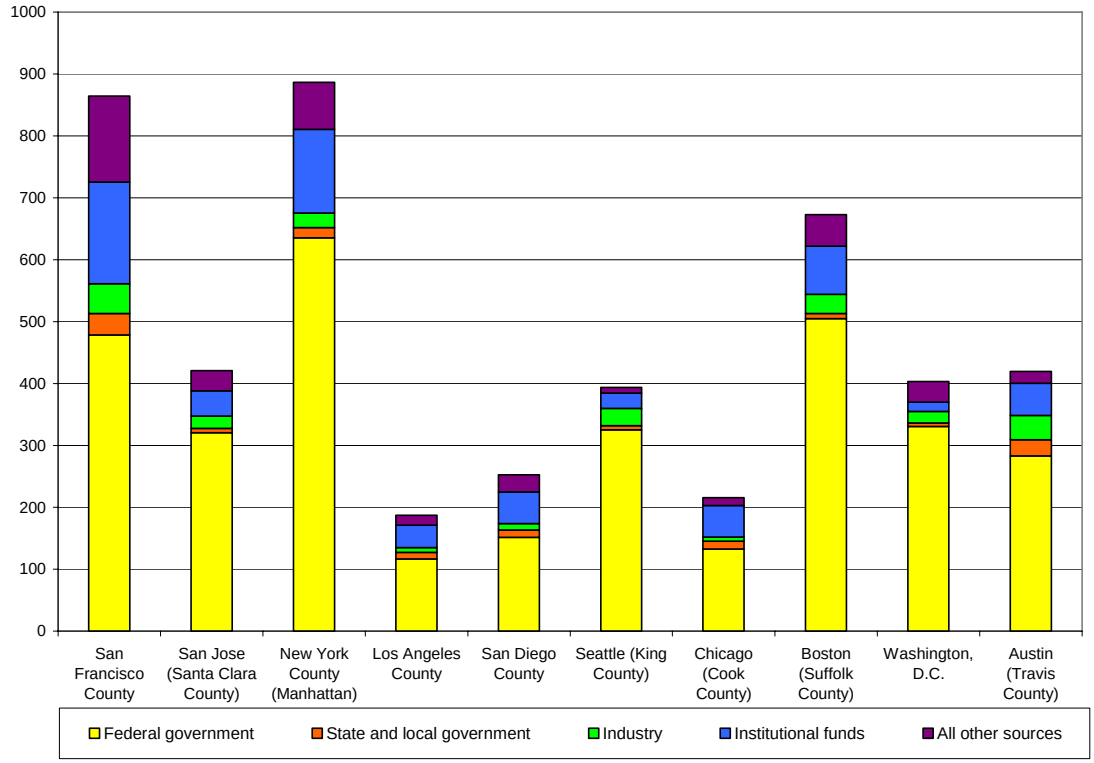
Figure 5: Total Academic R&D Expenditure by Source of Funds, FY 2003



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2003 (compiled in Chan, Daniel, and de Velasco, 2006).

The data indicates that San Francisco is an average, middle-of-the-pack competitor in the space for academic research and development funds. However, normalizing the totals for the size of the population reveals San Francisco to be at the top of the comparison list for academic research and development.

Figure 6: Academic R&D Expenditure per Capita by Source of Funds, FY 2003

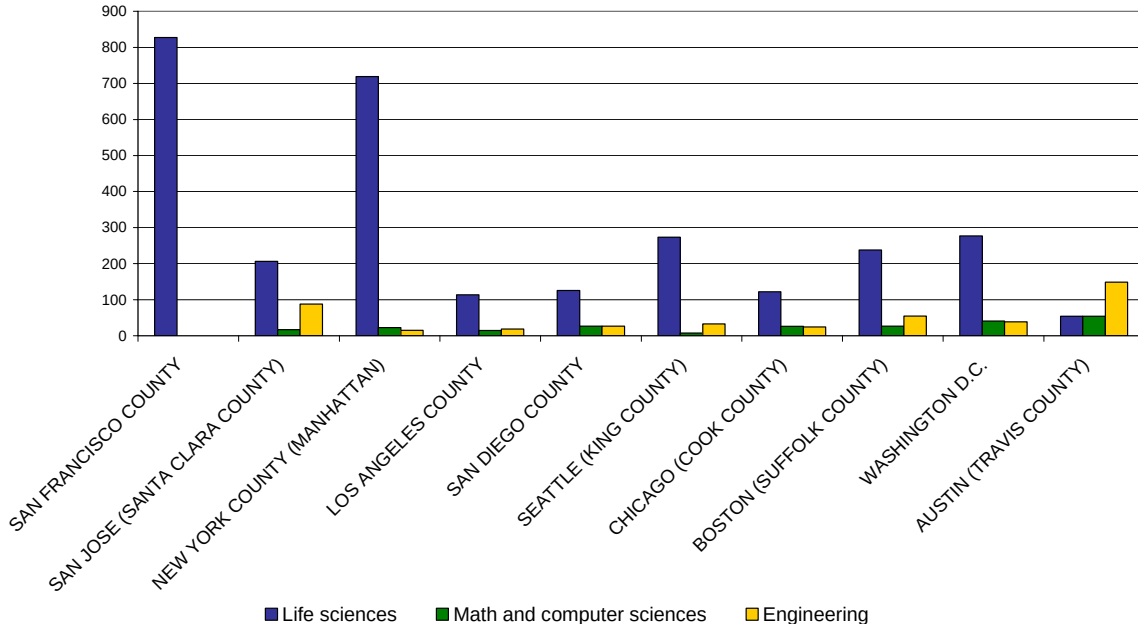


Source: National Science Foundation/Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2003 (compiled in Chan, Daniel, and de Velasco, 2006).

On a per capita basis, San Francisco led all cities, spending $864 per resident, roughly equal with New York, which spent $886 per resident, and more than twice the level of all other cities, except Boston, which spent $673 per resident.

Academic R&D Expenditure by Field of Study is highly correlated with the number of graduate students by field. San Francisco receives almost all of its research and development funding in the health and life sciences field, more than any other city in this comparative study.

Figure 7: Academic R&D Expenditure by Field of Study, FY 2003



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions, Fiscal Year 2003 (compiled in Chan, Daniel, and de Velasco, 2006).

San Francisco received virtually no funding in engineering, math, and computer sciences, indicating that there is little demand for research in these fields within San Francisco. While there is certainly demand in the private sector for R&D in these fields in nearby Silicon Valley, a desire to concentrate local economic development utilizing resources within the confines of the City suggests a focus on health and life sciences.

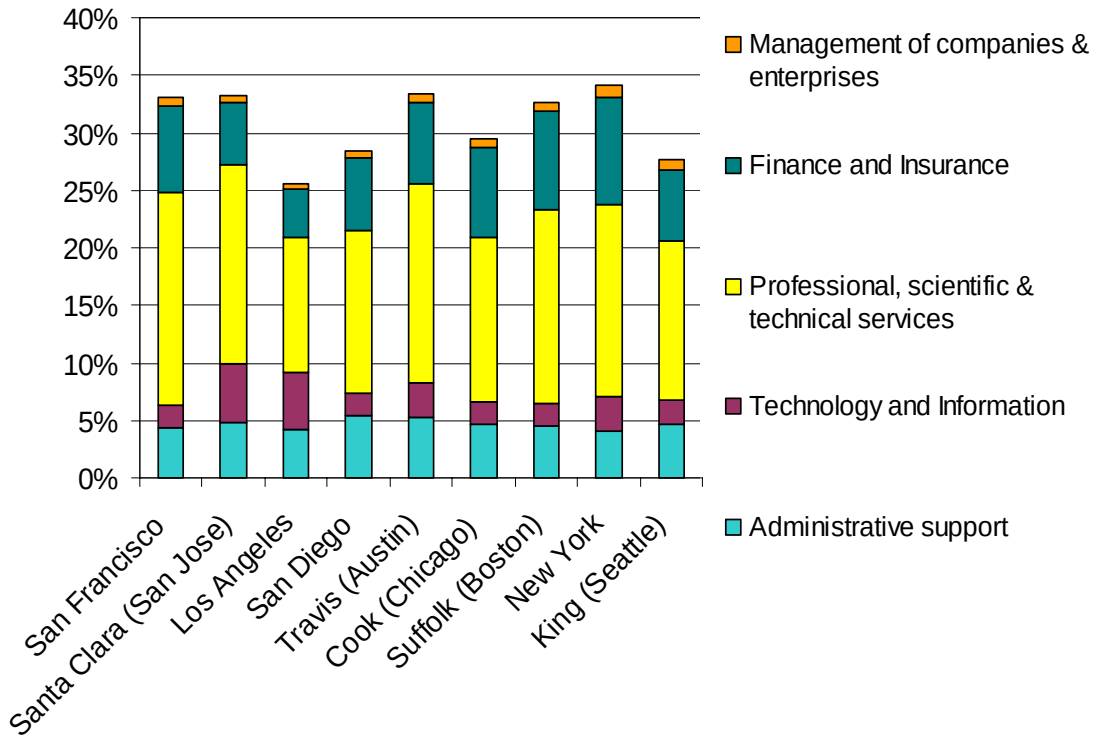
Technology Related Industries

The knowledge economy comprises technology-related industries and technology-related jobs, as identified by the U.S. Census Bureau with a certain collection of NAICS codes. Technology-related industries measure the innovative vitality of the city. Technology-related jobs measure more broadly the percentage of knowledge workers in the city.

Knowledge-Based Firms

As shown in the chart, over one-third of the firms in San Francisco can be classified as knowledge-based firms, based on the industry classification of their primary business. San Francisco stands near the top of the comparison city rankings. These knowledge firms in particular require a highly-educated and highly-skilled workforce, and can be expected to pay higher wages accordingly. Moreover, because this indicator measures firms that are expected to require both education and technology-related skills, these may under-count the jobs that may require technology skills, as will be shown in the next section.

Figure 8: Knowledge-Based Firms, 2003



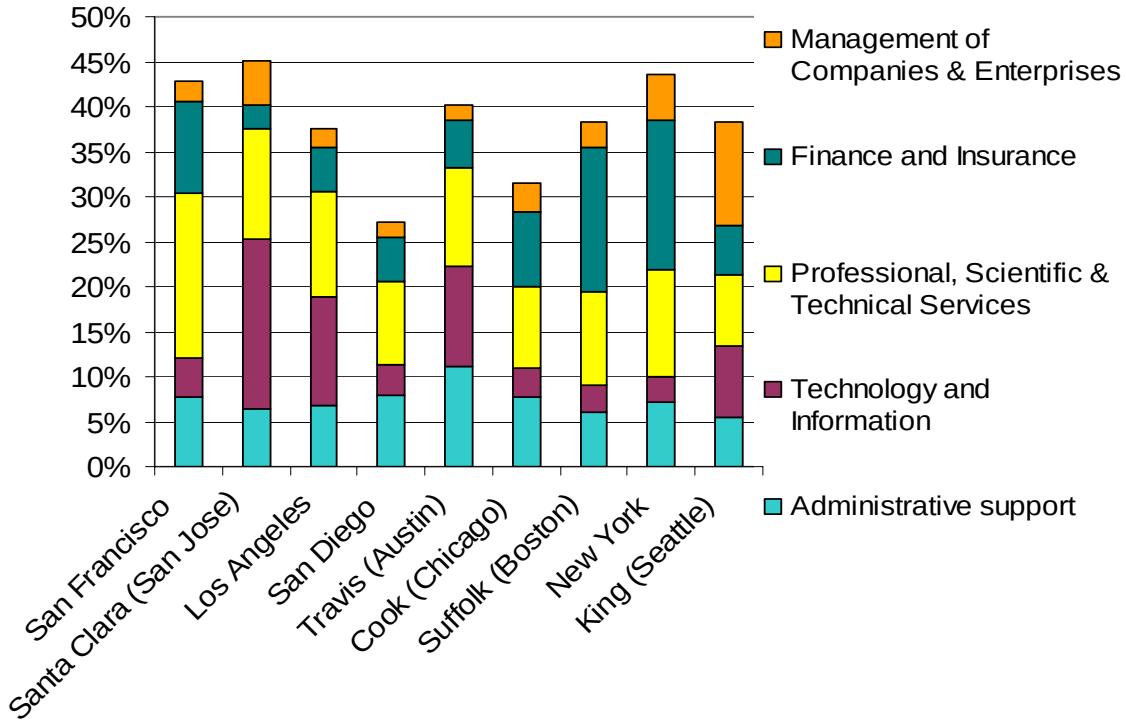
Source: U.S. Census Bureau, County Business Patterns 2003 (compiled in Chan, Daniel, and de Velasco, 2006)
Note: * Technology and Information includes technology related sub sectors within the manufacturing and information NAICS industries

These knowledge firms can be expected to cultivate a business culture that depends on technology-related skills within its workforce. A digital inclusion strategy for the City should provide more than just access to hardware and tools – it should promote opportunities for a career pathway towards employment with such firms, should a resident choose to follow that career pathway.

Knowledge-Based Jobs

An alternate focus on jobs, rather than firms, reveals San Francisco's particular dependence on knowledge-based jobs. Over 43% of the jobs in San Francisco in 2003 could be characterized as "knowledge jobs", as identified by the U.S. Census Bureau based on a certain collection of NAICS codes. San Francisco stands near the top of the comparison city rankings, trailing only San Jose and New York.

Figure 9: Knowledge-Based Jobs, 2003

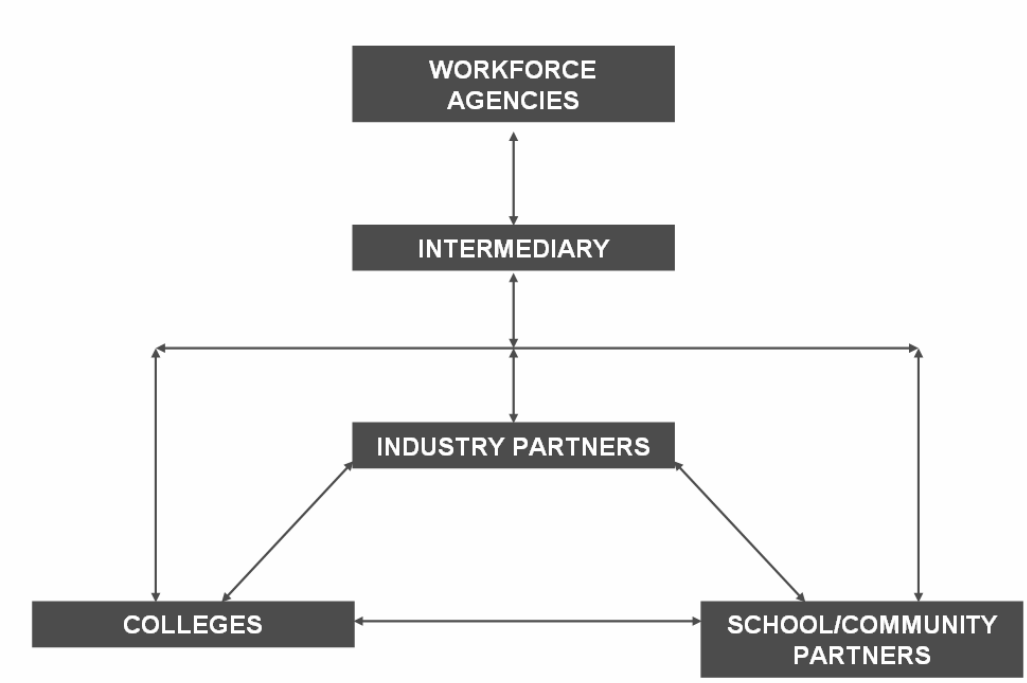


Source: U.S. Census Bureau, County Business Patterns 2003 (compiled in Chan, Daniel, and de Velasco, 2006)
Note: * Technology and Information includes technology related sub sectors within the manufacturing and information NAICS industries

Policy Recommendations: Linking Digital Inclusion with Upward Job Mobility

The most critical function of a local economic development policy that incorporates a digital inclusion strategy is to ensure that the institutional structures in the City are strong and the relationships between them are supported by government policy. The figure below represents the institutional relationships that must be nurtured to ensure a strong pattern of upward job mobility.

Figure 10: Institutional Relationships Supporting Upward Job Mobility



Source: Workforce Strategy Center 2006.

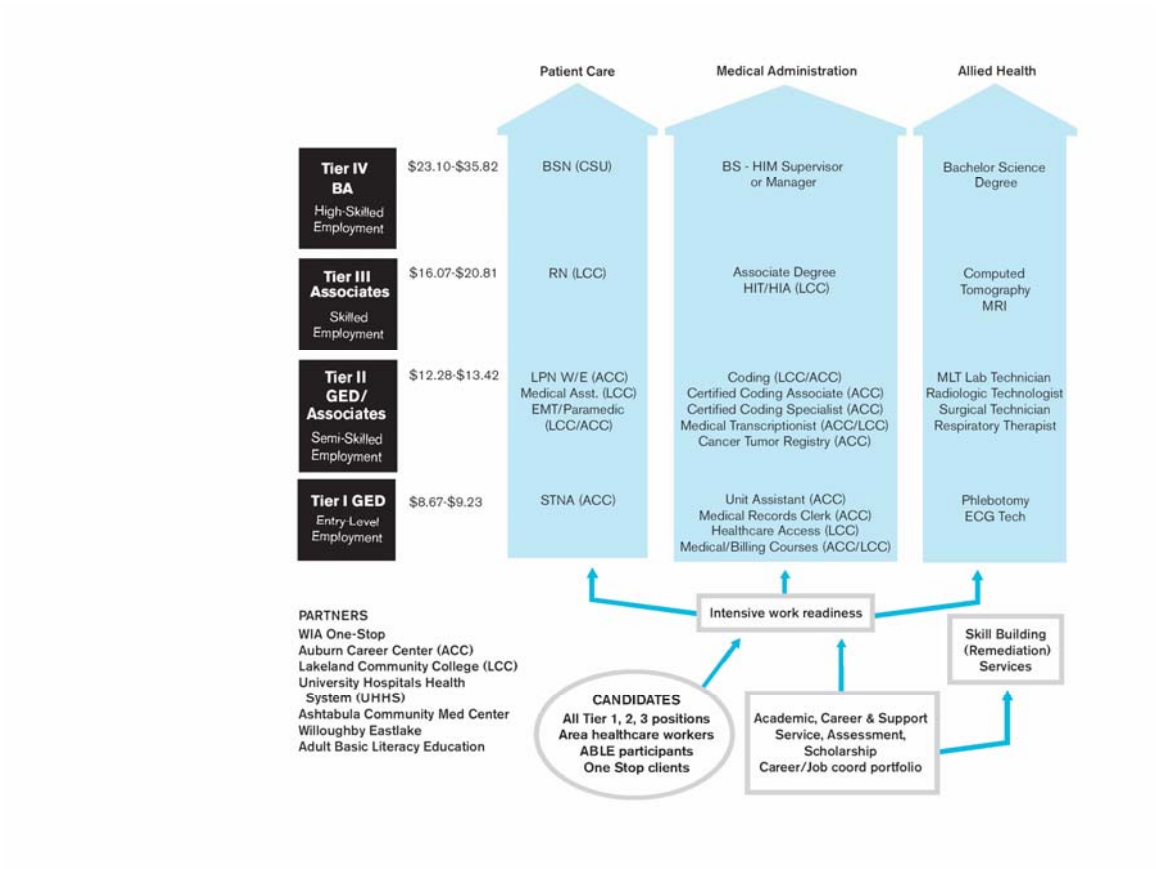
The role of workforce agencies cannot be understated – significant funds flow from the federal government through the state and then through local workforce investment boards to non-profit community groups. While industry plays a vital role in job mobility by actually hiring workers, there interests may fall short in the process of job training, because industry has disincentive to train workers who may take their skills to an industry competitor. Moreover, local non-profit community technology centers may qualify for additional funds if their programs explicitly include a workforce training component.

Example: Healthcare Career Pathway

As shown in the previous chapter, research and development in health is one of the strongest fields in San Francisco. Research and development is typically characterized by a highly-educated and highly-paid workforce. However, there are supporting roles in the

broader field of health care that can benefit from the significant institutional investments into health R&D. As illustrated in the figure below, there are a wide range of jobs with varying educational and skill requirements, with highly correlated wage levels that advance along with acquisition of education, skills, and experience.

Figure 11: Healthcare Career Pathways



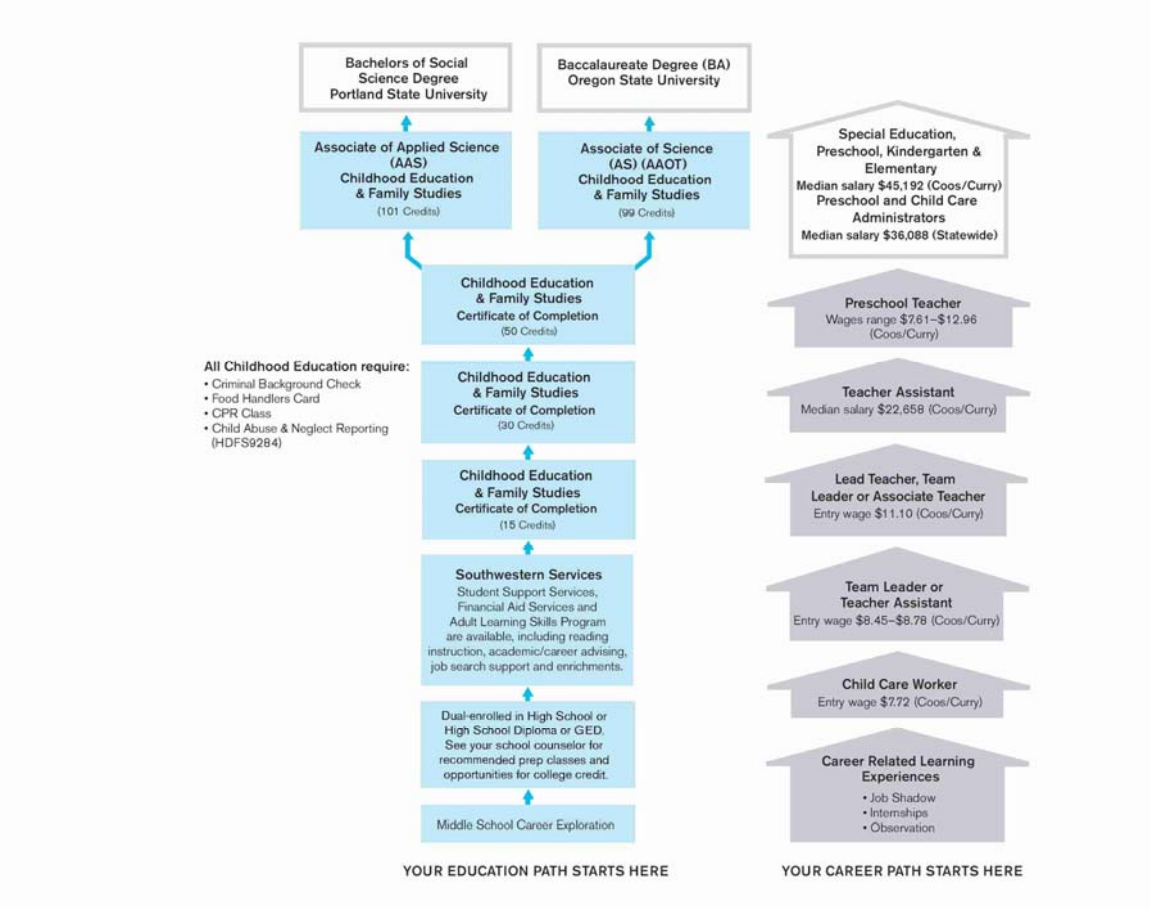
Source: Lakeland Community College, Ohio, taken from Jenkins and Spence 2006.

As San Francisco develops its Digital Inclusion strategy, particularly in regards to relevant content, a strong local economic development policy would include investment in local content and information related to workforce training, along defined career pathways in which San Francisco is most competitive, such as health, to benefit the broadest spectrum of residents towards enhancing their wage-earning power within the local economy.

Example: Education Career Pathway

The three largest and fastest-growing sectors in the service industry are government (particularly local), health care, and education. Therefore, an example for a career pathway in education is appropriate. As shown in the chart, there are a number of positions, with increasing wage levels, that can begin while still in high school (or enrolled in a GED program), and rise along the career pathway with additional education, towards Associate and Bachelors level education.

Figure 12: Education Career Pathway



Source: Southwestern Oregon Community College, Coos Bay, Oregon, taken from Jenkins and Spence 2006.

Conclusion

In 2004, San Francisco has announced plans to offer universal wireless internet access to all residents in the City. This effort will help close the digital divide gap for wireless access and for Internet access, but only for those people who already own a computer with a wireless antenna. San Francisco should focus substantial additional effort towards increasing home ownership of computers, and as a substitute for those who cannot afford one, increasing computers in the classroom and other community institutions.

Interviews conducted with community leaders and community technology center staff members indicate that providing Internet access and computer hardware devices is an insufficient program design for economic development. An effective program must provide skills training and ongoing support in the use, application, repair, and upgrade of both hardware and software to provide a more certain path up the job ladder. The multi-cultural and multi-ethnic composition of San Francisco also necessitates the development of locally relevant content and services in multiple languages.

San Francisco's recently published Draft Digital Inclusion Framework incorporates these recommendations into four program focus areas which require prioritization and funding:

- Access
- Hardware
- Skills Training and Support
- Content and Services

The Draft Digital Inclusion Framework leverages the existence and expertise of the local community technology centers and other non-profit groups to implement and coordinate the proposed programs. However, the Framework, in its Draft format, does not specify prioritization or funding sources for the proposed programs. Most importantly, the framework does not establish explicit linkages to workforce development programs established by the Mayor's Office of Workforce and Economic Development, the Private Industry Council, the Workforce Investment Board of San Francisco, or the Information Technology Consortium. The highest value of the long-term economic benefits to San Francisco's under-served communities will be most effectively realized if an explicit goal of the Digital Inclusion Framework is to establish a career cluster pathways strategy that promotes upward job mobility to higher-wage jobs by providing exposure to technology for local community residents; providing adequate funding for digital inclusion programs; and fostering strong public-private-institutional relationships.

Explicit linkages to workforce development programs can provide additional federal and state funds through workforce investment boards that may not otherwise be available for more general community technology center programs. Explicit coordination with groups such as the Information Technology Consortium can establish the public-private-institutional partnerships between neighborhood non-profit groups, academic colleges and universities, and private corporations that the non-profit groups might not be able to establish on their own. The City of San Francisco is currently engaged in developing its

first, official Economic Strategy, and the cluster analysis from the Economic Strategy should include and inform the explicit linkages between digital inclusion and workforce development, and form a primary foundation for the City's Economic Strategy.

References

APWA. November 16, 1998. *Valuation Of Street Right-of-Way Used For Telecommunications Facilities*. American Public Works Authority. Accessed on January 14, 2007 at http://www.apwa.net/documents/organization/row-va1.pdf.

Atkinson, R. and Gottlieb, P. April 2001. *The Metropolitan New Economy Index: Benchmarking Economic Transformation in the Nation's Metropolitan Areas*. Progressive Policy Institute (PPI) and The Center for Regional Economic Issues (REI) at Case Western Reserve University.

Bar, François, and Park, Namkee. November 22, 2005. "Municipal Wi-Fi Networks: The Goals, Practices, and Policy Implications of the U.S. Case". *Communications and Strategies, no. 61, 1st quarter 2006.* Annenberg School of Communication, University of Southern California. pp. 107-125. Accessed on January 14, 2007 at http://www-rcf.usc.edu/~fbar/Publications/CS61%20BAR_PARK.pdf.

Bay Area Economic Forum. February 2006. *The Innovation Economy: Protecting the Talent Advantage. Bay Area Economic Profile February 2006.* Bay Area Council, Bay Area Economic Forum, Association of Bay Area Governments.

Blanden, Jo and Gregg, Paul. April 2004. *Family Income and Educational Attainment: A Review of Approaches and Evidence for Britain*. The Centre for Market and Public Organisation. University of Bristol.

Castells, Manuel. 2001. "Information Technology and Global Capitalism" in W. Hutton and A. Giddens. (eds.) *On The Edge. Living with Global Capitalism*, London: Vintage.

Castells, Manuel; Fernandez-Ardevol, Mireia; Linchuan Qiu, Jack and Sey, Araba. 2006. *Mobile Communication and Society: A Global Perspective (Information Revolution and Global Politics).* London: MIT Press.

Chan, Andre; Daniel, Katherine; and de Velasco, Emilio Martinez. May 2006. "Technology and Innovation Foundation Report". *San Francisco Economic Strategy.* University of California, Berkeley.

Chapple, Karen. 2005. *Promising Futures: Workforce Development and Upward Mobility in Information Technology.* Institute of Urban and Regional Development, University of California at Berkeley. Accessed on December 28, 2006 at http://www-iurd.ced.berkeley.edu/pub/abstract_mg200501.htm

Chapple, Karen. 2006. *Moving Beyond the Divide: Workforce Development and Upward Mobility in Information Technology.* PolicyLink and Institute of Urban and Regional Development, University of California at Berkeley. Accessed on December 28, 2006 at http://www.policylink.org/Research/IT_Workforce/ and at http://www.policylink.org/pdfs/Moving_Beyond_the_Divide.pdf

Chapple, Karen. 2006. *Moving Beyond the Divide: Workforce Development and Upward Mobility in Information Technology.* PolicyLink and The Institute for Urban and Regional Development. Accessed on December 28, 2006 at http://www-iurd.ced.berkeley.edu/pub/abstract_mg200501.htm

City and County of San Francisco, Office of the Mayor. August 16, 2005. "SAN FRANCISCO TAKES FIRST STEP TO PROVIDE UNIVERSAL, AFFORDABLE WIRELESS BROADBAND ACCESS TO ALL SAN FRANCISCANS". Mayor's Office Communication Press Release. Accessed on December 21, 2006 at http://www.sfgov.org/site/mayor_page.asp?id=33949

City of San Jose. November 2003. *San Jose Economic Development Strategy*. Office of Economic Development.

CTC. January 29, 2007. "Fiber Optics for Government and Public Broadband: A Feasibility Study Prepared for the City and County of San Francisco January 2007 (Draft)". Columbia Telecommunications Corporation. Accessed on February 2, 2007 at http://www.sfgov.org/site/uploadedfiles/dtis/tech_connect/SFFiberFeasibility.pdf

DTIS. January 5, 2007. "WIRELESS BROADBAND INTERNET ACCESS NETWORK AGREEMENT BETWEEN THE CITY AND COUNTY OF SAN FRANCISCO AND EARTHLINK, INC." SF TechConnect. Accessed on February 2, 2007 at http://www.sfgov.org/site/uploadedfiles/dtis/tech_connect/process/SanFranciscoWirelessNetworkAreementFinal.pdf

Etzkowitz, Henry 2003. *Innovation in Innovation: The Triple Helix of University-Industry-Government Relations*. Science Policy Institute, State University of New York at Purchase.

European Commission Information Society Technologies. November 2003. *New eEurope Indicators Handbook.* SIBIS.

Florida, Richard. 2002. *The Rise of the Creative Class.* New York: Basic Books.

Fox, Susannah. October 5, 2005. *Digital Divisions: There are clear differences between among those with broadband connections, dial-up connections, and no connections at all to the Internet.* Pew Internet & American Life Project.

Hauge, Janice A.; Jamison, Mark A.; and Gentry, Richard J. 2005. *Bureaucrates as Entrepreneurs: Do Municipal Telecom Providers Hinder Private Entrepreneurs?* Telecommunications Policy Research Conference 2005. Accessed on January 14, 2007 at http://web.si.umich.edu/tprc/papers/2005/428/MuniEntryinLocalTelecom.pdf.

Horrigan, John B. 2006. *Home Broadband Adoption 2006*. Pew Internet & American Life Project. Accessed on December 1, 2006 at http://www.pewinternet.org/pdfs/PIP_Broadband_trends2006.pdf

Hüsing, T. November 2004. *The Impact of ICT on Social Cohesion: Looking Beyond the Digital Divide*. European Commission Joint Research Centre, Institute for Prospective Technological Studies.

Jacobs, Jane. 1984. *Cities and the Wealth of Nations*. New York: Vintage.

Jenkins, Davis. August 2006. *Career Pathways: Aligning Public Resources to Support Individual and Regional Advancement in the Knowledge Economy*. Workforce Strategy Center.

Jenkins, Davis and Spence, Christopher. October 2006. *The Career Pathways How-To Guide*. Workforce Strategy Center.

Joint Venture. 2005. *2005 Index of Silicon Valley*. Joint Venture: Silicon Valley Network.

Johnson, Craig L. and Man, Joyce. 2001. "A Primer on Tax Increment Financing" and "Effects of Tax Increment Financing on Economic Development." Pp. 15-29, 101-109 in C.L. Johnson and J. Man, editors, *Tax Increment Financing and Economic Development: Uses, Structures, and Impacts*. Albany, NY: State University of New York Press

Information Technology Consortium. May 5 2006. *A Celebration of Nurses' Week at Laguna Honda Hospital.* Accessed on December 21, 2006 at http://www.itc-sf.org/general_info/news.php

Kerrey, Bob and Isakson, Johnny. December 2000. *The Power of the Internet for Learning: Moving From Promise to Practice.* The Web-Based Education Commission. Accessed on December 21, 2006 at http://interact.hpcnet.org/webcommission/index.htm

Lehr, William; Sirbu, Marvin; and Gillett, Sharon. May 7, 2004. *Municipal Wireless Broadbands: Policy and Business Implications of Emerging Access Technologies.* Massachusetts Institute of Technology. Accessed on January 14, 2007 at http://itc.mit.edu/itel/docs/2004/wlehr_munibb_doc.pdf.

Lopoo, Leonard M. and Mayer, Susan E. 2006. *Government Spending and Children's Educational Attainment and Eventual Income*. http://www.russellsage.org/publications/workingpapers/govtspendedattain/document

Marine, S. and Blanchard, J-M. 2004. *Bridging the Digital Divide: an Opportunity for Growth in the 21st Century.* Alcatel Telecommunications Review, 2nd Quarter 2004. Alcatel. Accessed on December 21, 2006 at http://www1.alcatel-lucent.com/publications/abstract.jhtml?repositoryItem=tcm%3A172-61861635

Massachusetts Technology Collaborative. 2004. *2004 Index of the Massachusetts Innovation Economy*. John Adams Innovation Institute.

Mazzeo, Christopher; Roberts, Brandon; Spence, Christopher, Strawn, Julie. December 2006. *Working Together: Aligning State Systems and Policies for Individual and Regional Prosperity*. Workforce Strategy Center.

McGoldrick, Jake; Mirkarimi, Ross, Ammiano, Tom. January 9, 2007. "Resolution urging the City and County of San Francisco to weigh the costs and benefits of a Google/Earthlink provided wireless Internet, versus an autonomous Wireless connection created and maintained by the City and County of San Francisco itself (File No. 070020)". San Francisco Board of Supervisors.

National Science Board (NSB). 1998. *Science & Engineering Indicators-1998*. NSB 98-1. Washington, DC: U.S. Government Printing Office.

Nadiri, I. 1993. *Innovations and Technological Spillovers*. NBER Working Paper No. 4423. Boston: National Bureau of Economic Research.

National Science Foundation. 2002. *Academic Institutional Profiles: 2002*. Division of Science Resources Statistics (SRS). http://www.nsf.gov/statistics/profiles/

National Science Foundation. 2003. Division of Science Resources Statistics (SRS), *Academic Research and Development Expenditures: Fiscal Year 2003*, NSF 05-320, (Arlington Vancouver).

Newsom, Gavin. October 21, 2004. "State of the City Address". Office of the Mayor. Accessed on December 21, 2004 at http://www.sfgov.org/site/uploadedfiles/mayor/speeches/SoCFinal.pdf.

Porter, Michael F. 1998. "Clusters and Competition: New Agendas for Companies, Governments and Institutions." Ch. 7 in *On Competition*. Boston: Harvard University Press.

Richtel, Mark. December 12, 2006. "Skype's Free Phone Call Plan Will Soon Have Annual Fee". *New York Times.* Accessed on December 12, 2006 at http://www.nytimes.com/2006/12/13/technology/13skype.html?ei=5088&en=1a6098681517ff82&ex=1323666000&adxnnl=1&partner=rssnyt&emc=rss&adxnnlx=1166765129-vee1qoFXDsTwzrvG+/AQ5Q

Sabel, Charles. 1989. "Flexible Specialization and the Re-Emergence of Regional Economies". In. P. Hirst and J. Zeitlin (eds.). *Reversing Industrial Design.* New York: Berg. Ch. 1.

Sargent, Mark. 2005. "Community Technology Centers: A National Movement to Close the Digital Divide". *Edutopia Online*. George Lucas Educational Foundation. Accessed

on December 21, 2006 at
http://www.exhibithall.org/php/article.php?id=Art_992&key=188

Schwartz, Jodi. L; Reyes, Pat; Tharp Jay; Bennett, Patricia M. Fall 2005. *San Francisco Beacon Initiative Second Year (2005) Evaluation Report*. Resource Development Associates.

Selhofer. H. and Hüsing, T. 2002. *The Digital Divide Index – A Measure of Social Inequalities in the Adoption of ICT.* Empirica.

Servon, Lisa J. 2002. Bridging the Digital Divide: Technology, Community, and Public Policy. Blackwell Publishing Professional. 1st edition.

Spooner, Tom. August 27, 2003. *Internet Use by Region in the United States: Regional variations in Internet mirror differences in educational and income levels.* Pew Internet & American Life Project.

Tassey, G. 1995. *Technology and Economic Growth: Implications for Federal Policy.* NIST Planning Report 95-3. Washington, DC: U.S. Department of Commerce.

TechConnect. December 22, 2005. *RFP 2005-19 Request for Proposals TechConnect Community Wireless Broadband Network.* City and County of San Francisco. Accessed on December 21, 2006 at
http://www.sfgov.org/site/uploadedfiles/dtis/tech_connect/TechConnectRFP_2005-19_12-22-05Rev1-17-06.pdf

TechConnect. April 5, 2006. "SAN FRANCISCO CONCLUDES EVALUATION OF PROPOSALS TO CREATE UNIVERSAL, AFFORDABLE WIRELESS BROADBAND NETWORK". DTIS Press Release. Accessed on December 21, 2006 at
http://www.sfgov.org/site/tech_connect_page.asp?id=38562

TechConnect. April 20, 2006. "DEPARTMENT OF TELECOMMUNICATIONS AND INFORMATION SERVICES ANNOUNCES FORMATION OF TASK FORCE TO FOCUS ON DIGITAL INCLUSION". DTIS Press Release. Accessed on December 21, 2006 at http://www.sfgov.org/site/tech_connect_page.asp?id=38852

TechConnect. October 18, 2006. *San Francisco Draft Digital Inclusion Strategy.* Mayor Gavin Newsom and the Department of Telecommunications and Information Services. Accessed on December 21, 2006 at
http://www.sfgov.org/site/uploadedfiles/dtis/tech_connect/DraftSFDigitalInclusionFramework.pdf

Tournatzky, L., Waugman, P., and Gray, D. 2002. *Innovation U: New University Roles in a Knowledge Economy.* Southern Growth Policies Board.

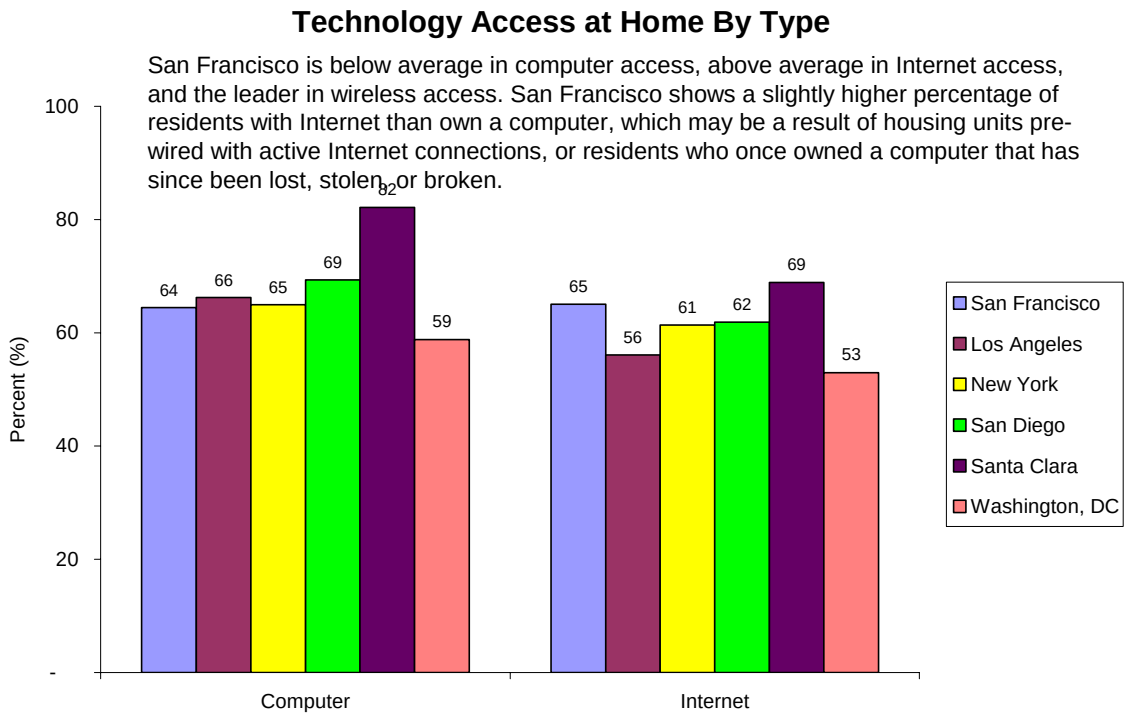
U.S. Department of Commerce. October 2003. *Falling through the Net: Toward Digital Inclusion A Report on Americans' Access to Technology Tools*. National Communications and Information Administration, Economics and Statistics Administration.

U.S. Department of Commerce. June 2000. *The Dynamics of Technology-Based Economic Development: State Science and Technology Indicators.* Technology Administration, Office of Technology Policy.

Appendix A: Comparison Charts

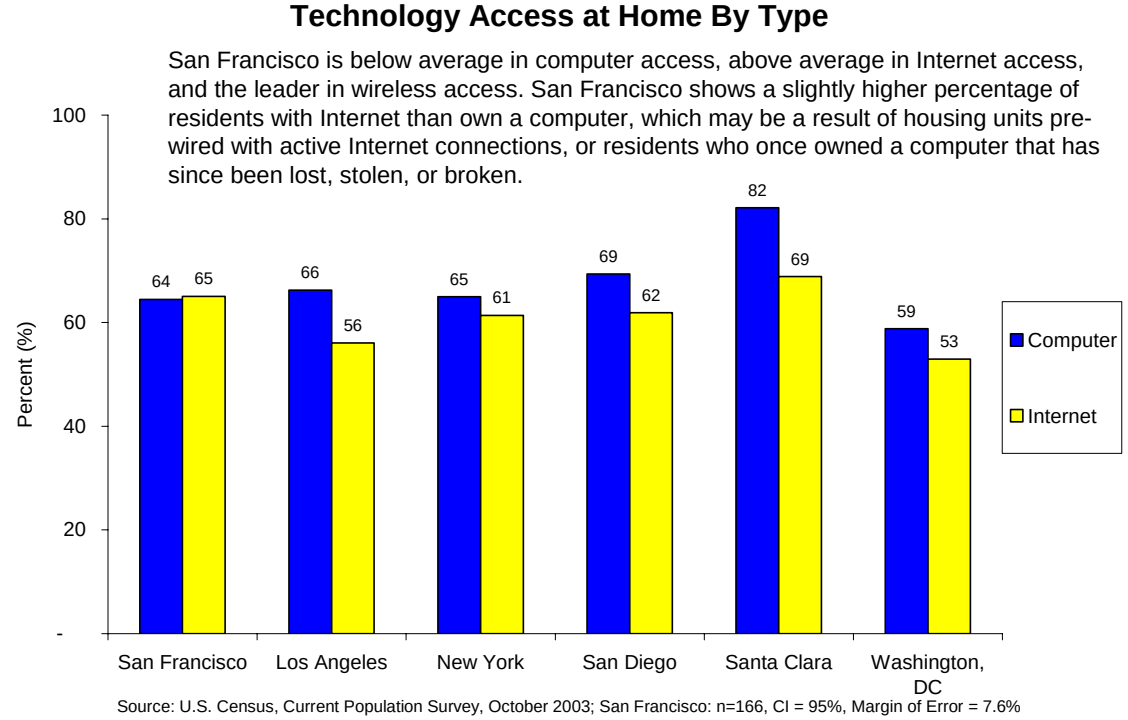
Digital Divide – Technology Access at Home

Figure 13: Digital Divide – Technology Access at Home by Type



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

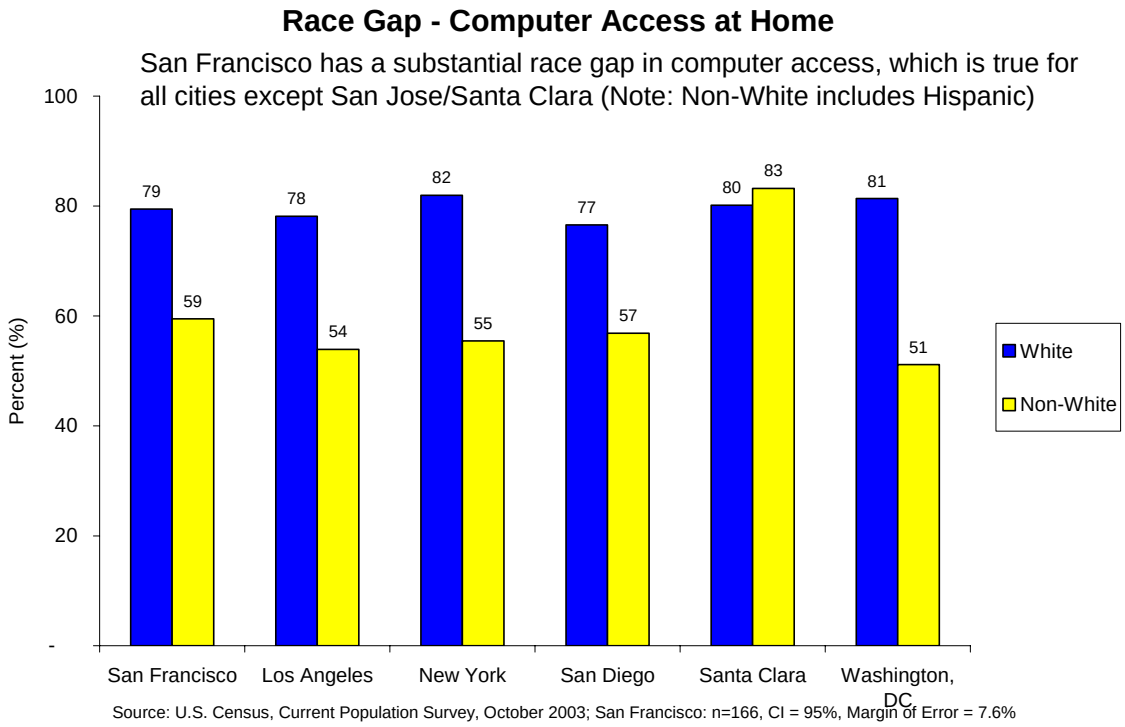
Figure 14: Digital Divide – Technology Access at Home by City



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

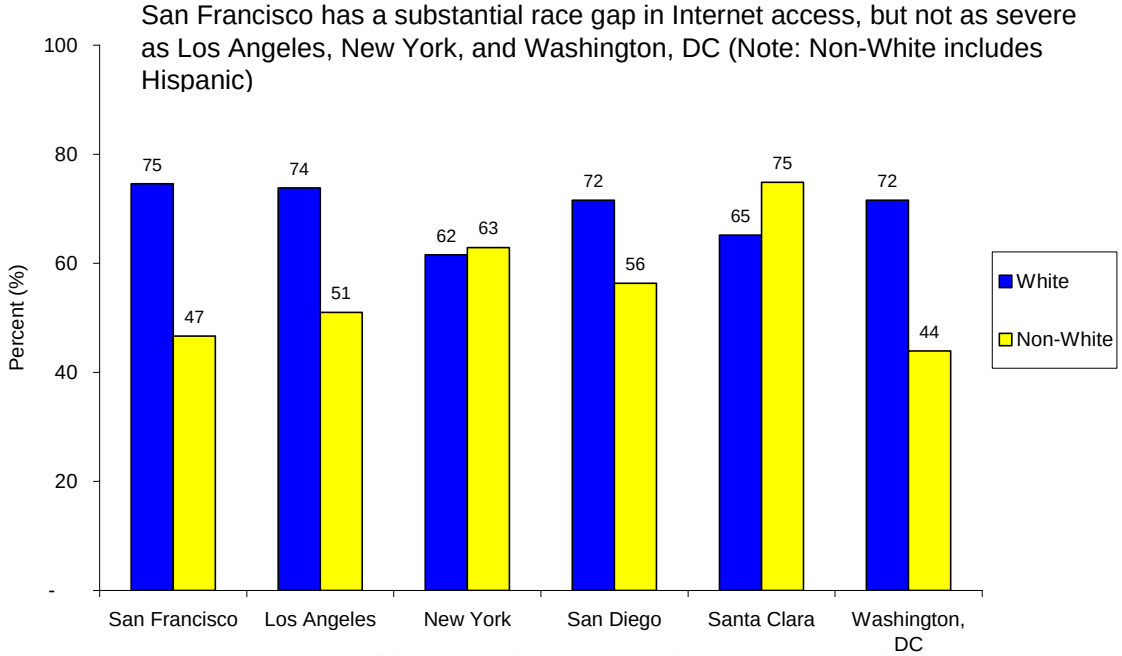
Digital Divide – Race Gap

Figure 15: Digital Divide – Race Gap – Computer Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

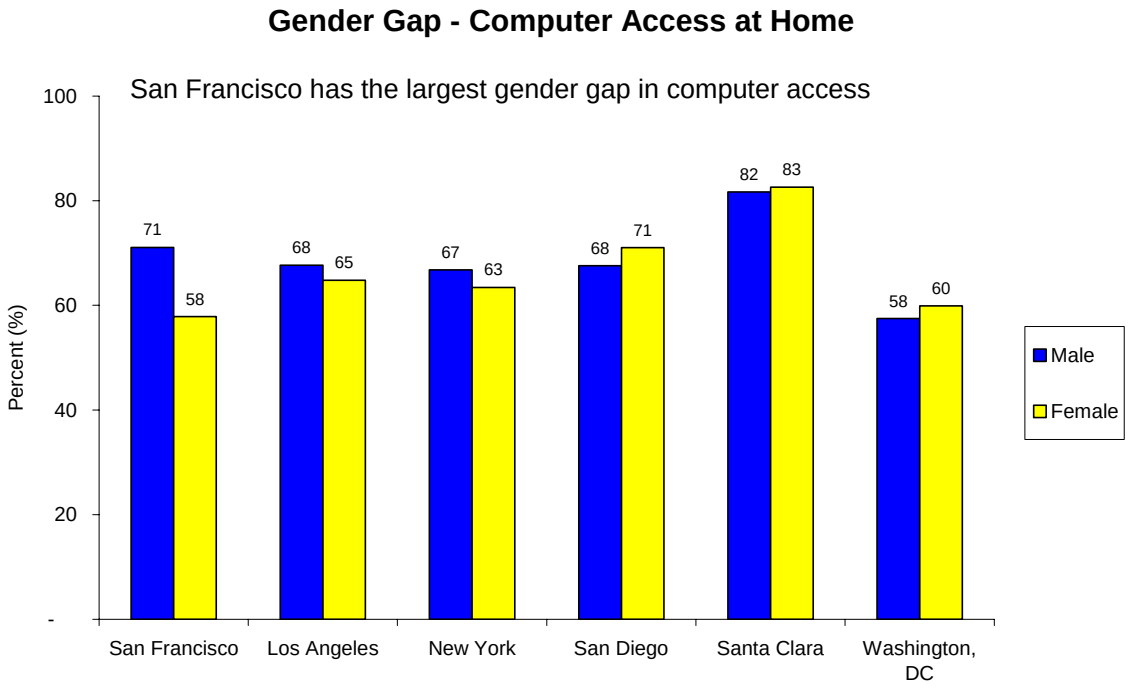
Figure 16: Digital Divide – Race Gap – Internet Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

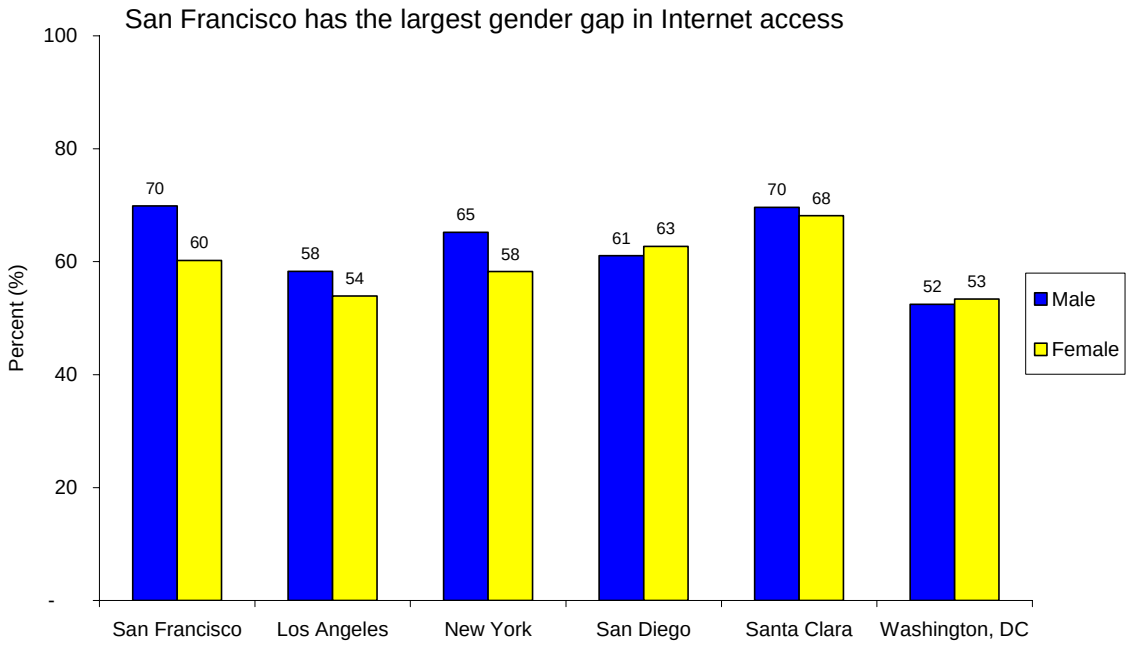
Digital Divide – Gender Gap

Figure 17: Digital Divide – Gender Gap – Computer Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

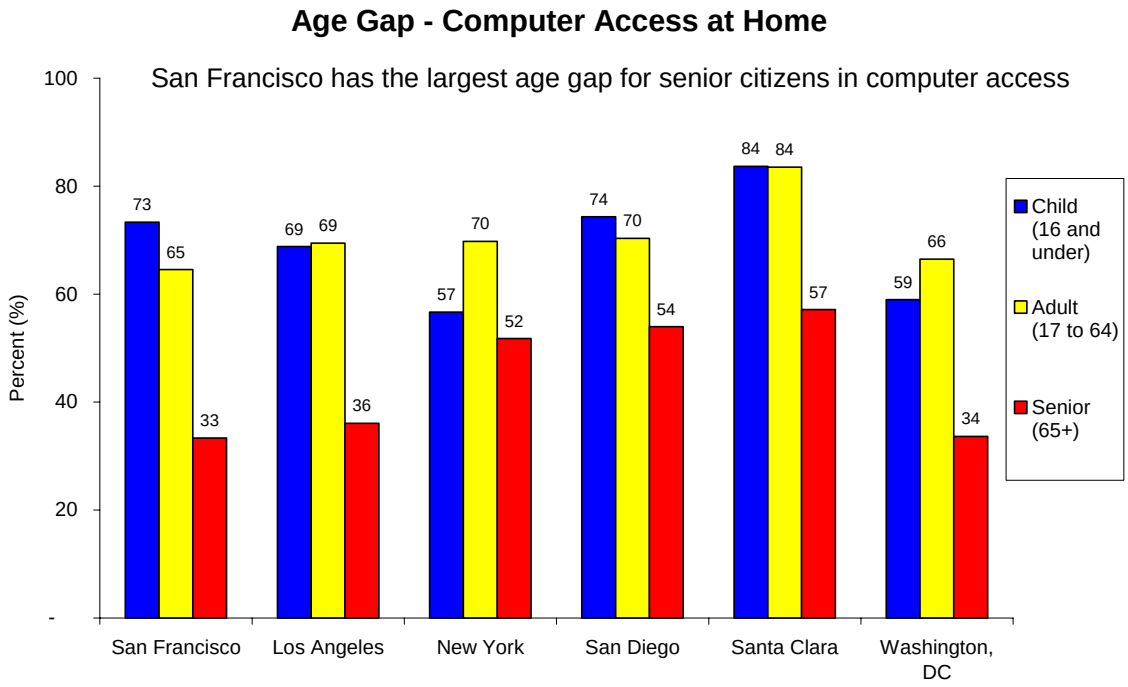
Figure 18: Digital Divide – Gender Gap – Internet Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

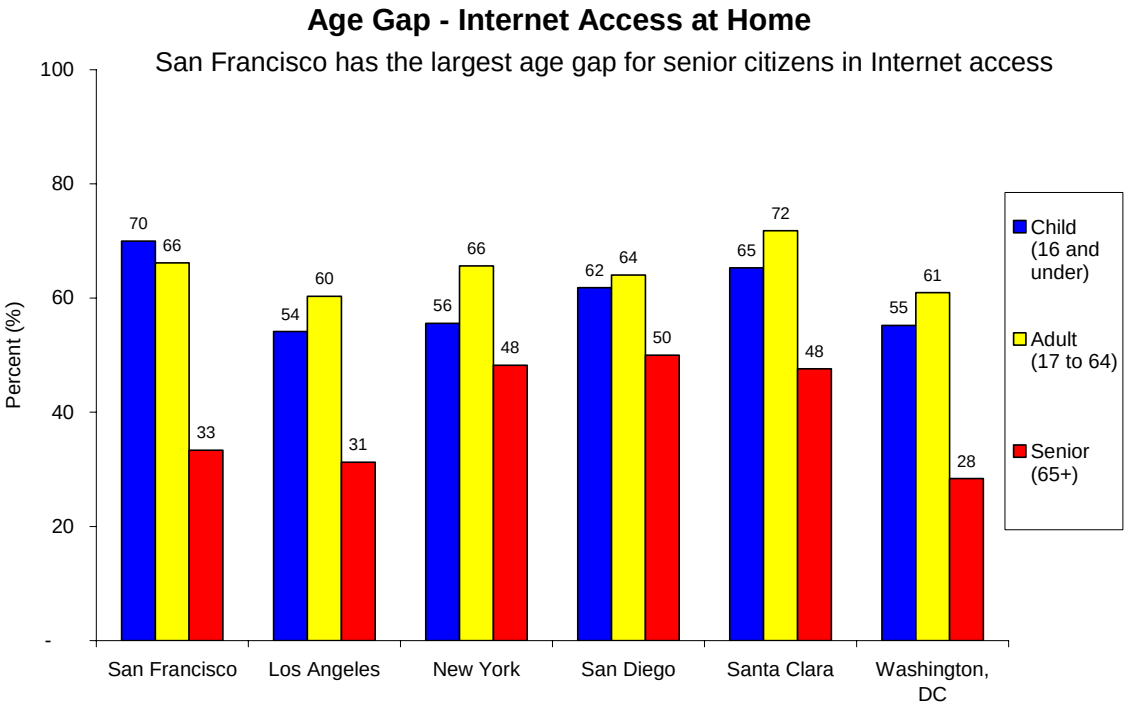
Digital Divide – Age Gap

Figure 19: Digital Divide – Age Gap – Computer Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

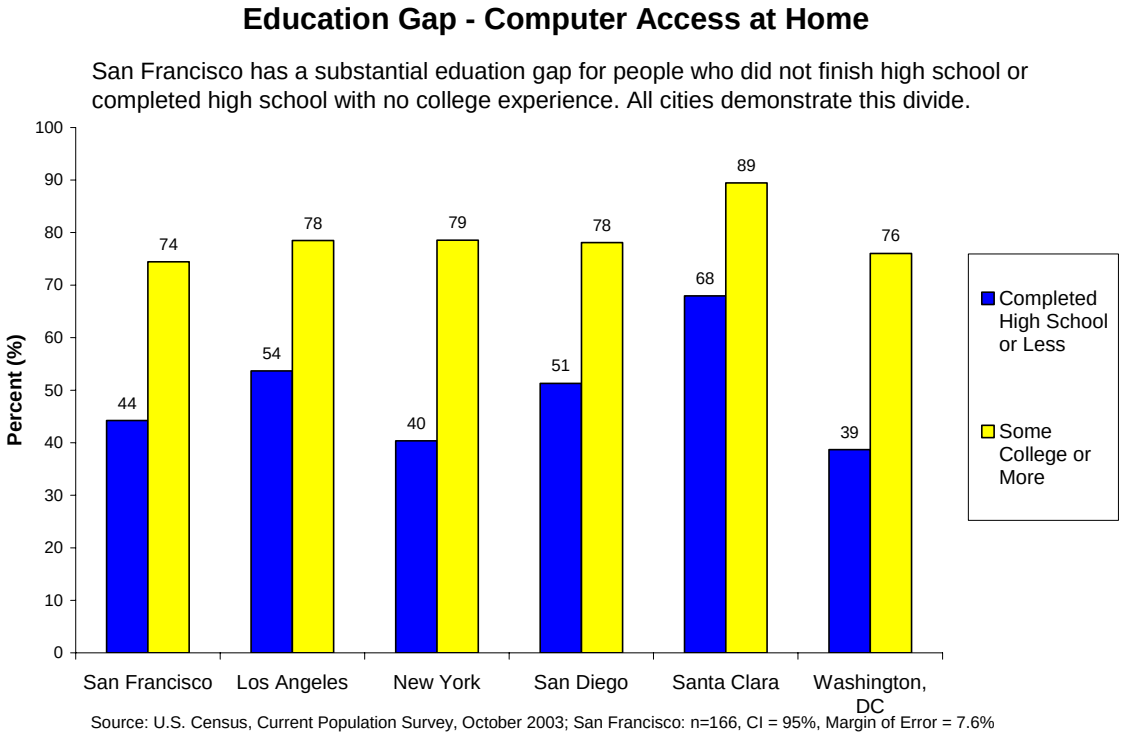
Figure 20: Digital Divide – Age Gap – Internet Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

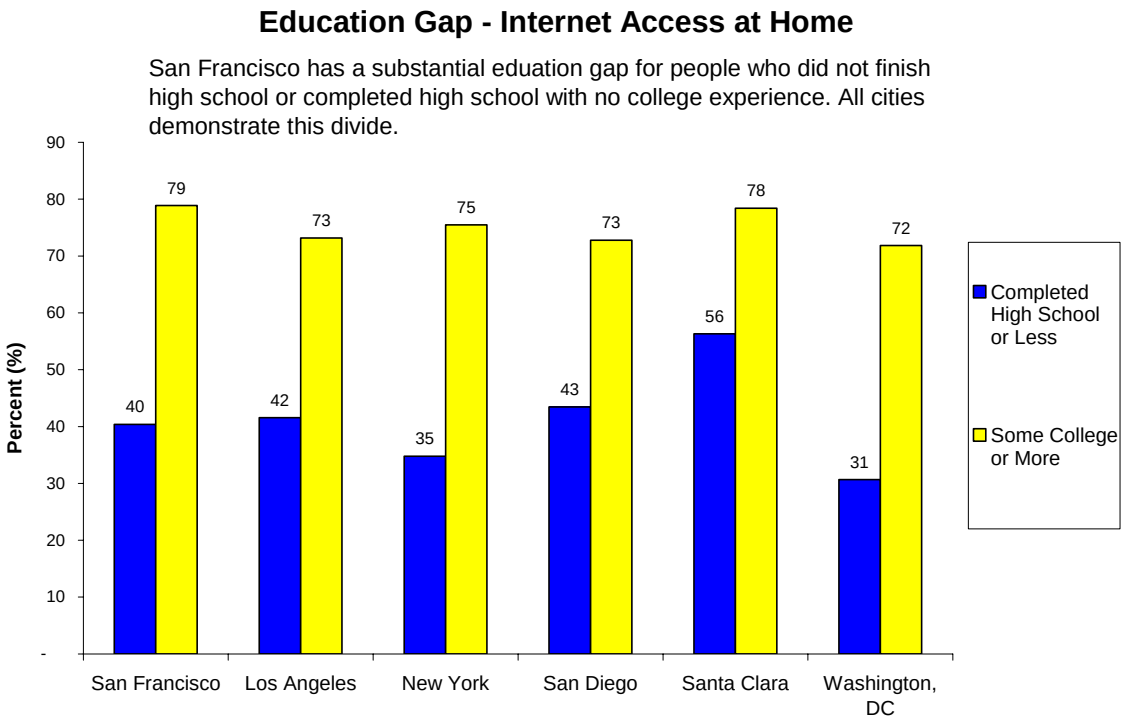
Digital Divide – Education Gap

Figure 21: Digital Divide – Education Gap – Computer Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

Figure 22: Digital Divide – Education Gap – Internet Access at Home



Source: U.S. Census, Current Population Survey, October 2003; San Francisco: n=166, CI = 95%, Margin of Error = 7.6%

Appendix B: McGoldrick Resolution Urging Consideration of Municipally-Owned Wireless Network (January 9, 2007)

FILE NO. 070022 RESOLUTION NO.

[Municipal Broadband]

Resolution urging the City and County of San Francisco to weigh the costs and benefits of a Google/Earthlink provided wireless Internet, versus an autonomous Wireless connection created and maintained by the City and County of San Francisco itself.

WHEREAS, Areas of the City and County of San Francisco primarily in the south-east sectors are "redlined" and have neither DSL nor cable modem connectivity for Internet access; and,

WHEREAS, A shared connection speed of 300 kilobits per second (300kb/s) barely meets the Federal Communications Commission definition of broadband, and is considered inadequate for many Internet applications; and,

WHEREAS, Silicon Valley, Mountain View and other communities have been offered free wireless fidelity (known as, WiFi) access at 1,000 kilobits per second (1,000 kb/s); and,

WHEREAS, WiFi has a reasonable life expectancy of less than five years, and less than two years with regards to general technological innovation; and,

WHEREAS, The information technology (IT) industry and community lauds fiber optic connectivity as far exceeding the reliability and stability over WiFi exceeding any technological advances for at least a decade; and,

WHEREAS, Nearly two years ago, San Francisco, in partnership with City College of San Francisco, finished the installation and owns over 35 miles of fiber optic network (with more than 220 strands) that has created a solid backbone for ultra-high-speed access that can carry Internet bandwidth speeds which has been reported at exceeding 100,000,000 kilobits per second (100,000,000 kb/s) = 100,000 megabits per second (100,000 mb/s) = 100 gigabits per second (100 gb/s) per fiber pair; and,

WHEREAS, Creating, now, a WiFi network connected to the city-owned fiber network backbone would essentially bring a far better solution to every resident with the vision of a fiber optic connection right into the home or premises in the near future as the continued "undergrounding" of electrical and other cables in addition to the sewer renovation projects would provide ample access to neighborhoods; and,

WHEREAS, The City and County of San Francisco adopted on October 2, 2004, by unanimous vote, a feasibility study on installing City-owned broadband facilities to be initiated; and,

WHEREAS, The Feasibility study on installing City-owned broadband facilities was finally commenced on August 15, 2006 by the Department of Telecommunications and Information Services (DTIS); and,

WHEREAS, The cost of a City-owned WiFi network including establishing a government-created non-profit consortium of information technology professionals, known as an internet exchange, would build out, manage, and maintain this hybrid WiFi/fiber network in addition to creating known fiscal schemas to provide low-cost leased access to local businesses; and,

WHEREAS, San Francisco is not in the business of making a profit; and,

WHEREAS, A City-owned service would provide for reasonable lower access costs for local businesses to help promote economic development and to provide sufficient revenues to the City for an ongoing build-out of true high-speed municipally-owned broadband access with full and equal digital inclusion; and,

WHEREAS, The City and County of San Francisco must retain full oversight over rates, costs, specifications, deployment, management, maintenance, and all other aspects of creating and serving the public with citywide Internet and communications access; and,

WHEREAS, The deployment of a substantial broadband deployment in San Francisco will bring in additional businesses and hence increase tax-based revenue; and,

WHEREAS, Community input is vital to any long-term service that will serve the public; and,

WHEREAS, San Francisco must keep consistent with this community oversight with its commission-based structure; now, therefore, be it

RESOLVED, That the City and County of San Francisco shall not do business with any vendor that does not offer the City and County of San Francisco the best terms, conditions, and prices compared to other cities ("Most Favorite City" status, akin to Most Favorite Nation trading status); and, be it further

RESOLVED, That the City and County of San Francisco conduct a meaningful trial of the WiFi network in two separate one square mile areas of the City before any contract is signed; and, be it further,

RESOLVED, That the City and County of San Francisco not sign any contract that lasts longer than the useful life of the technology as is standard in the industry, which is less than five years for WiFi; and, be it further,

RESOLVED, That the City and County of San Francisco revive the Telecommunications Commission with a mix of appointments by the Mayor and Supervisors, plus expand its scope to include broadband Internet access; and, be it further

RESOLVED, That the City and County of San Francisco not approve or adopt any contract to provide the City and County of San Francisco and its residents with broadband Internet access under any medium, i.e., wireless, WiFi, fiber, etc., until all the above and any subsequent concerns have been satisfied; and, be it further

RESOLVED, That the City and County of San Francisco reaffirms that it currently does own and control a significant and substantial fiber network; and, be it further

RESOLVED, That the City and County of San Francisco demands that the feasibility study on installing City-owned broadband facilities adopted on October 5, 2004 and commenced on August 15, 2006 be released immediately; and, be it further

RESOLVED, That the City and County of San Francisco explore with due haste, the creation of a publicly governed broadband network enterprise to serve the people of San Francisco with free Internet access using modalities, such as, WiFi and the City's own fiber network or a combination of both, as appropriate, to bridge the digital divide and increase digital inclusion, with the lowest cost access to the Internet possible; and, be it further

RESOLVED, That the City and County of San Francisco retains full oversight over rates, costs, specifications, deployment, management, maintenance, and all other aspects of creating and serving the public with citywide Internet and communications access.