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A Model for Developing Urban Innovation Clusters

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Abstract : This paper seeks to build on previous work conducted by Porter, Devol, Florida, Bahrami and Evans, Wennberg and Lindqvist, and others contained in the literature, to construct a new way of looking at innovation cluster development. It seeks to describe the key elements contained in the research that serve as building blocks for innovation clustering, adding analysis dimensions that aim to further illuminate understanding of this process. It compares those building block characteristics to the innovation topography of U.S. urban centers, to shed light on a new framework through which urban innovation cluster formation can be considered.

It identifies three building block analysis categories: 1) Technological Capability and Capacity (TCC); 2) Intellectual Propulsion Capacity (IPC); and 3) Structural Creative Inspiration (SCI). These three pillars form the architecture for creation of a Strategic Innovation Network (SIN), upon which clustering can be systematically analysed and built. The purpose of the SIN is to optimally organize and connect all available resources that include physical, financial, and human, such that innovation clustering is inspired, encouraged, nurtured, and ultimately constructed as fully functioning socio-economic organisms that provide both local and regional benefits.

It is designed to aid both private enterprise and public policy leaders in their strategic planning considerations, and to enhance urban economic development opportunities.

Keywords : Innovation, Urban, Suburban, Location, Economic Development, Technology, Clustering, Strategic, Creative Inspiration, Agglomeration Economies, Enterprise Performance

BUILDING A NEW SILICON VALLEY

Debate over duplicating Silicon Valley has been widespread for more than a decade, as local and regional policy makers aim to create formulas that will result in improved economic performance and opportunities in their respective geographic areas. However, while a substantial amount of research on cluster development has been contributed to the literature, discovering the actual precise ingredients, placed in just the right configuration, at just the right time in an economic cycle, has proven quite elusive. Even more difficult, has been the challenge of developing innovation clusters in US urban centers, because of both real and perceived features inherent in those areas, that have come to be viewed as natural impediments for effective economic development.

In order to elevate strategic thinking about how to improve US urban economic development, there must be recognition that positing the question of how to duplicate the topography of "Silicon Valley-like" areas is a flawed angle of vision. Fundamentally, it is essential, that in constructing new innovation models, consideration must be given to unique location equities, and how they can be amplified and leveraged, as well as the inequities concentrated in urban centers, that must be mitigated to achieve optimal outcomes. However, benefit can be gained from examining the unique innovation qualities Silicon Valley presents just the same, and in other US innovation clusters, with an aim on

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World Technopolis Review

WTR 2013;2:81-95 http://dx.doi.org/10.7165/wtr2013.2.2.81

developing a process to build them in urban centers.

Based on the literature, and a direct survey of area features, argument can be advanced that when comparing Silicon Valley even to other successful major US clusters, it is somewhat of an outlier. "The Valley" as it is colloquially labelled locally, has a unique constellation of elements, conditions, and resources that yield a particular innovation DNA. That DNA in turn, fuels the intense level of discovery and invention characteristic of the region. Other areas, including US urban centers can create their own unique constellations, which can potentially yield their own innovation DNA, if they are able to systematically leverage both physical resources and human capital, which research shows is relatively abundant. So, the question becomes "why hasn't that happened?" Research shows a clear suburban location bias when it comes to high-intensity innovation enterprises, particularly in the technology sector. Devol documented this suburban bias in one the early technology topography studies - *America's High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas* (Devol, R. (1999)).

To understand both the challenges and the opportunities that urban centers potentially harbour, it is instructive to examine both the need, and what some of the leading urbanologists have theorized about these unique geographies.

An example that vividly illustrates the need, is reflected in the US nationwide unemployment picture for blacks, who occupy a significant percentage of urban populations. In November of 2011 for example, as the national unemployment rate began its descent from a 2009 peak of 10%, the seasonally adjusted rate of black unemployment nationwide, according to the Bureau of Labor Statistics (Dept. of Labor), was 15.5%. The unemployment rate for Latinos was 11.4%. The national rate was 8.7%. Blacks saw unemployment rise as high as 16.8 in that same year, as the national rate hovered around 9%.

In November of 2012, the seasonally adjusted rate of black unemployment nationwide was 13.2% and 10% for Latinos. The national rate was 7.7%. Since the last quarter of 2008, the period that economists cite as the trigger of what has come to be known as "The Great Recession," black unemployment has registered from 75% to double the national unemployment rate. Economists generally agree that nationally, when those who only work part-time, those considered under-employed, and those who have become so discouraged they have stopped looking for work, are added to the existing unemployment rate, that number rises by another half (around 25% for Blacks, 16% for Latinos).

In a stark example of just how severe this chronic unemployment has become in urban centers, government officials and economists studying the Detroit Metro Area, one of the most densely black populated cities in the country, estimate that contrary to published statistics, the real unemployment rate there for black males, could be as high as 50% - an alarming situation for societal stability and public policy. It is a city that at this writing, is under the control of a state appointed emergency manager, in charge of liquidating major assets in order to reduce staggering debt that has caused Detroit to declare bankruptcy (Detroit Free Press, June, 2013).

NEW THINKERS IN US TECH DEVELOPMENT

This writer theorizes that if more technology firms were encouraged to locate in urban areas, they would likely pursue hiring practices that would help mitigate the challenge of urban chronic unemployment. Devol's Milken Institute study also found that when "clustering" of technology firms occurs, it produces a range of other economic opportunities, jobs among them, in support service categories. What it also found is that the clustering of larger technology firms is often a catalyst for the emergence of considerable small business activity by entrepreneurs (Devol 1999).

Dr. Richard Florida's research into urban regeneration echoed the Devol-Milken Institute findings regarding the benefits that accrue to metropolitan areas as a result of technology firm "clustering." However, his research went on to theorize that such clustering can have a profound impact on urban economic development, because the clustering triggers the attraction of highly intelligent, creative and skillful people that elevate the geographic area's overall economic capabilities and prospects (Florida 2002 ; 2011).

Edward L. Glaeser, renowned Harvard economist, states in an article, *The New Economics of Urban and Regional Growth* (Clark, Feldman, and Gertler 2001), "The new economic growth theory suggests that cities should be understood as centers of idea creation and transmission." He goes on to suggest that "If this is so, then cities will grow when they are producing new ideas or when their role as intellectual centers is increasing in importance."

Harvard University's Dr. Michael Porter, and founder and leader of the Initiative for a Competitive Inner City, has sug-

gested from his research that the land/asset mix of urban areas, along with a well-educated workforce, present unique economic opportunities for firms that select them as the location of choice. He argues that these opportunities are not easily duplicated in other geographic areas (Porter 2009).

Recently retired semiconductor giant Intel's CEO, Paul Otellini, at a 2010 conference at the Brookings and Aspen Institutes (Wash. D.C.), stated: "While America still has the quality work force, political stability, and natural resources a company like Intel needs, the US is badly lagging in developing the next generation of scientific talent and incentives to induce big multinationals to create lots more jobs here." (New York Times 2010)

In 2011, Thomas Friedman and Michael Mandelbaum authored *That Used To Be Us: How America Fell Behind In The World It Invented and How We Can Come Back*. The book, through a comprehensive examination of the factors that drive innovation and economic growth in a global economy, catalogs the challenges the US faces in order to both regain and maintain competitive leadership in the 21st Century (Friedman and Mandelbaum 2011).

One example Friedman references is an interview he conducted with chemical behemoth DuPont's CEO, Ellen Kullman. She characterizes the nature of just what makes a quality workforce in what has become an extremely competitive global economic environment, and how it is essential to spurring enterprise innovation. Kullman says, "Today, you have to have employees that are present, so that they are additive and not just taking up space." She explains that employees that are present "must be able to think, interact, and collaborate." She goes on to explain that the firm "does not operate with cheap labor. One of the big factors we look at when deciding where a plant should be located, is the availability of an educated workforce" (Kullman 2011).

URBAN ECONOMICS AND ENVIRONMENTAL CHARACTERISTICS

In addition to US domestic competitive intensity, the significant difference in wages between American workers that do have the requisite skills, and qualified workers in foreign countries like India and China, where US firms can spend about half as much on salaries for similar services, is a threat to the US middle class standard of living, and workforce stability. Workforce stability, as defined in the literature, includes such factors as availability of qualified workers for a given technology, comparative wage rates, impact of turnover on enterprise performance, and the policy environment that helps shape workforce dynamics. The framing of workforce stability is viewed as an essential strategic element of any innovation or technology environment (*VHA's 2002 Research Series—The Business Case for Work Force Stability*).

That difference, starting in 1999, has spurred a tidal wave of outsourcing by American firms for such technology tasks as product development, software development, and product assembly.

Now, there is even a rush to resettle call-centers that execute customer care services in foreign countries rather than in the US In Mumbai, India, and areas throughout the Philippines for example, customer care (call centers) has become a major source of high growth economic activity in those countries. These factors would appear to put added pressure on firms looking to expand, and making the choice between an urban center and what might appear to be a more favorable environment in a US suburb, or perhaps more probable today, a foreign country.

Other cost elements, such as the cost of real estate for operations, insurance, municipal business taxes, and crime rates, are key factors to be considered when deciding on business location. Joel Kotkin's 2005 study of *The Best Places to Do Business* indicates that some urban centers like New York, Boston, Chicago, and San Francisco, rank among the highest cost locations in the country to do business. Other urban centers like Atlanta, San Antonio, Las Vegas and San Diego rank very favorably in terms of cost (Kotkin 2005).

Empowerment Zones established by the federal government and run by the Department of Housing and Urban Development (HUD), and Enterprise Zones established by some states such as California, were designed to create tax incentives to attract high wage employers to urban centers with the goal of job creation. However, after nearly two decades of existence (they were enacted into law in 1993), by and large, the Zones have showed mixed results, and had budgeted grant funding eliminated for the last two years of the Bush Administration.

The early work of economist Joseph Schumpeter, cataloged in *The Theory of Economic Development*, began to introduce the influence of location choice as one key

WTR 2013;2:81-95 http://dx.doi.org/10.7165/wtr2013.2.2.81

determinant in the success of the firm, even though he considered firm size and shape to be more critical factors (Schumpeter 1934). His pioneering focus on highlighting the importance of the entrepreneur, and his theory of *innovation and progress*, included in his highly popularized "creative destruction" model on the rhythmic dynamics of capitalism, also included discussion of the relationship between location and enterprise success in the context of location analysis and spatial theory (Schumpeter 1942).

QUALITY OF LIFE AND WELL BEING

Finally, quality of life issues reveal an important element of strategic competitive behavior. As an area of scientific inquiry receiving increased attention, QOL is being recognized as a key element in attracting talent with high levels of education and/or unique skill sets seen as vital to enterprise success. And firms across the country are now vying for this rather scarce pool of talent, especially when trying to recruit talent to fill key positions in technology and other innovation-driven firms. A good deal of attention has been given to the subject of quality of life (QOL) as it relates to work life in recent years. It is believed to have been first introduced, or "popularized" in modern management thinking in the 1970s, when UAW and General Motors created quality of life programs to improve employee life linkages to their communities. The underlying assumption of the initiative was that it would have a direct bearing on productivity inside the firm.

Geert Hofstede conducted early research on this subject that culminated in an article published in the Academy of Management Review titled: *The Cultural Relativity of the Quality of Life Concept*. What he found in researching value patterns in 53 countries, is that life quality is a concept of perception based on one's values, and that those values are a function of the culture in which one has been brought up. What he also found, is that work and life quality are not separate and distinct concepts, but directly linked to each other in part, because they are value driven, and that values are a matter of personal choice that affect just about everyone (Hofstede 1984).

This recent consideration of *quality of life* factors, has been integrated into location analysis, as an examination of just how factors outside the immediate enterprise work environment impact actual performance inside it. Specifically, *quality of life* factor integration with location analysis, has surrounded the strategic examination of how these factors, which vary from location to location, can be leveraged to create competitive advantage, particularly in terms of attracting human capital (talent pool), and which might denigrate such potential.

Leo Jeffries and Cheryl Bracken, have conducted very recent research in a nationwide survey, asking direct questions about the factors that impact qualify of life perceptions. Their hypothesis for the research was that QOL perceptions correlate with the number of so-called "Third Places" individuals could identify in their respective communities. Third places in their model are defined as locations within a community or close geographic area that go beyond home, school, and church, and typically involve culture and/or recreation. These would include proximity to shopping and entertainment locations, recreational parks, museums, and other cultural destinations of interest (Jeffries, Horowitz, and Bracken 2011).

In recent years, there have been a variety of metric reports published in an effort to characterize QOL data, and relate it to a range of economic indicators for a given geographic region. The Economic Intelligence Unit of *The Economist* (magazine), publishes a periodic *Global Liveability Report* (GLR). The Gallup-Healthways Well-Being Index, Kiplinger'ss Best Cities Report, and Forbes/CNN Money Magazine's annual *Best Places For Business and Careers* are among a growing number of efforts to analyse this important innovation attraction feature.

COMMON INNOVATION CLUSTER BUILDING BLOCKS

Notwithstanding the clear impact of structural factors that have been found to trigger innovation, i.e. manufacturing location, or trade specialty, productivity measures, etc., some scientists believe more fundamentally, that interaction between people is the real driver of new idea generation. Emily Badger captures this theory in her report on MIT's Wei Pan, of the Human Dynamics Lab (Badger 2013). Previous work at the Santa Fe Institute has mathematically proven that as urban population density increases, it results in exponential growth of patents, GDP, and innovation. Of course, they found the same is true of crime, health hazards, and other urban ills. But what is most striking about the findings is that exponential growth means that instead of city benefits grow-

ing linearly, they grow *super–linearly*. Pan has taken this foundational science to analyze how human interaction intensity contributes to this explosive growth, and found that two factors impact outcomes most: mobility, and education level.

Urban mobility can be observed through the prism of public transportation accessibility and utilization, which is also widely viewed in the literature as a key infrastructure element that fuels innovation. Education can be analyzed using the multiple elements that measure K-12 school performance, and higher education metrics available in the public domain.

Huang and Horowitt echo similar observations when analyzing innovation potential through the framework of social interaction as a function of culture and distance. They suggest that innovation is inhibited by distance, and that these barriers yield higher transaction costs on multiple levels. Specifically, they cite the inhibitors to the development of innovation relationships as:

1) Geographic barriers (physical distance)
2) Social Network Failures (people belonging to different social circles)
3) Cultural and language differences (inability to facilitate understanding)
4) Lack of trust (people fearful of working together)

When considering these two respective theories, it would suggest further credence applied to the natural habitat offered by urban areas to facilitate the flow of innovation.

So, given these measures, theoretically, one might assume that particularly in larger urban areas where public transportation accessibility is high, human interaction intensity is facilitated rather favorably. Yet, it is difficult to find the super-linear outcome results the science suggests in many urban areas. Is it perhaps the skewed impact of poor education systems currently under siege due to municipal and state funding mechanisms? Or is it something else? This consideration is offered as a backdrop to the analysis further developed herein.

It is instructive to examine the context of existing innovation clusters to identify common building blocks that could potentially be transferable to urban innovation cluster development. Bahrami and Evans describe a type of *constituent eco–system,* that fuels both the internal and external capabilities of the enterprise environment within the "Valley."[1] Relative to strategic location choice, they hone in on specific elements that bolster enterprise capability, and without which, the successes associated with the Silicon Valley would likely not exist (Bahrami and Evans 1995).

Briefly stated, when considering what they term as the *focal firm,* it is this constituent eco-system that helps determine not just success, but sustainability as well. They are: first, *universities and research institutions*-these institutions have a strong technology orientation, and are the engine of entrepreneurial fertilization and cultivation, training young engineers, and other creative potentials that constantly seek to start firms within Silicon Valley. Then, these universities and institutions also serve as a source of pre-commercialization stage technology incubators, in part through the works of the students they train, that also become a source of innovation to the general area. Bahrami and Evans, suggest that these institutions may be the actual "nutrient base" of the eco-system itself.

Bahrami and Evans, include financial resources as a critical "birth" component to entrepreneurial activity seeking to develop, nurture, and cultivate innovation. In the Silicon Valley, the presence of a significant *venture capital* community, is a driving force not just in the continuation and sustainability of the innovative and creative streams that characterize the area, but in essence, also provide significant management know-how and expertise in what this writer defines as "strategic mentoring" capacity, a unique feature not widely distributed in other US innovation clusters (Morse 2001). In other innovation clusters, there are venture capitalists looking to fund, and then exploit new technologies and creative innovations, but few that provide this unique, and critical incremental value-added feature.

A *sophisticated service infrastructure* is a key component of the constituent eco-system, according to Bahrami and Evans, that allows focal firms to concentrate on their unique innovations. This service infrastructure includes such features as: contract manufacturing services that develop prototypes and/or sub-systems to disseminate finished goods. It includes public relations firms providing strategic marketing, and other product-related functions. And it includes accounting firms, that have specialized high-technology-innovation

[1] referring to Silicon Valley

WTR 2013;2:81-95 http://dx.doi.org/10.7165/wtr2013.2.2.81

practices. These are but a few examples of how start-ups particularly, are able to leverage little internal capability into scalable function, needed to build and grow their enterprises.

Because of the global reputation of the Silicon Valley, the *talent pool* represented there, becomes a strategic asset and eco-system capability. People from all over the world come there for any number of reasons, some to study at the bevy of top-notch universities in the area, i.e. Stanford, Cal Berkeley, University of San Francisco (USF), etc. Others are moved there to work and thus, there is a concentration of talent diversity that contributes to a global capability that can be ramped up rather quickly.

And finally, the drive and thrust of the *entrepreneurial spirit,* is an additional and fundamental element. California for example, has a history of pioneers, and this pioneering spirit serves as a strong underpinning and driving force of the entrepreneurial spirit. One key feature of this spirit, essential to Silicon Valley success, is that entrepreneurs bring a singular focus to the innovation process. Schumpeter once said, "The inventor produces ideas, the entrepreneur gets things done" (Schumpeter 1939)

An element that research shows is a key, but often absent feature in an innovation cluster environment, is a high tolerance ratio for failure. Despite all the research that has been done to date, and the introduction of new innovation building models, including in this writing, there is no "magic" formula for producing affirmative innovation outcomes. In fact, it can be argued that failure in an innovation environment, is a necessary feature that is accretive to optimal outcome development. It is recognized that while high-technology firms generally experience high failure rates, Silicon Valley continues to thrive and prosper. Again, Bahrami and Evans characterize this unique nature of failure-recapture, namely, when one firm fails it often spawns the creation of new firms either directly or indirectly. In this process of *flexible recycling,* novel re-configurations of knowledge and human capabilities facilitate success in these newly created firms, leveraging the experience gained from the failures of their predecessors.

One can point to few regions in the US, or even the world for that matter, in which this unique environmental feature exists. In many regions suffering from economic stagnation, the US industrial Midwest for example, otherwise commonly referred to as the "rust-belt", when a major firm fails, it is often followed by the demise of most other industry-related and support firms, crippling the entire region economically. For example, the driving economic motivation for the January, 2009 auto Bailout of General Motors and Chrysler, was as much about saving all the related firms in the downstream value chain, as it was about saving the auto-makers themselves. Ford, while electing not to take government funds for help, acknowledged that without the bailout, it too, would have been severely crippled due to the adverse impact failure would have on its supplier and distribution network. There are countless documented examples of those kinds of realities occurring in that geographic region. This phenomenon of regeneration, as described in Silicon Valley and which Bahrami and Evans describe as a key element for innovation generation, is not present in most other areas.

As previously indicated, examination of US cluster development patterns show that just about all of the major clustering has occurred near major urban areas, but clearly in the suburbs outside of them. Examples of major US clusters would include the Boston-Cambridge cluster, which is driven in large part by its close proximity to Harvard University, and the Massachusetts Institute of Technology (MIT). Note that the real clustering dynamic is anchored outside of Boston and not in it. A recent Boston Globe report covered a new initiative launched by the Boston mayor, in an effort to stimulate economic energy, that targets cluster development within the city of Boston itself (Boston Globe 2011). The report indicates that it has been a slow process because of the shadow impact of the Cambridge cluster, which is widely considered the most attractive location in the greater Boston area for such work.

This example illustrates the challenge that urban areas have when competing for talent, as just one element of innovation capability response development. There is very little clustering activity occurring in urban centers, and clustering enhances enterprise capability response development. Similar efforts are present in Los Angeles, and San Francisco, which, like the Boston initiative and its subordinate status to Cambridge, is overshadowed by the significant, and globally dominating presence of Silicon Valley.

Wennberg and Lindqvist, found that agglomeration by sector, otherwise known as "clustering," was responsible for strong enterprise performance (2010). They amplified existing literature, regarding the theory that clustering enhances capability response, as a result of the formation of *agglomeration economies.*

Research conducted by this author regarding comparative analysis between urban and suburban factors contributing to

Table 1. Urban vs. Suburban Innovation Quality Index (IQI) Sampling (Morse, 2013)

Innovation Quality Index (IQI)

WAI Score + QOLI Score /2 = IQI Score

Urban Location	Workforce Availability Index(WAI)			Quality of Life Index (QLI)						
	Workers W/Requisite Skills (WRS)	Education Accessibility Index (TEAI)		Home Ownership Index (HOI)	Arts, Enter & Rec. (AERI)	Primary/Secondary Education Quality Index-(K-12) (PEQI)				
	Total Tech Employ/pop	S,M, E & Tech. Univ./Schools	WRS + TEAI/2 = WAI Score	% Pop Owning Homes	# establ.	Reading at Grade Level	Math Comp	PEQI = RGLI (K-12) Var. + MCI Var./2	QLI Score	IQI score
Los Angeles	3.7	20	8.71	38	11,413	43	41	33.42	658.06	333.39
Rochester	5.0	18	10.31	40	294	29	32	-3.23	-29.47	-9.58
San Jose	12.9	19	73.32	58.5	500	53	58	76.11	18.93	46.12
Salt Lake City	7.1	15	13.81	51	264	70	58	103.53	9.90	11.85
Dallas	4.2	27	40.83	31	916	84	76	154.23	62.89	51.86
New York	3.9	20	10.21	44	4,130	68	77	129.99	243.68	126.94
San Diego	10.4	20	58.71	48	1,091	49	58	69.66	47.38	53.05
Chicago	4.5	20	14.69	44	1,746	61	68	104.64	96.84	55.76
Atlanta	6.9	20	32.60	44	488	85	94	183.97	46.77	39.68

Innovation Quality Index (IQI)

WAI Score + QOLI Score /2 = IQI Score

Suburban Location	Workforce Availability Index(WAI)			Quality of Life Index (QLI)						
	Requisite Skills (WRS)	Education Accessibility		Home Ownership Index (HOI)	Arts, Enter & Rec. (AERI)	Primary/Secondary Education Quality Index-(K-12) (PEQI)				
	Total Tech Employ/pop	S,M, E & Tech. Univ./Schools	WRS + TEAI/2 = WAI Score	% Pop Owning Homes	# establ.	Reading at Grade Level	Math Comp	PEQI = RGLI (K-12) Var. + MCI Var./2	QLI Score	IQI score
Lowell	6.4	11	-7.63	43	681	49	44	47.78	12.60	2.48
Costa Mesa	6.2	14	3.04	40	974	65	61	100.15	46.35	24.70
Santa Clara	21.6	8	93.64	70	500	68	61	104.99	34.42	64.03
Hillsboro	6.8	8	-16.81	52	150	76	73	136.64	14.51	-1.15
Minnetonka	9.2	8	1.10	76	600	51	47	55.70	27.13	14.11
Spokane Valley	3.5	16	-9.00	64	158	73	59	109.93	12.21	1.60
Santa Ana	2.8	18	-6.11	49	974	41	47	39.57	30.74	12.32
Acton	6.4	7	-23.85	76	681	94	88	189.11	76.53	26.34
Canton	6.4	9	-15.74	74	278	82	71	143.20	35.69	9.97
Hutchinson	7.3	7	-17.14	69	28	78	70	135.18	15.27	-0.94
East Syracuse	4.7	7	-36.54	46	202	60	67	101.46	2.89	-16.83
Sunnyvale	28.4	11	156.55	48	500	76	53	105.39	23.34	89.94
Fremont	21.1	10	98.01	65	487	75	67	125.66	37.97	67.99
Amityville	4.0	8	-37.71	69	821	47	50	53.93	36.42	-0.65

1. WRS Source: US Census Bureau. (2012). Percent of Civilian Employed Population 16 Years and Over in Computer, Engineering, and Science Occupations: 2010. Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_10_1YR_GCT2407.US22PR&prodType=table
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WTR 2013;2:81-95 http://dx.doi.org/10.7165/wtr2013.2.2.81

clustering, found that in assessing two key elements of strategic enterprise capability response, *Managerial Skill Set Alignment Quality,* and *Executive Team Tenure,* only marginal differences between ICTs in urban, and suburban locations was shown. However, if the challenge of access to capital by urban firms, an acknowledged phenomenon driven by perceived risk factors, is added to that dynamic, urban ICTs are unable to leverage what little capital they do control, due to the absence of agglomeration economies that result from clustering.

So, the question becomes: What will it take to build innovation producing features in US urban centers?

Research conducted by the author seeks to dispel some of the stubborn and lingering perceptions that urban centers are not conducive to innovation clustering. Using validated factors from previous research, directly linked to technology firm (ICTs) strategic location choice, an Innovation Quality Index (IQI), has been created to measure two variable categories: Workforce Availability (WAI) and Quality of Life (QLI). The ICT *Innovation Quality Index* (IQI) score is calculated as follows:

$$WAI + QLI/2 = IQI \text{ score}$$

Workforce Availability Index (WAI) can be measured by examining several factors. The research conducted focused on the availability of workers with the requisite skills necessary to sufficiently and effectively work in technology related occupations - a key illustrator of strategic innovation behavior. It also considered education. The literature provides ample evidence that geographic proximity to colleges, universities, and technical schools, providing technology-related education, is essential to technology workforce development. It also is a central ingredient in all of the technology "clusters", not just in the US, but around the globe. These institutions are now commonly referred to as S.T.E.M. – science, technology, engineering, and math education institutions.

The Workforce Availability Index (WAI) is a measure of two sub-elements: Workers with Requisite Skills (WRS), and Tech. Education Accessibility Index (TEAI), and is calculated as:

$$WRS + TEAI/2 = WAI \text{ Score}$$

Quality of Life is an important determinant in an enterprise's ability to attract the talent it needs to meet its strategic objectives-also a key feature facilitating innovation development.. There are numerous variables that can be considered in evaluating quality of life. The research conducted focused on 1) home ownership in a geographic area (an indicator of neighborhood quality), 2) the number of art, entertainment, and recreation establishments in a geographic area, representing what the literature refers to as so-called "third places" that influence quality of life and "well-being" perceptions, and 3) primary/secondary education quality (K-12) (Reading-at-grade level Index (RGLI), and Math Comprehension Index (MCI). Research shows that chief among the factors and concerns that influence occupational destination decisions (a move) is school quality, and whether or not parents can secure a good education for their children in a given area. This measure also directly influences long-term workforce availability.

A representative sampling of total IQI scores for urban areas compared to suburban areas compared to suburban areas are reflected in <Table 1>.

PORTER'S CLUSTER MODEL FRAMEWORK

Porter has provided a useful framework that includes cluster definition, and cluster types, used to advance cluster-based economic development strategies that merit description here, to serve as the basis for the expanded theoretical constructs offered in the new cluster development analysis model introduced in this paper.

Porter begins by defining clusters broadly as geographic concentrations of interrelated, competitive firms and related institutions, that are of sufficient scale to generate external economies that are not found in regions lacking such concentrations (Porter 2009). However, this writer adds to that definition below by also considering the interrelated enterprises that may not satisfy conventional scale assumptions, but do contribute either directly, or indirectly to targeted economic activity that contributes to cluster formation (see Modular Innovation Clusters (MOICs) and Micro Innovation Clusters (MICs) below).

He goes on to suggest that "the concentrations that characterize clusters typically include competitive firms, cooperating suppliers, service providers, knowledge providers, and associated institutions that do business with each other and share needs for common talent, technology, and infrastruc-

ture." He goes further stating "Interdependencies that define clusters include supply chains, core technologies, and proximity to natural resources or distribution channels," also referring to these elements as "economic ecosystems," similar to descriptions previously presented herein.

Presenting three fundamental reasons clusters exist, Professor Porter indicates that they "generate wealth in a region, give a region a competitive advantage, and provide the basis for cost-effective economic development strategies." He defines types of clusters in six unique categories:

- Emerging (low scale, high growth)
- Competitive (high scale, growing)
- Mature (high scale, stable or declining)
- Stabilizing (diversifying)
- Strategic (based on the plans and/or needs of public sector actors rather than on current business performance)
- Potential (pinned on hopes and dreams)

Porter suggests that clusters "tend to be more successful when some type of collective organization-such as a network-is present."

So, the question arises – "what method might be used to build the innovation echo - system, given all of the information that has been gathered in the literature by scholars like Porter and others? Thus the analysis and building model featured in this writing is highlighted as a portal to capture these essential elements.

STRATEGIC INNOVATION NETWORK (SIN)

Given all that we know, this author has categorized the key building blocks within a new context that gives added dimension to existing features present in current innovation clusters.

Most scholars agree that governments do not build clusters. There is no single example of a government-built cluster in the US, if not the world. However, there is plenty of evidence that institutions, both public and private, without question serve as the pillars upon which innovation clusters can be effectively constructed. The Strategic Innovation Network (SIN) serves the purpose of creating both a contextual and functional architecture that enables individual and unique innovation silos to become fully integrated and connected to the local and regional economy. The benefits accrue to the enterprises forming these innovation silos, and to the geographies in which they function as well.

Clusters have historically had close proximity to a natural resource, physical features that have industry generating potential, or human capital concentration, i.e. specialized research scientists, etc.. However, external reach has been expanded and amplified due to digital capability intensity, and global economic dynamics, thus creating opportunities beyond merely the local and regional economies in which they are located.

In order to determine viable paths to urban innovation cluster development, and the robust debate about how to create them, there is a need for effective methodologies to assess area innovation development potential.

This author suggests that Innovation Development Potential (IDP) is based on three fundamental pillars: 1) Technological Capability and Capacity (TCC); 2) Intellectual Propulsion Capacity (IPC); and 3) Structural Creative Inspiration (SCI). These three pillars form the architecture for creation of a Strategic Innovation Network (SIN), upon which clustering can be systematically built. The purpose of the SIN is to optimally organize and connect all available resources that include physical, financial, and human, such that innovation clustering is inspired, encouraged, nurtured, and ultimately constructed as fully functioning socio-economic organisms that provide both local and regional benefits. This rationale is consistent with Porter's model previously described. However, it also encapsulates additional factors that other research suggests is also instrumental in cluster formation and geographic economic development.

An environmental scan of most densely populated urban areas will reveal that independent innovation silos exist, even if not known or identified as such, based directly, or indirectly on the unique socio-economic features of the area. However, these silos, characterized as such because of their cylindrical, vertical integration tendencies, are often functioning independently, without integration and connection to the macro-economic currents at-hand, either locally, regionally, or even globally. A significant goal of the SIN is to create a framework by which these unique, and sometimes disparate innovation silos, are connected and integrated into the local and regional value chain. This assimilation is a fundamental building activity of innovation cluster formation. Huang and Horowitt, similarly describe this phenomenon as forming an *innovation echo system* or *rainforest* (Huang

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Starategic Innovation Network (SIN) Elements and Enterprises

Area Coverage	Technological Capability and Capacity (TCC)	Intellectual Propulsion Capacity (IPC)	Structural Creative Inspiration (SCI)
Local and Regional	1) Number of existing industry innovation silos	1) Number of STEM institutions (including scientific think tanks) (Metropolitan Statistical Area specified)	1) Number of SCI enterprises - museums, concert halls, professional sports teams/venues
Local and Regional	2) Number of existing enterprises participating in innovation silos	2) Percent of PhDs or doctorate equivalent per capita	2) Number of three-star and above restaurants and hotels
Local and Regional	3) Strategic innovation silo enterprise diversity intensity	3) Number of annual management, economic, and scientific conferences	3) Number of special annual events and exhibitions
Local and Regional	4) Workforce Quality – Percent of area population with two or more years of post-secondary education	4) Number of enterprise – STEM Institution Strategic Alliances/Partnerships	4) Number of houses of worship and other spiritual development venues
Local and Regional	5) Commercial real estate square footage availability – divided between percent office space, and percent industrial use	5) Number of professional clubs, and associations with area chapters	5) Number of recreational facilities divided by health and fitness clubs, public parks, bike paths, and public and private golf venues
Local and Regional	6) Amount of invested capital from venture capital and other innovation-oriented financial sources	6) Primary/Secondary Education Quality (K-12) (PEQI)	

Fig. 1. Strategic Innovation Network (SIN) Elements and Enterprises

and Horowitt 2012). However, this model is unique.

Innovation silo integration has occurred more effectively and efficiently in existing suburban clusters, Silicon Valley perhaps being the most vivid example. However, very little attention has been given to this concept in the limited efforts to date to create urban innovation clusters.

Each of the three pillars have specific contribution impact to the creation of innovation clustering, and are defined by factor metrics that enable systematic analysis designed to enhance private sector planning, and local and regional public policy development.

Technological Capability and Capacity (TCC), is comprised of six factor elements that include: 1) Number of existing industry innovation silos in local and regional economy; 2) Number of existing enterprises participating in silos – local, regionally; 3) Strategic innovation silo enterprise diversity intensity; 4) Workforce Quality – Percent of area population with two or more years of post-secondary education; and 5) Commercial real estate square footage availability – divided between percent office space, and percent industrial use – local, regionally; and 6) Amount of invested capital from venture capital and other innovation-oriented financial sources – local, regionally.

The principal purpose of analysing TCC is to assess what innovation silos already exist that can be enhanced through various strategic application streams. It is also used to determine what local and regional features exist that enable an area to attract new and/or complimentary enterprises, that enhance silo connection and integration, thus enabling cluster formation.

Intellectual Propulsion Capacity (IPC), is comprised of six factor elements that include: 1) Number of STEM institutions within the local area (including scientific think tanks) and region (Metropolitan Statistical Area specified (MSA); 2) Percent of PhD.s or doctorate equivalent per capita – local, regionally; 3) Number of annual management, economic, and scientific conferences held - locally, regionally 4) Number of enterprise – STEM Institution Strategic Alliances/Partnerships – local, regionally, 5) Number of professional clubs, and associations with area chapters – local, regionally; i.e. Chambers of Commerce, trade associations, professional associations, scientific inventors and innovation clubs, social media clubs, etc.; and 6) Primary/Secondary Education Quality (K-12) (PEQI) – local, regionally.

The principal purpose of analysing IPC is to assess what resources and activities provide the kind of intellectual propulsion that enhances innovation silo development, connection and integration, and future development, thus enabling cluster formation.

Structural Creative Inspiration (SCI), is comprised of five factor elements that include: 1) Number of SCI enterprises - museums;, concert halls, professional sports teams/venues – local, regionally; 2) Number of three-star and above restaurants and hotels - local, regionally; 3) Number of special annual events and exhibitions (Detroit Auto Show; Academy Awards – Los Angeles)– local, regionally; 4) Number of houses of worship and other spiritual development venues - local, regionally; and 5) Number of recreational facilities divided by health and fitness clubs, public parks, bike paths, and public and private golf venues.

The principal purpose of analysing SCI, is to assess important structural quality of life (QOL) indicators, that research shows play an important role in the development of creativity and talent attraction that feeds innovation development.

In this important element, it is instructive to note, as previously referenced, that much attention has been given to Dr. Richard Florida's creative class economy model (Florida 2002 ; 2011), which argues that attracting so-called "hip", creative class individuals, i.e. artists, musicians, programmers, and an emphasis on attracting creatively talented Gays and Lesbians, can collectively lift the economic prospects of urban areas. Notwithstanding the creative potential that theory might provide, this model suggests that development of structural portals that inspire creativity further enhance the capture of a larger pool of elements that might have positive innovation yields. It argues that the structural creative inspirational elements and enterprises present in a given location can be leveraged to attract high-value talent, across a wide range of occupations, to participate in individual innovation silos, and strengthen the local and regional Strategic Innovation Network (SIN). SCI assessment enables an area to identify all SCI existing components, their level of strategic integration, and identify other existing enterprises and venues that can be attracted to an area and integrated into the SIN. And very importantly, it enables assessment of civic will - whether or not it exists to build SCI components.

A vivid example of the role civic will plays in helping to construct the SCI components of a SIN, is a recent process advanced by the US National Basketball Association (NBA), in which the owners of the Sacramento Kings franchise wanted to sell it. Two groups bid on the team. One was a group from Seattle, that included Microsoft co-founder Paul Allen, and

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another group put together by former NBA star and now current Sacramento Mayor, Kevin Johnson (Sacramento Bee, May 2013).

When the process began, it looked very much like the Seattle group had the upper-hand to win the bid. However, with an unrelenting press on civic will in Sacramento, and the cultivation of commitment by both public and private resources to build a new basketball arena, the City of Sacramento won the bid to have the team stay there. Mayor Johnson stated both during the process and after the decision that a driving force behind the efforts of he and his team was a recognition of the innovation development potential, linked to life quality, the presence of the Kings represents.

In addition to the debate over what elements are key to cluster formation, there has also been a debate about what is and what is not an innovation cluster. However, when analysed and viewed through the prism of the Strategic Innovation Network (SIN), the context of that debate is subject to a different perspective.

For example, there is disagreement over whether or not science technology parks should qualify as clusters. Many scientific observers say no, because the density of enterprise presence, and the scale of agglomeration economies does not resemble what is typically viewed as a normal clustering outcome. However, if the SIN perspective is applied, like individual innovation silos, clusters can be viewed as emerging in different shapes and sizes. The SIN Model seeks to categorize these different cluster models, with the strategy that when integrated into the larger network, their individual and unique strategic impact does have the potential to be scalable. And they qualify as clusters because each must be considered within the contextual density in which it functions, which takes advantage of scalable benefits within that framework. Thus, four models of clustering are framed:

1) Regional Innovation Clusters (RICs) – these are clusters that include similar industry enterprises that have flagpole nodes that stretch to the outer boundaries of a given region, and have discernible strategic and economic impact on the region's macro-economic profile. RICs play an important role in the development of the Strategic Innovation Network (SIN).
2) Local Innovation Clusters (LICs) – these are clusters with rather dense strategic enterprise participation and nodes are scattered throughout a local geographic area. Local innovation clusters have discernible strategic and economic impact on the local economy, and as such, also serve as contributory veins to the regional macro-economic profile. LICs serve as cluster nodes of the larger regional cluster development initiative, and also play an important role in the development of the Strategic Innovation Network (SIN).
3) Modular Innovation Clusters (MOICs) – these are the technology parks often found on the outer borders of a given local geography or with regional orientation. They are clusters because within their environment, they have the potential to create agglomeration economies, just on a smaller scale, and knowledge sharing that can be beneficial to all participating enterprises. MOICs serve as cluster nodes of the larger regional cluster development initiative, and also play an important role in the development of the Strategic Innovation Network (SIN).
4) Micro Innovation Clusters (MICs) - these are entrepreneurial start-up innovation incubators, of which there may be multiple locations within a larger local innovation cluster, and have an important contributory role in the rhythm and flow of the Strategic Innovation Network (SIN). Like the other sub-regional clusters MICs serve as cluster nodes of the larger regional cluster development initiative, and also play an important role in the development of the Strategic Innovation Network (SIN).

KEY STRATEGIC INNOVATION NETWORK (SIN) ACTIVITIES

Innovation clusters don't simply emerge like unintended weeds in a field. Rather, they need a type of bridge-builder. Innovation environments require what Huang and Horowitt refer to as Keystones (Huang and Horowitt 2013), or what this writer calls Innovation Activators. These Keystones or Strategic Innovation Activators are key players in the environment who spend a good deal of time, whether for virtuous reasons or for material gain, connecting people and institutions together so that the rhythm of an effective innovation echo-system can fully materialize.

PRIVATE ENTERPRISE STRATEGIC MENTORING

History and experience has provided strong evidence that to facilitate the development of paradigm changing economic models, strong private and public advocacy leadership is essential andrequired. And that leadership responsibility falls on private enterprise leaders, local and regional innovation facilitators, and public policy developers alike.

Private enterprise leaders can play a vitally important role, by engaging in the formation of Strategic Innovation Networks (SINs), and not just because it might appear to be a good thing to do, or even to demonstrate good corporate citizenship. Rather, it can be done because it is in an enterprise's "self-interest" to help build a framework from which it can benefit economically, and in terms of attracting and developing talent pools that sustain its strategic future.

To that end, *Strategic Mentoring* models (Morse 2001), should be activated in the enterprise environment. Strategic Mentoring is a form of enterprise mentoring of small business enterprises, by providing leadership coaching, innovation development advice, and operational counsel where appropriate. In some cases, Strategic Mentoring may take the form of contractor to sub-contractor relationships, or strategic alliances/partnerships, in which a small innovation enterprise provides a product, component, or service of value to the larger enterprise. If one larger innovation enterprise chooses one small innovation enterprise to mentor, this process, over time, will help strengthen the viability prospects of the innovation enterprise being mentored, and overall yield potential of the Strategic Innovation Network (SIN) itself.

STEM INSTITUTION STRATEGIC MENTORING

STEM institutions (including think tanks), like private innovation enterprises, can garner significant benefit from engaging in Strategic Mentoring. By mentoring innovation enterprises located in the early stage development of the Regional Innovation Clusters (RICs), Local Innovation Clusters (LICs), or Modular Innovation Clusters (MOICs), STEM institutions can provide scientific expertise that helps advance innovation enterprise development projects.

Mentoring the Micro Innovation Clusters (MICs) can be commercially opportunistic for STEM institutions as well. Some prominent US universities, have in fact, established these kind of relationships, in which innovation projects are mentored by the institution, and it participates in the technology commercialization transfer process that has the potential to yield substantial revenue. The Stevens Center For Innovation at the University of Southern California is an example.

PUBLIC POLICY LEADERSHIP

Public policy leaders play a key role in helping to facilitate the evolution and development of innovation clusters at all levels. It is in this area where the recruitment and leveraging of civic will can make either huge differences, or serve as impediments to the development of innovation clusters, particularly in urban areas.

Public policy leaders can lead by creating policies on the local and regional level, that encourage and promote innovation cluster development. Policies do not necessarily have to be resource allocations from government. Instead, and perhaps most helpful, is the creation of policies that lead to private sector innovation development through tax incentives and regulatory accommodation where appropriate.

INNOVATION CAPITAL FORMATION

Financial resources, as previously indicated, serve as a key component of the engine that drives innovation. The Strategic Innovation Network (SIN) must recruit venture capitalists, and other innovation financial sources to participate. The presence of the private enterprise and STEM Strategic Mentoring models provide some assurance to venture capitalists, that innovation entrepreneurs are not standing alone. That they have help. This mitigates risk reality and perception, and encourages capital formation. Additionally, the strategic management expertise of the venture capital principals themselves lends to the strengthening of the Strategic Mentoring models. Bill Campbell, widely considered a "Silicon Valley Elder Statesman" gives his views of how he coaches start-up entrepreneurs: "Since I've been around a little bit, I give a little advice here and there," Mr. Campbell continued. "How fast should they grow, how fast should they hire, how should they raise money, how should they use the money, when should you bring in financial people. It's just basic stuff." (New York Times, November 15, 2010).

Famed Silicon Valley venture capitalist John Doerr,

WTR 2013;2:81-95 http://dx.doi.org/10.7165/wtr2013.2.2.81

Managing Director, Kleiner Perkins, has mentored hundreds of entrepreneurs leading start-ups, and like Campbell, is considered one of the wise men of the Valley. Despite a known culture in which venture capitalists are often seen like vultures, eager and willing to eat up companies and sell them for their own self-interested gain, some of the more seasoned executives in this area also realize that is in indeed in their self-interest to cultivate young entrepreneurs running companies that have huge upside potential that can be enhanced by some level of the kind of strategic care and feeding they are uniquely qualified to deliver.

SIN MEASURABLE OUTCOMES

Innovation metrics can be developed that enable urban areas to track innovation cluster development progress, and the impact the Strategic Innovation Network has on local, and regional economies. Metrics to be discussed in a future article include: Regional Macro-Economic Impact Rating (RMEIR), Local Macro-Economic Impact Rating (LMEIR), and Strategic Impact Multiples. Each of these measurement tools enables private enterprise and public sector leaders to track the progress of developmental efforts employed in the construction of the Strategic Innovation Network (SIN), and thus urban innovation clusters.

The combination of these analysis elements, used as the basis to create the Strategic Innovation Network (SIN), enables urban business leaders, and public policy makers to create strategies that can more effectively leverage the assets that exist in just about all urban areas across the country. What this system does is, rather than an area to create a magic formula to duplicate the Silicon Valley model, it can more effectively leverage the unique features that exist within its own innovation topography to create targeted clusters that have job creation potential. Of course, there is no single solution to urban economic development, however, this model offers an opportunity for closer examination of existing dynamics that perhaps have not been fully leveraged or strategically positioned.

CONCLUSION

As indicated at the beginning, the debate over how to duplicate the innovation of Silicon Valley has been, and continues to be robust. What has been most elusive, is how to create environments that foster innovation in US urban centers, that so vitally need economic uplift amidst severe chronic unemployment, and the socio-economic ills that are its offspring. The failure of private sector and public policy leaders to advance efforts to create such economic engines has been driven in part, by both real and perceived obstacles that stand in the way of the initiation of serious efforts. This paper attempts to provide background on the development of innovation clusters both in the US and generally, and to introduce a new framework that has the potential to enhance urban innovation cluster development.

By viewing the creation and development of innovation clusters through the prism of a Strategic Innovation Network (SIN), elements that were previously perceived as weak threads in the process, or even developmental impediments, can be considered in a stronger context. The connection and integration of independent, and sometimes disparate innovation silos, that do exist in urban economies-some detected, some not, provides the potential for construction of a new landscape that enhances the viability and sustainability of such phenomenon. The role of Strategic Mentoring, by both private enterprise and public policy leaders, can enhance application of this innovation, designed to foster new economic development models.

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