CONNECT UNIVERSUM 2018

МАТЕРИАЛЫ
IV Международной трансдисциплинарной научно-практической WEB-конференции «CONNECT-UNIVERSUM-2018»

ЦИФРОВОЙ БРЕНД-МЕНЕДЖМЕНТ ТЕРРИТОРИЙ: ГЛОБАЛЬНЫЙ И ЛОКАЛЬНЫЙ АСПЕКТЫ

29–30 ноября 2018 года

Национальный исследовательский
Томский государственный университет
Кафедра социальных коммуникаций

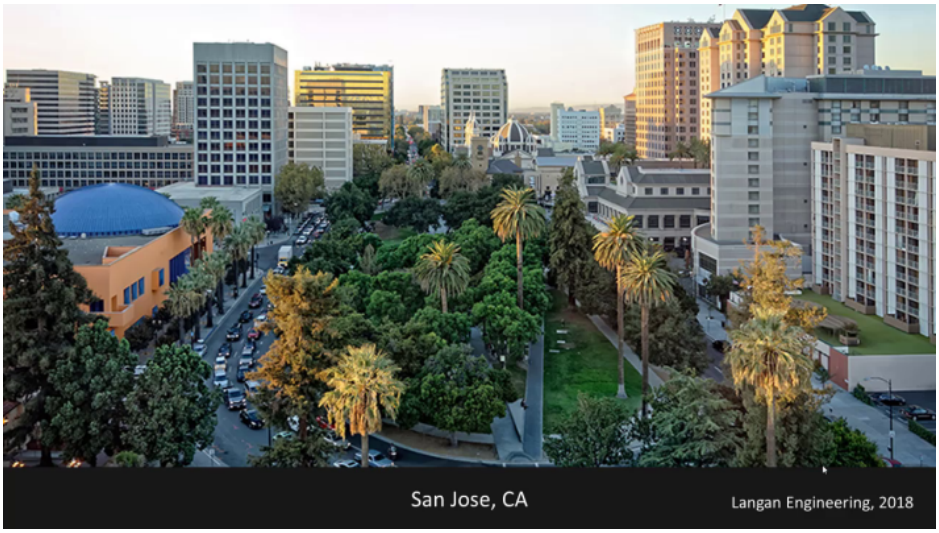
DOI: 10.17223/9785946218597/43

PLACES AS A NEXUS FOR TECHNOLOGICAL EMERGENCE

Scott W. Cunningham, PhD, Delft University of Technology (Delft, Netherlands)

Hello, this is Scott Cunningham from Delft University of Technology recording this today from Holland. I am going to speak to you about places as a nexus for technological emergence.

Why places? First, inventors prefer to live in cities, and, second, inventive companies prefer to locate in cities. Thirdly, cities are home to significant facilities like universities, laboratories, and start-up incubators.



So, this is a picture of my old home in San Jose, California. You may know San Jose as Silicon Valley. So, San Jose is at the Southern part of the broad innovative region very famous for Internet companies, and for semiconductor manufacturing. And what we think was so special about San Jose: Is it going to be able to keep that magic moving forward, or other places are going to overtake it?

So, when we ask questions like that, we are interested in the geography of technology. Geography is the study of a place; we have to be aware that many technologies have their own places. When we think about things like rifles, light bulbs, or cameras, automobiles or semiconductors, they all were first associated with a single place. And, as I said, places are well structured by organizations, facilities, and institutions. So, when we understand the geography of technology, and we prepare to make changes to organizations, facilities, and institutions, we can attract new innovation, and we can customize all locations according to our needs. That's the first claim of all I made: places are often the nexus for technological emergence.

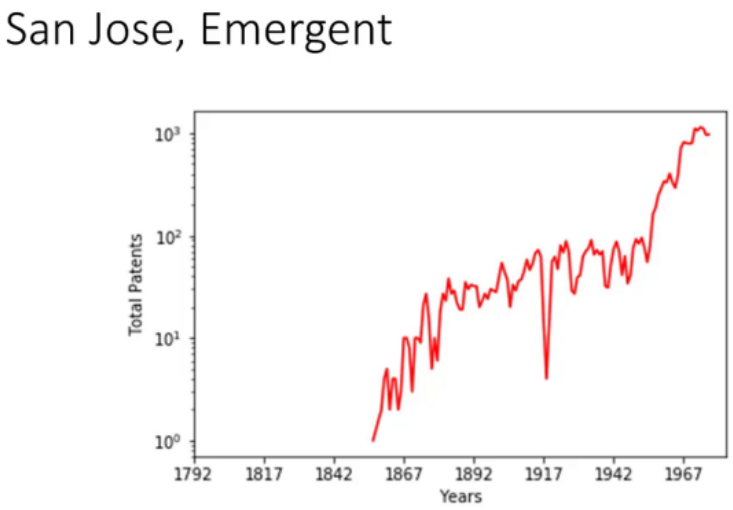
There could be exceptions. And this is a debatable exception, but the exception would be on things known as general purpose technologies. Some technologies are so powerful that they override the whole economy and they restart the new. They are just ways of creative innovation that destroy the system and then they have to rebuild it again from scratch. Some people claim that nanomaterials may be diffused throughout the economy, and maybe there won't be any particular place where nanotechnology is capitalized or emerge. I have other people though who really think that's not true – nanotechnology is like the most other technologies, they are really going to be located in a particular place. Another point is that supplier-led industries like materials lack strong agglomeration; you need them make strong economy work and, again, they are going to be diffused throughout all of the country and throughout the world.

Another idea is about the nexus: why is it that cities are so innovative? It is indisputable that they are. A group of researchers have been looking at key metrics about cities and they have been

tracking them as they scale when you change attribute to the cities, things like how this attribute changes when you add more people. As cities grow bigger, you get more crime, but you also get more wealth, income, and patents, and even more. What's important is that this grows more rapidly than population. Something magical happens as you put people together, they become a social reactor; the exchange of ideas, the access to new information enable cities to highlight growth, to enhance and increase growth.

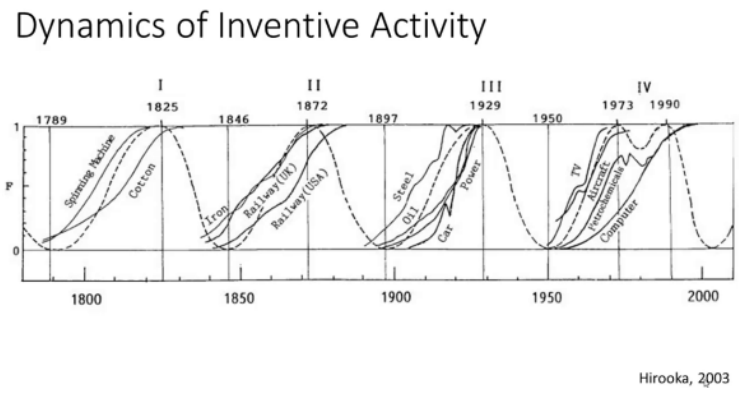
Now, one key idea very important to understanding cities in growth, I think, is the concept of density dependent growth. You can find this in ecology, or in biology, but let me tell you the idea of it in short related the idea of invention. Inventions are inversely related to density of inventors. So a low population of inventors means it is going to be unstable production of key indicators and inventions like patents. But higher population of inventors – this is going to be a stable production of patents. This creates the opportunity for sudden emergent growth. You can see this kind of swarming behavior in the natural world, where schools of fish group together, flocks of birds group together, or herds of animals group together enabling more animals to reproduce and to fill in niches in the natural world. The same thing happens with inventors – when they come to a particular place, it takes enough of them to make an effect, and then you lock in growth. And that's how you get a sudden emergence.

So, here is what San Jose looks like as an emergent phenomenon. You could see the way back to 1840, that's the California Gold Rush when there was a sudden burst to the interest, a sudden burst to patents in San Jose, and then it rapidly leveled off. That was an emergent phenomenon, the niche was filled and it remained stable for many years until about 1955 or so, when there was another burst, and the amount of patents that came out of San Jose more than doubled. And it became one of the United States leading innovative regions.



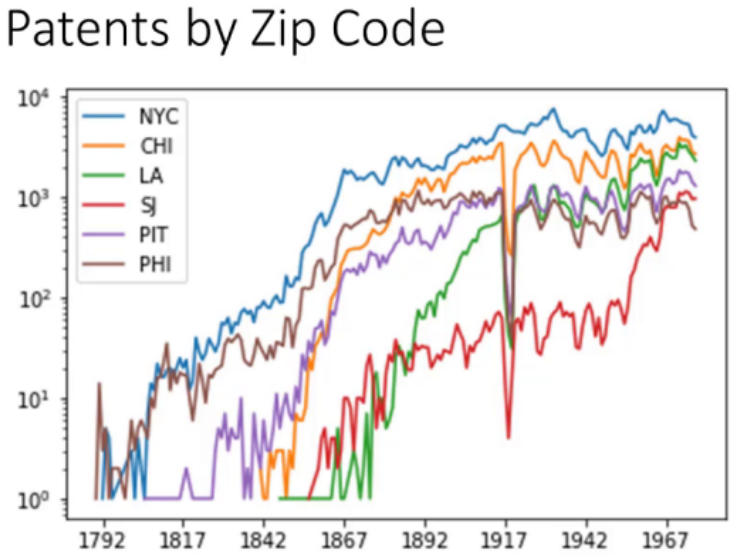
The key point here is that emergence is caused by density dependence keeping inventors in a single place and also by social reactors, the exchange of complex information over a short expansive space.

Another idea, that I think is really important, is understanding the dynamics of inventive activity. I've talked about creative waves of destruction. These are known as Kondratiev waves or long waves of inventive activity, and there have been at least 5 waves of activity in the modern economy. You could see the first wave starting in 1789 or so with a spinning machine and the Motor Cotton, and then it down-turned innovation. And then a new niche opened, innovative opportunities happened around: iron, and rail. Then there was the era of steel and oil, and cars, or aircrafts, petrochemicals, and computers. There are windows of time when more innovation happens, then those innovations are exploited – we shut out innovation for a while until a new wave happens, and we are ready to start again. So, this staggers the ability to innovate.



Here is my first quiz for you – long-term inventive areas. Which zip codes have been the most inventive in the US? This is over the long-term of the US history from 1790-1975. And the measure here is about where the companies are located. I'd also like to study some other areas than the United States, for instance, close to me is Eindhoven in Netherlands, where there is a great number of patents, but this has been a really good long-term history about US patents, so that's at least where I'll start for the questions tonight. So, the question is: which places in the United States have been the most inventive? New York. For the longest term, New York has been a really inventive place, then Chicago, Los Angeles, Pittsburgh, and then Philadelphia and Pennsylvania. So the places that we think about as being inventive today, have really not held this position for very long.

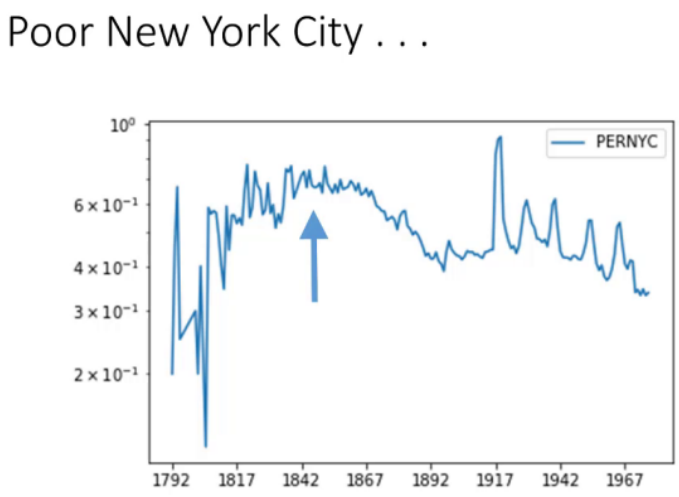
Look at these patents by Zip Code.



Pittsburgh and Philadelphia, in particular, were some of the first innovative areas, they reached a peak and then leveled out, and then there were successive waves of burst of activity. And, in particular, take a look at the New York City burst. This ends in 1907, and so the idea that Silicon Valley has always been an innovative place is most certainly not true. It's only a relatively recent phenomenon. And also, take a look at the curve about Los Angeles. For the longest, Los Angeles was a more innovative place than Silicon Valley was. I know that's a location of film industry, but it used to be a much more innovative place regardless of film than even San Jose, I find that really quite remarkable.

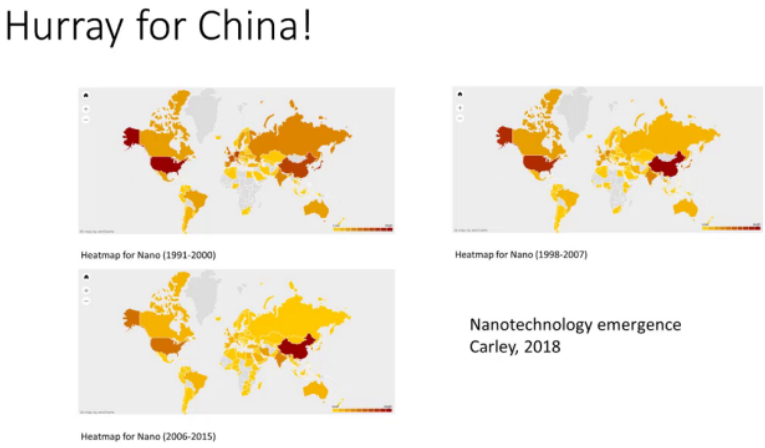
So city overtakes city, overtakes city. Persistence is not something that we can typically associate with these regions. It's not usual for a region to remain innovative over longer than 50 years. So, strongly innovative regions rarely persist over time.

And let's take a look, for instance, at New York City, what happened.



If you look at the absolute or relative growth of patents you can see that New York City was at the peak for a pretty short time between around 1842-1867. That is roughly around the time of the sign machine. Then ever since the rest of the nation overtook it, and New York may be, in absolute terms, did not decline, but relatively to other innovative regions it declined.

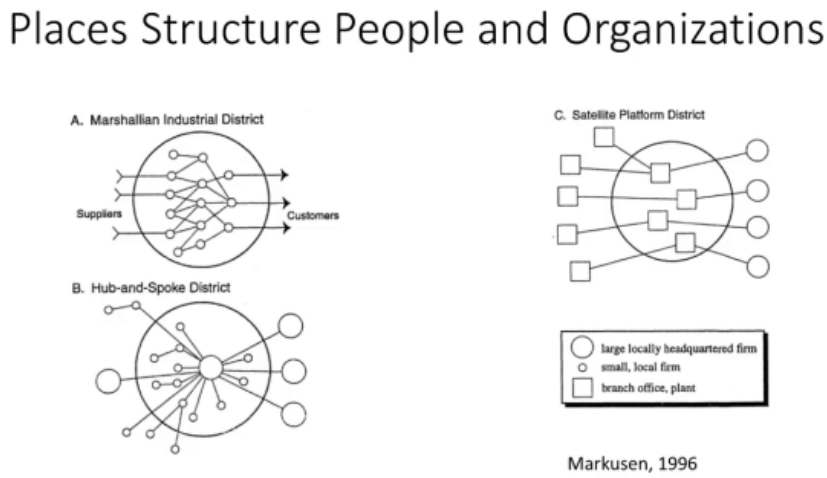
In that regard we can also talk about China. So what's happening in technologies like nanotechnology. China in a relatively short period of time has emerged in the world stage as a locus of growth for nanotechnology. These particular graphs are from my colleague, Steven Carley. In summary, places get a relatively short time in the spotlight.



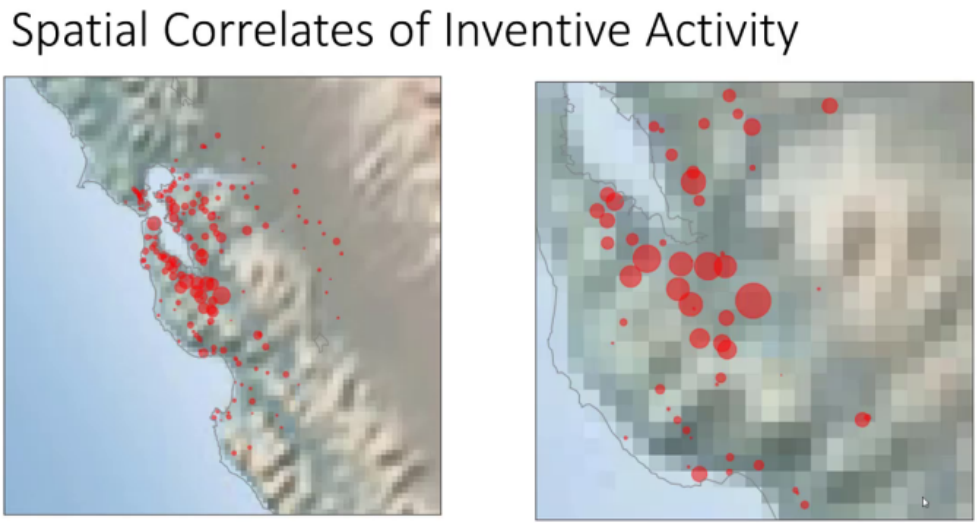
Another quiz: in which cities do US inventors actually live starting since for about 2010? I've got a hint though: this is a tricky question: Tokyo, Yokohama, Okayama, Shibata, and then San Jose, California. Funny enough, our inventors are often outside their own home. Many US inventors are actually Japanese. And if you'd go a little bit further down from San Jose, you would see Austin, Texas. Austin, Texas, until very recently, had not been known as an innovative region, but there is something special about that city now that makes inventors want to live there. And that leads to good prospects, I think, for the branding and the livability of this city.

So, how do places structure people and organizations? Ann Markusen in a classic paper about 20 years ago talked about different kinds of innovative districts. The classic one was named after Alfred Marshall, who talks about dense networks of suppliers and customers. His model was pin manufacturers in the city of London during the Victorian era, where workers and businesses could specialize, and there were small exchanges of information across markets easily cleared. But you could also have hub-and-spoke districts, where big companies employ small ones, or satellite platform districts, where international companies come in and they satellite both with knowledge, information, and money, and they parachute out products. Another one, that is not shown on this

graph, could be government centered districts, where targeted spending on universities, or national capitals, or local capitals, jumpstart the economy.



So, let's take a look at spatial correlates of inventive activity. This is a map of where all the inventions are happening in the barrier of California, I've told you about San Jose, that's down there.



The barrier is a sort of fingers taking out into Pacific ocean, and San Jose is down there at the bottom of the finger, but it reaches all the way out to San Francisco even across into the East bay. So, there are many places where invention is happening. If we could see that on the map, as you see here, we could think better about attracting innovation, about understanding its correlates.

So, with maps like these, you should ask: do you have enough inventors? Are they in the right place at the right time? Do they have the right knowledge? And maybe even can your urban region make it?

Attracting inventors is a tough challenge. There are many places where they could go. There are also only limited windows of time where you can brand a city with a specific technology that are in the air, and that are ready to restructure the economy now.

Let me just acknowledge a few of my sources, the Harvard Dataverse sources. Dataverse source is a great opened source website for patent and other kinds of information. There is the HistPat database, and also I really enjoyed working with the Patent Inventor database, the PatInv database.

I accomplish of using Python scripting. And this presents some challenges and opportunities for further work. The first question is: what do we intend to measure? These elements of geography and emergence present an opportunity for measuring emergent technologies using science and technology indicators. And how do we measure? These elements of geography and emergence present a challenge for measuring emergent technologies using these indicators.

So, I've got 4 conclusions to wrap up today: one is that places are often the nexus for technological emergence; two – emergence is caused by density dependence, and social reactors; three – places get a relatively short time in the spotlight; and four – as an innovation researcher, as a place brander, we've got some great new opportunities for measurement using Harvard Database and incredible tools from languages like Python. Thank you!