Film directors as hubs: how do the social networks of film crews interact with the spatial networks of physical locations?

A Thesis Presented to the Faculty of Architecture and Planning
COLUMBIA UNIVERSITY

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science in Urban Planning

By

Eui Na Kim

Malo A. Hutson (advisor)
Peter J. Marcotullio (reader)

May 2018

Table of Contents

Film directors as hubs: how do the social networks of film crews interact with the spatial networks of physical locations?

Eui Na Kim
Malo Andre Hutson (Advisor)

Abstract

Working relationships in Hollywood's film industry are some of the most tightly organized, and yet understudied, relationships in contemporary society. In this paper we study the linkages across the film industry by focusing on Hollywood directors as hubs in a network, with particular focus on the inhomogeneous networks that establish connectivity and dominance in a few particular cities (L.A., N.Y.). To date, no one has used a technique that directly connects individuals across space and empirically follows the social networks of film industry crews across major economic hubs. Overall, our analysis uses a dataset from the website imdb (including 177 movie titles, 25 film roles, and 11 directors) to study this social group and its network structures. In the end, our research makes clear that spatial proximity is crucial to cultivating creativity and innovation in the film industry, which further strengthens social and spatial networks. These findings prompt us to provide specific recommendations for the planning of urban spaces to further foster growth in this industry.

Key words: proximity, film director, film role, film crews, social networks, spatial networks, global cities, localities, industry cluster, spatial nodes, social nodes, spatial hubs, social hubs, scale-free networks, economic development

Introduction

Technology is breaking through in the blink of an eye. People are addicted and accustomed to the use of the Internet: in their homes, there is the Internet of things (IoT); in transportation, self-driving cars and new map algorithms; online, there is Amazon-go, online schools, and face communication technologies like facetime. In particular, new technologies have changed the world of film-making. Drones have allowed documentary filmmakers to capture dangerous, unapproachable environments in nature, and digital technology has replaced the materiality of film. But technology like the internet has also changed the way film crews work. Nowadays, less intimate work such as coloring and special effects can be sent out to animators and programmers in distant corners of the world. It has thus been argued that technology has removed localization from the film-making process. In other words, the film industry is now less dependent on location than it has ever been. Even without traveling, any director can now work with specialists, no matter where they are in the world.

However, the products of film making are not like other material goods (such as tea, computers, or robots); they are supposed to convey intuitions, impressions, moods, passions, or beliefs to the film viewers / audience. In other words, films have an intimate purpose of evoking emotion in their audience. To reach this purpose, film crews must gather in specific locations in order to communicate and collaborate

effectively with actors and crews. For example, crews have to be at the filming location to know how to adjust the lighting, edit frames in film, and develop a tactile sense with the actors. For example, the editor must be right there, beside the director, in constant communication to fine-tune the story they want to deliver. For example, Spielberg explained that given there are 24 frames in one second, it is very important to work closely with his crew to edit the film. Every single frame is important, and trying to describe each one to a distant director over the phone is simply too time-consuming. Spielberg himself said that *Jaws* is a horror film and one frame can make the difference between a real shark versus a plastic one. Unlike fast-paced online communication technology, then, the nature of film making requires film directors to have film crews on set, at physical locations to communicate the subtle messages that can complete his purpose of delivering emotions to the audience.

This nature of the film-making process requires being present at a physical location, creating spatial and social nodes at the same time. For instance, the physical locations of Los Angeles and New York City are heavyweights in the film industry. They can be considered the hubs of the film world. But it is not only the locations that are hubs. Rather, like Elizabeth Currid-Halkett's work that examines the social structure of celebrity, I will be examining film directors as hubs as well. When film crews continue to work together over time, they build strong social networks with the director being the central hub. Extending out from such a hub, nodes are individuals in the film crews,

such as editors or cinematographers, and the links between the hub and nodes are the interaction / relationship among these crew members and the director.

In this paper, I look at famous directors who are their own social hubs. A hub is a component of a network with a high-degree node. In this paper, I examine the hubs created by directors and by Hollywood itself as a region. For example, Steven Spielberg is a hub, for he works numerous times with musician John Williams and editor Michael Kahn as nodes, many more in comparison than with other nodes (crew roles) in the film network. This research paper asks, how do these social hubs interact with urban space in the film industry? Does working together on location strengthen social networks? If so, how? What does that then tell us about how social networks and spatial networks interact? My argument is about two simultaneous processes: on the one hand, any film-making location brings strength to social network systems. In other words, it doesn't matter where the movie was shot; what matters is that the film crews worked on site together. But on the other hand, there is a strong correlation between film crews that tend to work together and their residence. Specifically, the crew members with the highest technical and creative skills tend to live in close proximity to the directors. All 11 directors live either in southern California or New York. And while the film crews are not so totally localized to these two places, there is still a strong majority that live in either one or the other. This suggests that physical location *does* matter, prompting us to think through social networks and entire industries through an

urban planning perspective. If location matters, how do we plan cities to allow for

industries, such as film and entertainment, to thrive?

The research procedure started with collecting dataset from IMDb.com (Internet

Movie Database). The dataset includes 11 directors who live in Los Angeles or New

York and approximately 25 other film crew roles. To answer the research question, I use

Manuel Castells' theory of inhomogeneous /uneven power-law distribution networks. In

addition, I examine AnnaLee Saxenian's theory of proximity and regional advantage to

understand how we should think about physical space in relation to industry culture.

Ultimately, we will investigate the spatial process and patterns of the film industry,

which can help us identify the people and locations to target during urban planning. I

will offer some final recommendations for how urban planners can better structure their

cities to accommodate the social network needs of the film industry.

Theories and concepts

Manuel Castells' social science book The Rise of the Network Society (1996)

describes the importance of networks analysis. In Castells' theory, a network is a system

of nodes in which power is unevenly distributed. He explains these inhomogeneous

network systems by using geographical examples, writing that "megacities cannot be

seen only in terms of their size, but as a function of their gravitational power toward

major regions of the world" (403). In other words, rich nodes (like megacities) are

getting richer, and the poor are getting poorer; power is unevenly distributed. This theory of networks means that Castells disagrees with previous hypotheses that "assume[d] that networks have a fixed number of nodes" and that "the probability that two vertices are connected is random and uniform" (231). In contrast, Castells believes that networks are "inhomogeneous," where "a majority of the nodes have one or two links but a few nodes have a large number of links" (227). Castells writes that "It is this distinctive feature of being globally connected and locally disconnected, physically and socially, that makes megacities a new urban form" (404).

Manuel Castells explains his theory on localizing networks. According to Castells, "Some places are exchangers, communication hubs playing a role of coordination for the smooth interaction of all the elements integrated into the network" (413). These are the places like New York City, Chicago, Los Angeles, and San Francisco, which are literal hubs for flights, highways, and airports. They are the exchangers facilitating the "smooth interaction" of travelers from other cities. However, "Other places are the nodes of the network, that is the location of strategically important functions that build a series of *locality-based activities and organizations around a key function in the network*. Location in the node links up the locality with the whole network. Both nodes and hubs are hierarchically organized according to their relative weight in the network" (413, emphasis mine). In other words, if one is not a hub, one is a node, and the hierarchy privileges the former. But proximity matters: if a

node has "strategically important function," then its locality "links up the locality with the whole network." That is to say, it is the node's significance to the hub that makes it a part of the network at all. Castells goes on to say, "The functions to be fulfilled by each network define the characteristics of places that become their privileged nodes. In some cases, the most unlikely sites become central nodes because of historical specificity that ended up centering a given network around a particular locality" (414).

This brings us to Hollywood, whose history I will discuss briefly later. What we do know is that Hollywood is a hub for the film industry. For the purposes of this paper, the hub is not just the physical location of Hollywood, but also the person of the celebrity director, the one who maintains a consistent network among cinematographers, editors, and art directors. The two networks, physical and social, are in fact related. Manuel Castells writes, "I propose the hypothesis that the space of flows is made up of personal micro-networks that project their interests in functional macro-networks throughout the global set of interactions in the space of flows" (416). This means that a director's personal interests tend to favor working with certain crews. This pattern of favor eventually affects residential space in global mega cities such as Los Angeles. Ultimately, film-working-sites (nodes) flow to the headquarters of L.A., which tends to further cluster dominant functions in the film industry.

Similarly, AnnaLee Saxenian's Regional Advantage (1994) discusses the importance of physical proximity and geographical networks to the economic and

social activities in Silicon Valley. In fact, she adds to Castells' theory by defining what could be the ingredients for creating successful and profitable regional advantage. Saxenian contrasts the success of Silicon Valley, based around Stanford University in California, with Route 128, a similar group of tech companies near MIT in Massachusetts. She concludes that Silicon Valley's relative success is due to the openness of California's culture and geography, writing, "There is a community here, with a shared language and shared meanings" (37). Indeed, "The informal socializing that grew out of these quasi-familial relationships [in Silicon Valley] supported the ubiquitous practices of collaboration and sharing of information among local producers" (32). This means that people could talk about work as easily as they could about family and social topics, adding to efficiency and productivity. Another benefit of proximity is that "The geographic proximity of the region's firms facilitated occupational mobility. Moving from job to job in Silicon Valley was not as disruptive of personal, social, or professional ties as it could be elsewhere in the country" (35). Local proximity thus increases simultaneous job opportunity. For example, George Lucas was Steven Spielberg's writer seven times (out of 32 Spielberg films) while simultaneously himself being a director. And John Williams was George Lucas' musician seven times (out of 10 Lucas films) while simultaneously working as director Steven Spielberg's musician as well. In other words, the same person could work a variety of jobs for different companies. Working locally thus helps social networks to deepen which, in

turn, only increases industry productivity. Physical space and social networks are thus deeply connected.

In the end, Saxenian concludes that increased proximity improves an industry's chance of thriving through a four-fold process. First, proximity allows for more effective, in-person communication. She writes that "the level of communication is much higher when you can see each other regularly. You never work on the same level if you do it by telephone and airplane. It's very hard to work together long distance" (157). Second, proximity allows an industry to grow through learning from failure. She writes, "These [Silicon Valley] entrepreneurs learned both from their own experiences and from those of their colleagues and predecessors. An accumulation of local knowledge allowed them to experiment with new strategies and organizational forms as well as new technologies" (112). It is clear here that one has to be on site to take in the accumulated *local* knowledge; being part of a shared culture means being able to learn not only from your own mistakes, but from the mistakes of others around you.

Thirdly, Saxenian emphasizes the importance of face-to-face connection when it comes to productivity. Without being in-person, "You don't have a feel for who the people are, they are just a disembodied voice" (157). As my data will show, most of the film crews live in L.A., which suggests the accuracy of Saxenian's theory especially with regards to the creative process. Finally, Saxenian addresses creativity itself, writing that proximity encourages innovation. Saxenian writes that proximity "facilitated the

frequent face-to-face communications needed for successful collaboration, while also intensifying competitive rivalries" (156). Competition, as a byproduct of proximity, allows new ideas and new leaps in technology to form. That is why all the directors in my study live in proximity to a central hub like Hollywood, where they can comment and critique on each other's work more easily.

In the end, Castells and Saxenian agree that localization plays a significant role in heightening cooperation in an industry. This then impacts how that industry thrives and localizes even further, creating a feedback loop that should impact the way we design our cities.

Hypothesis

Applying social network analysis, I hypothesize that as the number of times film crews work together onsite increases, the more likely social networks will strengthen between the director and staff who work in important technical and creative roles. This creates inhomogeneous social networks, which in turn affects where these people live. If my hypothesis is confirmed, I hope to test this relationship with other country's film industry and / or animal, children, disability healthcare industries. These industries have an intimate purpose of delivering care to their clients. To provide quality care, the medical doctors, professionals, and staff must gather in specific locations to intuit subtle mental and physical changes and use their tactile sense to gather and effectively

share information with other staffs. This is the same reason some of the most creative tasks in film production has to be done together on-site. Ultimately, I argue that directors prefer to work with the same creative individuals, which creates inhomogeneous social networks. This in turn impacts where crew members live and work, which should then impact the way that we design cities to allow this industry to thrive.

Research design (data and methods)

The data from www.imdb.com and imdbpro.com was used for the analysis of social network systems among film crews who have worked with 11 directors: Steven Spielberg, George Lucas, Martin Scorsese, James Cameron, Quentin Tarantino, Stanley Kubrick, Michael Bay, Jonathan Demme, Tim Burton, Sam Raimi, and Bryan Singer. These were randomly picked from Hollywood's list of highest grossing directors. From the IMDb (Internet Movie Database) dataset, 25 different film roles were obtained. These are: director, writer, producer, music, cinematography (Director of Photography), film editing, casting, production design, art direction, costume design, set decoration, make up department, production management, assistant director, art department, sound department, special effects, visual effects, stunts, camera department, costume department, editorial department, music department, and location management. Other minor production roles were removed from the measurement.

The data only counted feature films. TV series and documentaries are removed

in order to better compare the directors across one consistent medium. I performed

web scraping on imdb.com using R studio, obtaining data from 11 directors, 177 film

titles, and 25 different roles of the film crews, those collaborating with directors from

1974-2018. In other words, I collected each director's film titles, and the names of their

film crew and their production roles from 1974-2018. I input the data into a Microsoft

excel file, and I used Python programming to count the number of collaborations

between directors and specific staff. These relationships are sorted with the most

frequent first. After this, I conducted social network analysis and visualized it with

diagrams made with Gelphi and Lucid chart software. These diagrams allow us to see

social networks and to display the linkages that connect them. Figure 1, 2, 3 show the

social network systems with the nodes as individuals and the lines connecting crew to

the directors. The thickness of the line indicates how frequently a specific staff worked

with that director onsite. The thicker the line, the stronger the connection.

Results and discussion: explanations and implications

This research asks, how do the social networks of film crews interact with the

spatial network of physical locations? The excel data (table 1) shows the collaboration

frequency between the director Steven Spielberg and his main production crew. For

example, Steven Spielberg has produced 32 featured films. As a hub, Spielberg

worked significantly more with musician John Williams (29 times/32 films, or 91% of the

time), with editor Michael Kahn (29/32, 91%) and with cinematographer Janusz

Kaminski (19/32, 60%) as nodes, in comparison with other nodes in his social networks.

Table 1. Frequency of individuals working with director Steven Spielberg.

Film role	Crew Name	Frequency
director	Steven Spielberg	32
writer	Geroge Lucas	7
producer	Steven Spielberg	19
music	John Williams	29
cinematography	Janusz Kaminski	19
Film editing	Michael Kahn	29
casting	Mike Fenton	5
Production design	Rick Carter	10
art direction	William James Teegarden	4
set decoration	Anne Kuljian	3
costume design	Joanna Johnston	7
make up department	Lois Burwell	4
production management	Erica Frauman	6
assistant director	Sergio Mimica-Gezzan	8
art department	John Villarino	8
sound department	Ron Judkins	12
special effects	Michael Lantieri	6
visual effects	Tim Geideman	10
stunts	Vic Armstrong	9
camera department	David Devlin	10
animation department	Edwina Ting	2
casting department	Barbara Harris	6
costume department	Susana Gilboe	2
editorial department	Gary Burritt	14
location management	Kevin Berman	3
music department	Sandy DeCrescent	10

Sources: Internet Movie Database; director Steven Spielberg; generated by Eui Na Kim; using full cast and crew; http://imdb.com; (04 March 2018)
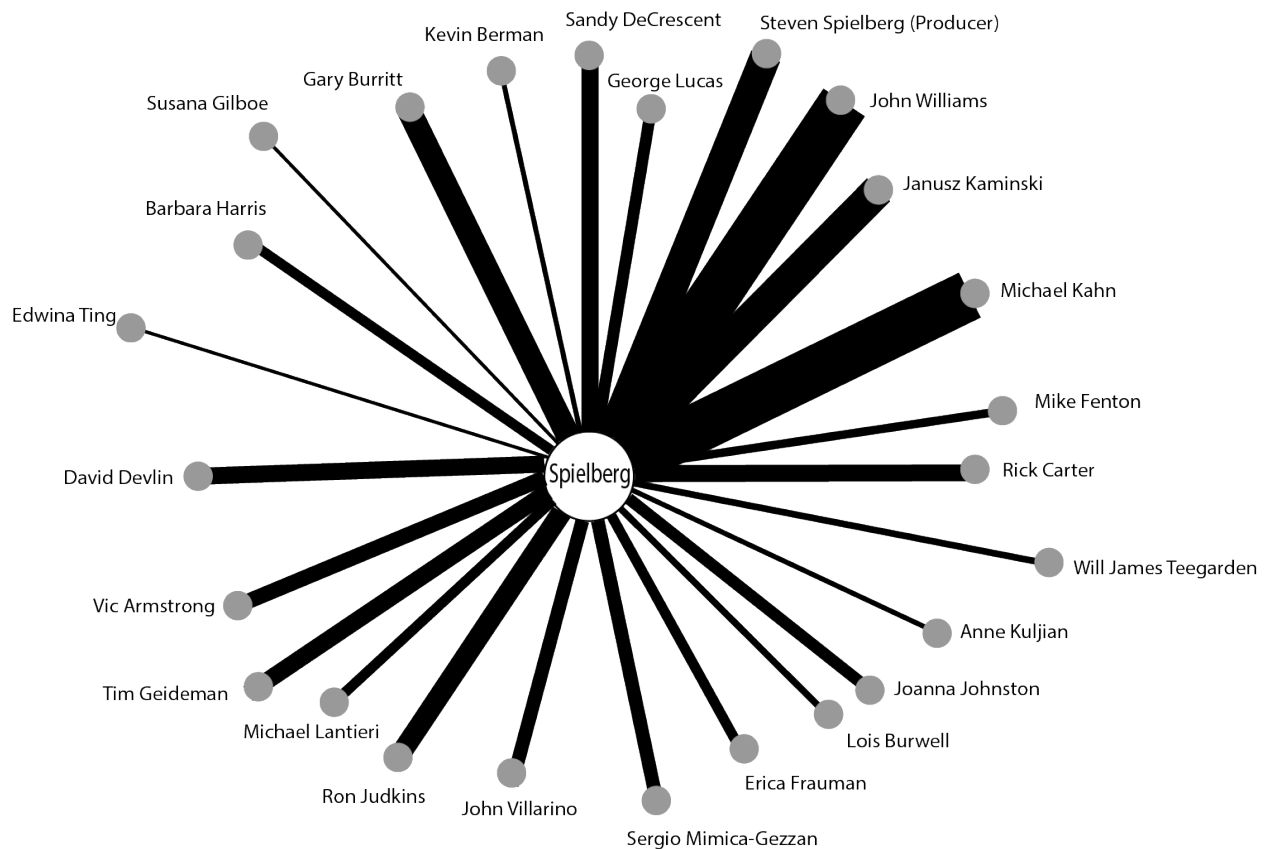
Figure 1. Visualization of director Steven Spielberg's inhomogeneous social networks. The line thickness shows the strength of social connection between the crews (outer nodes) and the hub (the director).

These graphs show that Stephen Spielberg's social network is inhomogeneous: he works more with a certain producer and musician much more than he works with other film crew roles (set decoration, art direction, and animation department). Castells says that these uneven distributions happen because people's interests are different. He writes, "The theory of the space of flows starts from the implicit assumption that societies are asymmetrically organized around the dominant interests specific to each social structure" (415). In other words, because each director's "dominant interests"

are different, they will privilege different film crew roles with different frequency. If I use

Castells' theory to identify and describe my film network analysis, we can see each

director's different working patterns and preferences. We can see directors as hubs and

staff as nodes, using network theory to understand the linkages between them.

We can see this pattern in all the other directors in this study. For example,

Bryan Singer exhibits similar inhomogeneous lines in his social network. Singer most

frequently worked with the same musician (10/10, 100%); cinematographer (10/10,

100%), film editor (10/10, 100%), casting director (7/10, 70%), and costume designer

(6/10, 60%). This is an extremely inhomogeneous network, also providing evidence for

Table 2. Frequency of individuals working with director Bryan Singer.

Film Role	Crew Name	Frequency
director	Bryan Singer	10
writer	Bryan Singer	5
producer	Bryan Singer	11
music	John Ottman	10
cinematography	Newton Thomas Sigel	10
film editing	John Ottman	10
casting	Roger Mussenden	7
production design	John Myhre	2
art direction	Michelle Laliberte	2
set decoration	Geoffrey Gosselin	2
costume design	Louise Mingenbach	6
make up department	Rita Ciccozzi	4
production management	Debra K. Chinn	3
assistant director	Brian Smrz	4
art department	Bruce Morris	3
sound department	Craig Berkey	5
special effects	Cameron Waldbauer	3
visual effect	Aaron Dennis	3

stunts	Gary Jensen	3
camera department	Anthony G. Nakonechnyj	3
Animation department	Chris Lentz	1
costume department	Paul Thompson	1
music department	Cliff A. Zellman	1
other crew	Kirsty Kinnear	1

Sources: Internet Movie Database; director Bryan Singer; generated by Eui Na Kim; using full cast and crew; http://imdb.com; (04 March 2018)
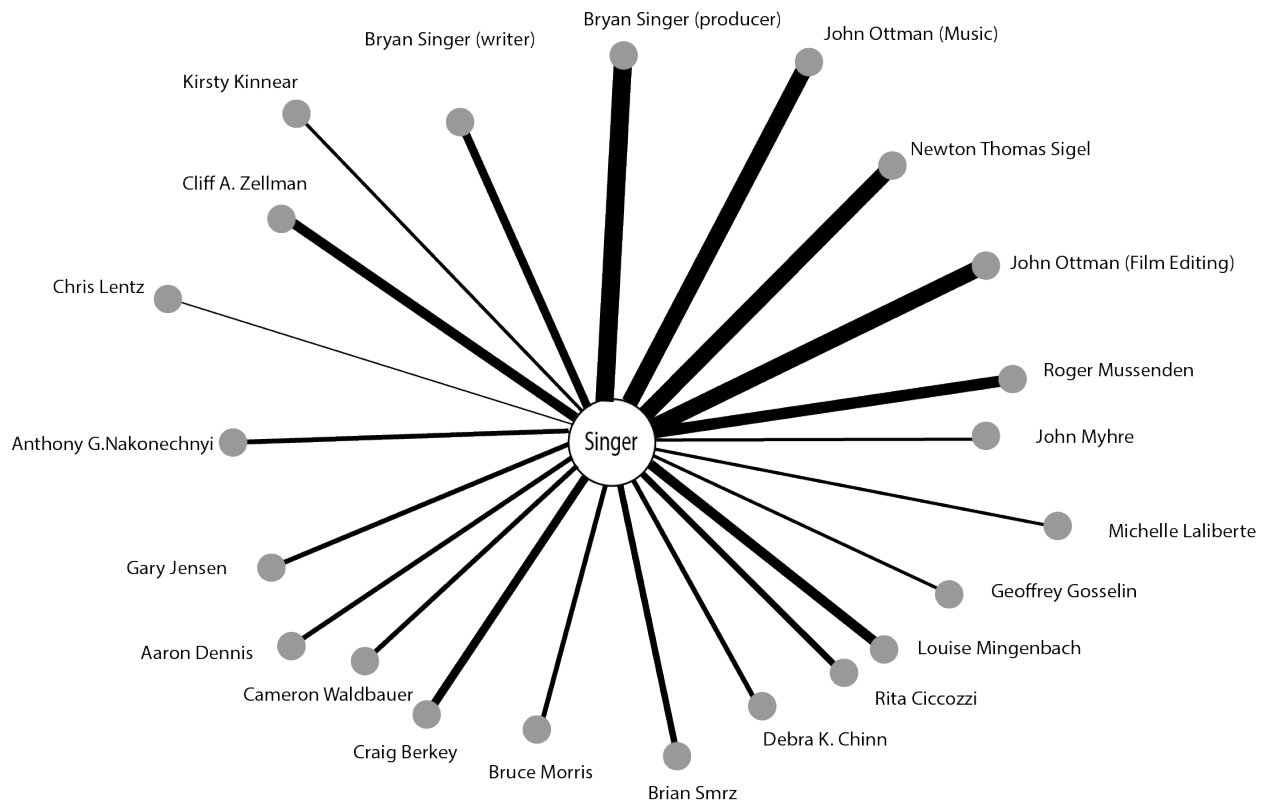

Figure 2. Visualization of director Bryan Singer's inhomogeneous social networks. The line thickness shows the strength of social connection between the crews (outer nodes) and the hub (the director).

Table 3. Frequency of individuals working with director George Lucas.

| Film Role	Crew Name	Frequency
director	George Lucas	10
writer	George Lucas	13
producer	Rick McCallum	7
music	John Williams	7
cinematography	David Tattersall	5
film editing	George Lucas	6
casting	Robin Gurland	3
art direction	Peter Russell	3
production design	Gavin Bocquet	3
production management	Jamie Forester	3
set decoration	Peter Walpole	2
art department		
costume design	Trisha Biggar	3
sound department	Matthew Wood	7
makeup department	Danny Wagner	3
visual effect	Howard Gersh	4
special effects	Tony Dyson	4
stunts	Nick Gillard ... stunt coordinator	3
assistant director	Moez Kamoun	3
camera department	Mark Harris ... electrician	3
animation department	Jay Rennie ... animator	3
casting department	Matthew Wood	5
costume department	Tony Dyson	3
editorial department	Howard Gersh	3
music department	London Symphony Orchestra ... music performed by	4
other crew	Peter Taylor	1
location management	Simona Serafini ... location manager: Italy	1
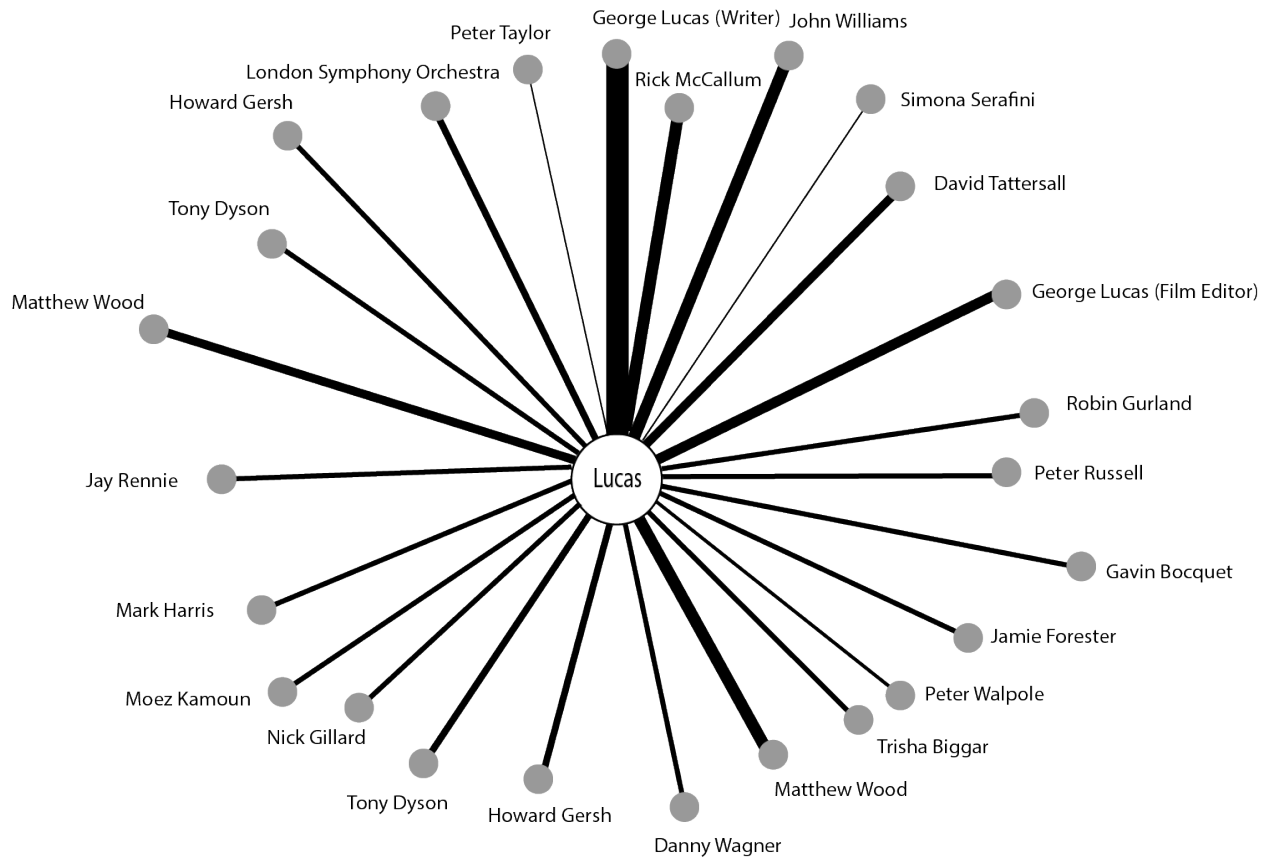
Figure 3. Visualization of director George Lucas' inhomogeneous social networks. The line thickness shows the strength of social connection between the crews (outer nodes) and the hub (the director).

George Lucas most frequently worked with producer (7/10, 70%), music (7/10, 70%), film editing (6/10, 60%), cinematography (5/10, 50%).

Table 4. Frequency of individuals working with director James Cameron.

Film Role	Crew Name	Frequency
director	James Cameron	10
writer	James Cameron	13
producer	James Cameron	6
music	James Horner	3
cinematography	Russell Carpenter	3
film editing	James Cameron	5
casting	Margery Simkin	3
production design	Peter Lamont	3
art direction	Aashrita Kamath	2
set decoration	Michael Ford	1

costume design	Deborah Lynn Scott	3
make up department	Peter Tothpal	2
production management	Steven Barnett	2
assistant director	Jonathan Southard	1
art department	Phillip Norwood	2
sound department	Sean England	2
special effects	Robert Spurlock	2
visual effect	Gary Rhodaback	3
stunts	Troy Gilbert	2
camera department	Kevin Cook ... grip	2
animation department	Danny Testani ... animator: Weta Digital	1
casting department	Ashley Slater ... casting assistant	1
costume department	Tyra Youland ... textile artist	2
editorial department	Gary Burritt ... negative cutter	2
location management	Justin Harrold ... location manager	2
music department	Jim Henrikson ... supervising music editor	2
other crew	Judy Taylor	1

Sources: Internet Movie Database; director James Cameron; generated by Eui Na Kim; using full cast and crew; http://imdb.com; (04 March 2018)

James Cameron most frequently worked with producer (6/10, 60%), film editing (5/10, 50%).

Table 5. Frequency of individuals working with director Martin Scorsese.

Film Role	Crew Name	Frequency
director	Martin Scorsese	26
writer	Martin Scorsese	7
producer		
music	Howard Shore	5
cinematography	Michael Ballhaus	8
film editing	Thelma Schoonmaker	21
casting	Ellen Lewis	14
production design	Dante Ferretti	9
art direction	Luca Tranchino	3
set decoration	Francesca Lo Schiavo	6
costume design	Sandy Powell	7
make up department	Manlio Rocchetti	5

production management	Kelley Cribben	4
assistant director	Joseph P. Reidy	11
art department	Dave Weinman	4
sound department	Tom Fleischman	17
casting department	Sylvia Fay	4
editorial department	Tom Foligno ... first assistant editor	4
special effects by	R. Bruce Steinheimer	5
visual effect	Craig Barron	5
stunts	G.A. Aguilar	7
camera department	Larry McConkey	4
costume department	David Davenport ... costume supervisor	6
music department	Randall Poster ... music supervisor	4
other crew	Bobbie Sierks	2
location management	Robin Citrin ... location manager	2

Sources: Internet Movie Database; director Martin Scorsese; generated by Eui Na Kim; using full cast and crew; http://imdb.com; (04 March 2018)

Castells' theory about individuals' social networks being led by dominant interests.

And indeed, this is the pattern we see with the other eight Hollywood directors. Martin

Scorsese most frequently worked with film editing (21/26, 81%), sound department

(17/26, 65%), casting (14/26, 54%), assistant director (11/26, 42%). Jonathan Demme

most frequently worked with cinematography (11/19, 58%), producer (7/19, 37%), film

editing (7/19, 37%), sound department (8/19, 42%). Michael Bay most frequently

worked with sound department (11/13, 85%), make up department (9/13, 70%), music

(7/13, 54%), special effects (7/13, 54%), film editing (6/13, 47%). Quentin Tarantino

most frequently worked with producer (8/11, 73%), make up department (7/11, 73%),

sound department (7/11, 73%), film editing (6/11, 55%), production design (6/11, 55%)

set decoration (6/11, 55%) assistant director (6/11, 55%). Sam Raimi most frequently

worked with, producer (8/15, 53%), film editing (7/11, 64%), music (5/11, 45%), production design (5/11, 45%), assistant director (5/11, 45%), sound department (5/11, 45%), special effects (5/11, 45%). Stanley Kubrick most frequently worked with, casting (5/15, 33%). Tim Burton most frequently worked with, music (16/18, 89%), film editing (14/18, 78%), costume design (12/18, 67%).

In addition, the frequency of collaborations also tells us the frequency of working onsite together. This is the nature of the film industry. For example, *Indiana Jones and the Last Crusade* (1989) was shot in Utah, Jordan, Colorado, Spain, Texas, California, Italy, New Mexico, England, and Germany. This means that the film crews had to be present with Spielberg as his selected collaborators; they traveled the world together. My argument is that all this time together reinforces the inhomogeneous social network systems among film crews. AnnaLee Saxenian gives us reasons for the advantage of being in close physical proximity while working together. In her analysis of Silicon Valley culture, Saxenian writes that the "localized accumulation of technical knowledge enhanced the viability of Silicon Valley start-ups and reinforced a shared technical culture" (37). This is especially in contrast to a similar technological industry that had less physical proximity: "Technology companies in Massachusetts were scattered widely along the Route 128 corridor and increasingly along the outer band, Interstate Route 495, with miles of forest, lakes, and highway separating them. Unlike Silicon Valley, where firms clustered in close proximity to one another in a dense

industrial concentration, the Route 128 region was so expansive that DEC began to use helicopters to link its widely dispersed facilities" (60). For Saxenian, physical proximity in working relationships is what makes the difference between successful collaborations and less successful working environments.

The dominant interests of any director are only strengthened by increased on-site collaboration. Saxenian describes the importance of working in-person with one's creative partners, especially when one has to communicate one's artistic vision clearly; as mentioned above, "the level of communication is much higher when you can see each other regularly. You never work on the same level if you do it by telephone and airplane. It's very hard to work together long distance. You don't have a feel for who the people are, they are just a disembodied voice" (157). This means that face-to-face connection is only possible with proximity. Creating and editing a film naturally requires this much on-the-ground communication. As Saxenian writes about Silicon Valley, "They'll give us feedback on the features they like and don't like. It's an iterative process: we define a product, we get feedback and improve it, we refine it and develop associated products" (115). The creative process between a film director and his editors/writers is similar. The more a pair of collaborators works together, therefore, the more trust and faith are built between them.

At the same time, working together in close proximity onsite also enhances the product that is created. Saxenian writes that working closely together allows failure to

become opportunities for learning. She says, "The continuous recombination of differently specialized resources in turn strengthened [Silicon Valley's] industrial fabric. According to one semiconductor executive:

> There is a unique atmosphere here that continually revitalizes itself by virtue of the fact that today's collective understandings are informed by yesterday's frustrations and modified by tomorrow's recombinations . . . Learning occurs through these recombinations. No other geographic area creates recombination so effectively with so little disruption. The entire industrial fabric is strengthened by this process (112).

In other words, Saxenian suggests that what makes learning and innovation work is an environment, a "geographic area," that allows constant recombination. In a sense, this means that proximity makes failure possible. Film making requires constant footage retakes on trying different scenes. Film editing requires adding and removing frames while in constant conversation with the director. Only by doing so can the director deliver their intended moving story. These scattered filming locations thus affected the social nodes of these film networks by enabling better communication, encouraging more creative collaboration, and face-to-face connection. In the end, it doesn't matter where the movie was shot; what matters is that the selected film crews worked on site together.

In additions, I think we can use this analysis to create a model that predicts future collaboration. The more times a director works with a crew member, the more likely the crew member will be recruited for the director's next movie. This means that

the thicker the lines, the stronger the bonds, which represents a higher probability that the crew member will be on-site with the director at his next production. In fact, I believe that we can find a strong correlation between the strength of a director's collaboration with a film crew member and the film crew member's eventual place of residence. In this way, spatial network proximity breeds stronger social networks, which then breed megacity-like spatial networks, such as Los Angeles and New York City.

All 11 directors and most of their production crews live either in southern California or New York. In particular, the crew members who have strong linkages to the director are more likely to live in close proximity to them. For example, director Bryan Singer, and his musician/editor John Ottman (10/10) live in Los Angeles; director George Lucas, and his musician John Williams (7/10) live in Los Angeles; director Martin Scorsese and his film editor Thelma Schoonmaker (21/26) both live in New York, and his casting director Ellen Lewis (14/26) lives in both New York and Los Angeles; director Michael Bay's make-up artist Edouard F. Henriques (9/13) and his musician Steve Jablonsky (7/13) all live in Los Angeles; director Sam Raimi, and his film editor Bob Murawski (7/15) both live in Los Angeles; director Steven Spielberg, his musician John Williams (29/32), his film editor Michael Kahn (29/32), and his cinematographer Janusz Kaminski (19/32) all live in Los Angeles; director Tim Burton, his musician Danny Elfman (16/18), his film editor Chris Lebenzon (14/18) all live in Los Angeles. This recalls that physical location *does* matter. But there are also exceptions. Director Jonathan

Demme lived in New York, and his cinematographer Tak Fujimoto (11/19) lives in Los

Angeles. But, it is important to note, both still lived in the two major cities of the film

industry. Thus, while the film crews are not so totally localized to these two places,

there is still a strong majority that live in one or the other. In fact, most live close to

each other. According to Castells, "The functions to be fulfilled by each network define

the characteristics of places that become their privileged nodes. In some cases, the

most unlikely sites become central nodes because of historical specificity that ended

up centering a given network around a particular locality" (414). Directors and film

crews thus largely live in Los Angeles because of the accumulated history of the film

industry there. Hollywood has long been "Film City," and it has an efficient and robust

network there that is only getting stronger.

Recommendations

What then does this mean for urban planning? The film industry is known for

being exclusive: every director has their own set network of collaborators. It is hard for

newcomers to break into this industry. Since the film network systems are exclusive

against new film crews, we need to think about how we can bring equal economic

opportunities to the "incoming film crews" to the existing or brand new film network

systems. In this project, I have used social network analysis to demonstrate the nature

of these inhomogeneous networks. My findings show that specific directors prefer to

work with the same film crew members, and that these relationships are only strengthened over time as directors and film crews travel and work in the same places. These staff members tend to work in the most important roles in film production, which also are the highest paying jobs. This exclusiveness empirically demonstrates how social networks reproduce this exclusivity with high salaries. "An experienced cinematographer can expect to earn $10,000 to $20,000 a week. On a low-budget indie fare, DPs (cinematographers) often take home $2,000 to $5,000 a week" (*The Hollywood Reporter* staff). This can create socio-economic inequality and a disparity in rank, eventually.

This inequality in social networks can be addressed by policymakers in L.A. Using social network analysis to examine the connections between the director and the film crews, I propose that economic incentives should be targeted at famous directors because directors are the "point person" as a hub. Using social networks can thus help us identify people and locations to target in a focused and active way. To break this disparity in income and opportunities for new blood, I think that California policy makers should require famous directors (white men, at least all 11 that were examined for this study) to hire more diverse applicants (based on race, socio economic status, gender) for their incoming crews or entry level positions, such as second assistant director, from California's local film schools such as UCLA and USC. Creating partnerships with film schools and the directors as hubs can resolve the disparity of rich

and connected nodes only getting richer and more connected. In return, adding new blood to the exclusive networks can provide creative and fresh ideas for the existing film networks. One of the main goals of film is to engage viewers and evoke emotions from them. Therefore, while solid, static networks of directors and staff who always work together builds trust in the short term, in the long term this can also limit the creation of fresh ideas, which ultimately stunts innovation in the film industry. It is thus important that these experts also pass on their knowledge and skills to new professionals.

The findings of this project are also significant to urban planning because we can utilize and apply the tendency toward inhomogeneity of scale-free social networks to identify spatial nodes as well as social ones. That is, we can figure out which physical locations should be targeted with specific incentives. On a concrete level, I propose that economic incentives (industry planning policy) should be targeted at making/building "incentive packages" for start-up crews providing working spaces for pre and post-production in LA, offering film students low-cost facilities for making films. This incentive package can include reducing tuition debt, encouraging local L.A. rookie directors to shoot and work. Providing these "incentive packages" for start-up creatives will promote more face-to-face opportunities for them to deliver clear messages to each other and inspire each other to create more. This "incentive package" will make the film-city of Hollywood stronger by starting new social networks.

These lessons from Hollywood can also help us to think about social networks as they interact with urban spaces. The more face-to-face connections are required to gather and share information for decision-making, the more important is proximity for efficient and robust productivity. In other words, thinking in terms of face-to-face connections is the key to making decisions when planning for urban investments, especially for the film industry in today's technology-driven society. Based on AnnaLee Saxenian's work, cities seeking to promote the film industry should be designed to eradicate geographical divisions (for example, one should avoid swaths of forests and lakes and extreme weather) that can prevent in-person collaboration. Indeed, based on this study, the film industry could expand to other, new urban centers.

If Florida were to want to be the next Hollywood, they would have to replicate this pattern of geographic localization, where directors and film crews can live and work in close proximity. Florida should locate facilities in the region. The film studio can establish ties with universities nearby, thereby developing loyalties among students who are trained in film studio systems. They can promote incentives to build local film production companies. But, if the region is separated by rivers, mountains, and bad weather which inhibits film crews from meeting each other, I would recommend finding a better location. Since the exact location often changes based on a movie set, Florida can have as good a chance as any city for promoting the development of a film industry by hosting an annual film festival. All that is needed is local support and

community involvement: a broadening and deepening social network based on spatial proximity. The boundaries of the film industry can thus start to dissolve as local producers continue to define new products, markets, and industries. The lessons of Hollywood's network system can thus begin to diffuse to other regions, reinforcing what Saxenian calls "the importance of geographic proximity even in an era of market globalization" (159).

Limitations

For privacy reasons, the residential location of the crew members at the time of filming was not available.

Some of the crew members, especially directors and famous cinematographers, have houses in more than one location.

A film crew member's death may cause aberrant patterns to arise in a directors' social network. That is, if the crew member had not died, they would likely have continued to work with a director, and the pattern of collaboration may be still valid and strong.

Film crews may move frequently. The scope of this project is not big enough to account for each film crew member's relocations over the past 45 years. But, these relocations do not provide a strong counterexample against my argument, which proves a general trend in director-key film crew member relations.

Conclusions

      This research asks, how do these social hubs interact with local place in the film industry? Does working together on location strengthen social networks? If so, how? How do the social networks of film crews interact with the spatial networks of actual, physical locations? From our findings, we can conclude that the social network systems of the film industry are extremely exclusive and closed-off. But this is true only of certain roles, albeit the highest ones. Every director also has different preferences, which guide the formation of their preferred networks. Nevertheless, the more the directors work together with the appointed crew members on any filming/working site, the specific crew members generate inhomogeneous social linkages to the director, who serves as a hub. In other words, *any* filming/working location becomes a tool to strengthen the inhomogeneous social networks among film crews. Spatial proximity is what strengthens social networks. These linkages around the director as a hub then generate localization in major film cities in Southern California and New York. This concludes that *any* filming location affects (creates) strengthening inhomogeneous social networks which again affects the major film location to live around a director.

      In conclusion, our findings reaffirm preexisting understanding of cultural film industry hubs, but we go further by articulating the interconnectivity between these locations and identifying the social connections and their exclusiveness that show to

correlate with their competitive regional advantage. This allows us to direct future

urban planning around certain industries should the need for such development arise.

References

Castells M, 1996 The Rise of the Networked Society (Blackwel, Cambridge, MA)

Saxenian A, 1994 Regional Advantage: Culture and Competition in Silicon Valley and Route 128 (Harvard University Press, Cambridge, MA)

The Hollywood Reporter staff, 2014, "Hollywood Salaries Revealed, From Movie Stars to Agents (and Even Their Assistants)", https://www.hollywoodreporter.com/news/hollywood-salaries-revealed-movie-stars-737321

Tables and Figures:
Sources: Internet Movie Database; 11 directors in total, 5 shown here; generated by Eui Na Kim; using full cast and crew; http://imdb.com; (04 March 2018)