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MANAGERIAL COGNITION AND AN APPLICATION TO DISEASE CLUSTERS

Diana Reese
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Reviewed and approved* by the following:

James B. Thomas
Dean of the Smeal College of Business
Thesis Supervisor

Charles Snow
Professor of Business Administration
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

Abstract

Disease cluster analysis is conducting almost strictly using statistical analysis, and is by nature subjective and inconsistent. The narrow focus and simple "lens" used for establishing cause-effect linkages promotes unsupported and ambiguous conclusions.

In-order to get away from these prescribed methods and use of constrained cognitive maps, and thus constrained conclusions, this thesis seeks to introduce some new methodologies for investigating disease clusters. This thesis introduces the idea of using "new" cognitive lenses, drawing upon tools from strategic management and market research. These fields both work to establish cause-effect linkages, in their own fields, and thus can be effective in establishing cause-effect relationships in disease cluster analysis. These tools would provide a new perspective as to how make the cognitive shift that would be needed to make disease cluster analysis more effective and consistent. In the collective, these new ways of "seeing" the problem and making sense of each situation may have a profound effect on the field.

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Chapter 1

Introduction

According to epidemiologists and other representatives from the Center for Disease Control and Prevention, the established methods for determining the existence of a disease cluster are the most appropriate and useful approach to making an accurate conclusion. However, the current methodologies ignore any evidence that does not demonstrate an indisputable (often solely statistically based) link between a toxic site and elevated levels of disease in a community. At issue is this use of a prescribed "cognitive lens" to analyze the linkage problem, while ignoring information that may be pertinent but lies outside the constrained field of perception.

Individuals and even whole organizations tend to assume that the cognitive lens we use to understand a problem is the most appropriate point of view. We base both the formulation of problems and their solutions on "cognitive maps" which encompass the connections made between different phenomena and provide meaning. [1] However, these assumptions can blind individuals to additional factors, or cause us to ignore information that exists outside of what we expect. These outliers can be critical to properly establishing a cause and effect situation.

This same principle of cognitive bias can be applied to almost any situation where an attempt to prove cause and effect is taking place. An example of this is the process of proving the existence of a disease cluster, and proving the correlation between a toxic site and a disease cluster. The process of proving the existence of a disease cluster follows a standardized set of steps, which are meant to gain the clearest understanding of the problem possible. However, the analysis of the data collected is highly subjective and thus the outcomes of this process may be entirely different depending on the outlook, lens, and maps used by the individual researchers.

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[1] Meindl, pg. 6

At the heart of this thesis is that the study of disease clusters can be greatly improved by shifting cognitive lenses, thereby introducing the possibility the outcome may be different if we used a different lens. Looking through "lenses" from other disciplines that focus on deriving their own cause-effect linkages, such as marketing research and strategic management, may greatly improve outcomes in the disease cluster problem and even in lives.

The marketing research perspective that will be discussed below asks how markets are established between a product and the consumers. If this same methodology is applied to the problem of disease clusters, we can follow the same line of reasoning to understand a new way of how connections are made between a toxin-producing facility and a disease cluster. Using this line of reasoning allows us to see what principles of marketing would provide researchers with a new way to assess the possibility of cause and effect between these facilities and disease clusters. This would open up researchers to the possibility of other methods of testing cause and effect, other than relying purely on statistical data and inconsistent interpretations.

Similarly, a strategic management perspective asks how business strategies are created in order to pinpoint certain markets, achieve certain goals, or embody new visions. How is the analysis of the goal or market used to establish relationships between the corporation and the stakeholders? This basic idea can then be applied to disease clusters, asking how planning and assessment methods of analysis in strategic management can be used to establish interrelationships between a toxin producing facility and a disease cluster.

Examining the issue of disease clusters from the perspectives of the marketing research lens and strategic management creates a very different understanding of the disease cluster problem, and establishes a new definition for deriving the cause and effect relationship. These new types of analysis make it clear that a different, supplemental lens is necessary in order to

fully understand the problem of disease clusters. These other disciplines offer perspectives that provide opportunities for new methodologies that are perhaps more pertinent to the problem than the established protocols in disease cluster analysis. Studying the problem through these new lenses also gives a different perspective on how the problem of toxin producing facilities and disease clusters should be handled, and examines the complex relationship between them, which the established methods of disease-cluster identification ignore.

These new lenses allow us to create new cognitive maps that reorganize the way we think about the cause and effect relationships. Looking again at the issue of disease clusters, the new lenses give a new perspective on the issue. The new perspective also allows us to create new cognitive maps, which alter our understanding of the relationship between the disease clusters and toxin producing facilities. Most studies on the relationship between these facilities and potential disease clusters start with the disease. Epidemiologists look at the elevated levels of disease in a community, and work backwards to see if they can find a connection between the disease levels and a nearby facility. But creating a new cognitive map means changing how we understand this connection, and thus the study of the connection.

These perspectives may even mean changing what we identify as the "problem", and work through the issues in a different way. In the instance of disease clusters, the new lens may identify the toxin-producing facility as the problem or the issue, and thus looking at the potential effects it may have on the surrounding environment. This creates a new cognitive map, which starts with the facility, and works outward to see how the surrounding area is being affected. Following this line of thought would then reveal to us the elevated levels of disease in the surrounding community, and lead us to believe that perhaps the facility is the cause of the diseases. This new map is perhaps more useful, because it starts with the bigger picture and looks

to see how the details fit. This focus is different to the currently used methods that tend to look at one tiny detail, and try to determine all of the surrounding information.

The thesis begins with a section on the theory associated with cognitive maps and their effect on thought and action. This is followed by a close examination of disease clusters, associated analyses and problems associated with determining cause-effect relationship. The next two chapters examine example lenses and methods associated with the different fields of marketing research and strategic management. These tools and methods are offered with the hypothesis that such methods would improve disease cluster analysis. Lastly, the thesis takes a prescriptive tone that goes beyond just methods to suggest specific/collective ways these other fields can contribute to the disease cluster linkage problem.

Chapter 2

Theoretical Background

The theories of managerial cognition and cognitive maps deal with the idea that our thoughts, ideas, and understanding of the world around us are largely shaped by the knowledge we have, our experiences, and what we believe to be true. The process of cognition has been studied many times over, always focusing on a different aspect of the process. Predominately, studies of the cognitive process look at how the process is changed by the decisions maker's understanding of the precursor events and the circumstances surrounding the decision.[2] These studies also examine how trying to understand the information surrounding a decision is impacted by the lenses dictated by the business strategy and subsequent organizational action.[3] This is important to understanding how the decision making process for any business occurs. However, simply studying this process ignores a major factor in the cognitive process, which perhaps has the most bearing on the important decisions that an organization must make.

The concept of interpretation in the cognitive process has been studied at several different levels, each with a particular focus that enables a greater understanding of the process. These three levels are the individual, group, and organizational level.[4] The individual level looks to see how an individual's understanding of the world and the individual's knowledge base affect what they are able to interpret.[5] The group level looks at how an individual's knowledge base affects the group's knowledge base, creation of shared meaning, and reality validation.[6] Finally, the organization level focuses on the way that an organizational framework can affect the way top

[2] Thomas, Clark and Gioia, p. 1
[3] Thomas, Clark and Gioia, p. 1
[4] Thomas and McDaniel, p. 267
[5] Thomas and McDaniel, p. 267
[6] Thomas and McDaniel, p. 267

management interprets information and the environment.[7] The frameworks partially determine which issues or decisions that management will address, and which issues they believe have the potential to fall in line with the business strategy, and have a dramatic impact on the organization. [8]

Perhaps the most important part of the cognitive process to understand is how top managements' "sensemaking" abilities transform into the actions of an organization.[9] The notion of "sensemaking" includes understanding the business environment, internalizing the information, and acting in response to these understandings.[10] Top management's "sensemaking" abilities have a dramatic impact on the choices of the organization, and the directions that an organization may take. Making complex decisions based on uncertain outcomes has become one of the major roles of top management in any organization.[11] Their ability to interpret and create meaning out of these uncertainties is what makes someone fit for management. This is because management's ability to create these interpretations is extremely important to the success of an organization, and to the organization's ability to remain competitive in the market.[12] These interpretations also have lasting effects on the organization. Management's interpretations, and the decisions that are based on these interpretations, will be used in the future as a basis for further plans and strategies.[13]

These same interpretations are what management uses to understand the implications of cause and effect. Management goes through the cognitive process in-order to make sense of how one object or process can affect or relate to another. This process is the determination of cause

[7] Thomas and McDaniel, p. 267
[8] Thomas and McDaniel, p. 267
[9] Thomas, Clark and Gioia, p. 2
[10] Thomas, Clark and Gioia, p. 2
[11] Thomas, Clark and Gioia. P. 2
[12] Thomas, Clark and Gioia, P. 2
[13] Thomas, Clark and Gioia, P. 2

and effect, which is very often applied to business situations. In the case of Strategic Management, management looks to see how the strategy they have developed relates to the strategic environment of the business, and how well the strategy works in that environment. Similarly, the business has to look at how the strategy that management has developed was shaped around the strategic environment in which the business operates.

In the case of marketing research, the analyst looks at a particular product that the business has developed in relation to the product market. Management analyzes how the product fulfils the needs that are missing from the market, how the product stands up against competitors, and what changes can be made to make the product a better option in the current market. This analysis also looks at how the introduction of the product changes the market, and thus what new opportunities the business can find by responding to these market changes.

Both of these types of analyses can be applied to the problem of chemical facilities and disease clusters. Corporate action and corporate choice have an impact on the surrounding physical environment and on the corporate stakeholders. Typically, when disease clusters are studied, epidemiologists begin at the supposed disease cluster, where they have seen elevated levels of disease in a particular community. The epidemiologists then work backward, trying to link the elevated levels of disease back to a chemical facility through purely scientific methods. The methods are predominately statistical analysis of the levels of disease, and epidemiology work which analyzes the diseases on a molecular level, to see if there is scientific proof that the facility caused the disease. Unfortunately, these methods usually provide inconclusive results, leaving the community and the corporation without answers. However, if the types of analyses that are done in Strategic Management and Marketing are applied to the issue of proving the existence of a disease cluster, there is the potential to have a very different outcome. This method

of analysis would start at the chemical facility, and work forward to analyze the potential consequences that the facility may have on the surrounding community, the potential for the facility to cause an abnormal occurrence of disease in a community. This method is vastly different from the current disease cluster identification methods because it starts at the facility and works forward towards the possible disease cluster. This "forward" analysis makes it much easier to establish causation, and create linkages between the facility and the elevated levels of disease clusters.

Applying these theories to the problem of disease cluster analysis demonstrates why looking at a problem through different lenses is so important to any team. Always looking at a problem from one perspective will always produce the same solution. However, when that solution does not work, it is imperative to try and see the problem from another lens, which can provide insight that may have an impact on the decisions one's ability to solve the problem. In the case of disease cluster analysis, it may mean saving lives.

Chapter 3

The Process of Identifying, Researching and Proving the Existence of a Disease Cluster

In the United States, there are currently only seventy-seven proved disease clusters or disease cluster hot spots.[14] Although there is limited data available as to the number of suspected or investigated disease clusters each year, over 1000 suspected cancer clusters alone are reported in the United States every year, not including any other non-communicable diseases.[15] A disease cluster is defined as "an unusual aggregation, real or perceived, of health events that are grouped together in time and space and that is reported to a public health department."[16] The process of identifying and proving the existence of a disease cluster is extraordinarily complex, and has enormous implications for the community in question. In order for a local organization to even begin to investigate the existence of a cluster, the community must first organize themselves to bring the issue to the attention of the Center for Disease Control and Prevention. The community must have some general idea of the number of individuals with the disease, and have as much information on the residents as possible. Another common path to reporting a suspected disease cluster is that a local doctor in the community, through his or her work with his or her patients in the community, observes a trend of a common type of disease, and reports it to the local public health department. [17] The local public health department is responsible for investigating the existence of a suspected disease cluster, and thus is responsible for taking the next step towards collecting information regarding the suspected disease cluster, and beings an initial evaluation of the case.

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[14] National Disease Cluster Alliance
[15] Juzych
[16] CDC 1990
[17] ASDTR, pg. 6

According to the Agency for Toxic Substances and Disease Registry, the local public health department is responsible for " collecting accurate case information and conducting active surveillance through local surveys or use of health data registries,"[18] to begin the disease cluster investigation. These steps are the beginning of the basis for determining if there is a disease cluster. Unfortunately, due to the complexity of defining a disease cluster, there are numerous confirmations that must be made before epidemiologists are brought in to study the case.

In addition to the initial research, the local health department must also characterize the case definition, which creates a place for the epidemiologists to begin their work. The case definition tells the epidemiologists what characteristics about the potential cluster are the most important and the most notable in-terms of finding a correlation between the diseases, and the cause of the disease. [19] When defining a case, a broader definition includes more symptoms and illnesses, while a narrow definition includes fewer symptoms, and generally makes the cause more difficult to identify.[20] This portion of the process makes the classification of a disease cluster very subjective. There is no documentation available on specifications on how broad or narrow the case definition should be. The local health department representatives determine, based on their research, what specific types of diseases and what physical symptoms should be studied by the epidemiologists. This allows for the personal beliefs of the local health authorities to bias their conclusions. The bias of the local health authorities may work to the advantage of the local community in some instances, and work against the community in others.

Similarly, the biases of the local health authorities also have a major impact on the potential consequences for the companies responsible for the potential hazards. If the goal is to have environmental justice (i.e., appropriate corporate accountability), then perhaps it is

[18] ATSDR, pg. 8
[19] ATSDR, pg. 10
[20] ATSDR, pg. 10

necessary to have a more objective set of instruction on how to define a case. Once the case definition is established, epidemiologists are able to begin their study of the case, to work to find out if there is a correlation between all of the incidences of disease, and to determine if the diseases are linked to a common health factor in the community, including any environmental hazards.

When epidemiologists are looking into a disease cluster, they are looking for very specific qualities, which they must identify before they will even consider the possibility of classifying the incident as a disease cluster. According to the National Cancer Institute, any one of the following three characteristics is a reliable clue to whether or not there is actually a disease cluster; (1) a large number of cases of one type of cancer, rather than several different types; (2) a rare type of cancer, rather than a common type; (3) an increased number of cases of a certain type of cancer in an age group that is not usually affected by that type of cancer.[21] These three characteristics are the basis for an epidemiologist to decide whether or not there is the possibility of a disease cluster, and thus whether or not the area is worth continued investigation. This is one of the major problems with the way in which disease clusters are investigated. Unless these criteria are met, the local health department is not required to complete further research. When a community is exposed to an environmental hazard, it is possible for one person's body to have a different response to the toxin from another's. Simply because the community has not all been affected in the same way does not mean that there is a non-correlation between the hazard and the reported illnesses. However, for the purposes of identifying a "disease cluster", as defined by the Center for Disease Control, there must be a common reaction, and thus the same strain and type of disease, in-order for the area to be considered for further study.

[21] National Cancer Institute, 2006

Despite all of these complications, the process of identifying a disease cluster does not end with meeting one of the requirements listed above. The epidemiologists must then determine if the number of reported cases is actually higher than would be expected for a population of that size over a similar geographical distance.[22] The first step to comparing these numbers is to determine the "population denominator", and convert it into person-years, one type of person-time. The purpose of calculating everything in terms of person-years is to account for the number of years each individual in the study had the disease for during the course of the study. In order to determine the population denominator, they must first identify the population at risk, and the number of people that fall into this category.[23] The population denominator is calculated by looking at a similar size population spread over a similar geographic region, and determining the number of person-years of disease that should have occurred on average.[24] The actual number of reported cases is converted into person years, and then compared to this population denominator to determine if there are a statistically significant number of people with a certain type of disease given the circumstances. The term "statistically significant" refers to the odds that a specific event would happen purely by chance.[25] When evaluating disease clusters, the number of people with a certain disease is typically deemed statistically significant if there is less than a five percent probability that the number of occurrences would happen by chance or coincidence. [26]

Once it is deemed that the number of people with the specified disease is statistically significant, the area may be classified as a disease cluster. Although this is one of the prescribed steps in determining the existence of a disease cluster, this method has some very serious drawbacks. If a community that is being investigated for the existence of a disease cluster does

[22] National Cancer Institute, 2006
[23] ATSDR, pg. 11
[24] ATSDR, pg. 11
[25] Stats at George Mason University
[26] National Cancer Institute, 2006

not have a statistically significant number of people with the disease, then the case is typically dismissed entirely. This means that even though a community may in-fact have some sort of environmental hazard nearby that is causing the high incidence of disease, the area will never be able to be classified as a disease cluster. The number of infected people must exceed the number of people who could be infected in a given area purely by chance. Otherwise, the case is completely disregarded, and the investigation is discontinued. This method also implies that unless a disproportionate number of people in the community are observably being adversely affected by the environmental hazard, the government, the local health department, and the company responsible for the environmental hazard are not obligated to act in any way.

Another major concern with determining if the number of people with the disease is statistically significant is that this number relies heavily on the boundaries of the geographic region that is being investigated. Part of the epidemiologists job is to determine the most "appropriate geographic (communities) and temporal boundaries" for research.[27] Once again, this determination is highly subjective, and is left up to the discretion of the epidemiologists. The United Kingdom Small Area Heath Statistics Unit, a relatively new facility in the U.K. that focuses on the study of disease clusters stated that, "The way in which areas are grouped into concentric circles around point sources (sources of toxins) is oversimplified and may not be the best representation of exposure around emission sources. Further analysis incorporating prevailing winds or utilizing population monitoring data or atmospheric dispersion modeling would help to define groups of areas according to pollution concentrations. This may provide a better estimate of the geographical exposure patterns surrounding such point sources."[28] The way in which the geographic boundaries are determined do not necessarily best serve the needs of the

[27] CDC
[28] Aylin, pg. 294

study being conducted, or the community in need. The geographic region may be chosen based on what appears to be the most logical boundary from their limited time in the community. They will not necessarily make connections about travel patterns of those in the community, and as previously mentioned, may not pay attention to way in which the toxins are actually dispersed through the water, air and soil in the community, by either wind, runoff, or other atmospheric conditions.

However, the outcome of this "number" decision has far more impact on whether or not a disease cluster will be identified in that particular area. For example, the location of the decided boundary could cause a significant portion of the sick population to be excluded from the study. The improper identification of the appropriate boundary may not necessarily be intentional, but may be due to the fact that the epidemiologists are not familiar with the area, and thus do not see the geographical connection between one community and another. The placement of the boundary may also intentionally be placed, such that portion of the sick community are excluded, to make it appear as though the number of ill residents is not statistically significant. The subjectivity of this decision allows not only for the personal biases of the scientists to enter into the decision making process, but also the influence of the companies who may be held responsible if a disease cluster is found. The delicate nature of these decisions, and the degree of impact that they will have on the community, makes it imperative to have a more objective rules for boundary placement when assessing the existence of a disease cluster.

The next phase of identifying a disease cluster includes looking into similar example of disease cluster, identifying the population at risk, and assessing the level of exposure the community has to environmental hazards.[29] This step is meant to begin to establish a cause and effect relationship between the disease cluster, and the potential environmental hazards. Looking

[29] ATSDR, pg. 12

into similar disease cluster patterns gives epidemiologists an idea of the type or even the location of the possible environmental hazard they should be looking for. [30] Similarly, identifying the population that has primarily been effected by the disease provides important clues as to the nature of the hazard. (For example, if epidemiologists uncover that the vast majority of those who are ill work at the same location, or attend the same school, it would be pertinent to look for an environmental hazard near the office or school.) Assessing the level of exposure the community has to toxins forces the scientists to look within the community for any potential environmental hazards, including landfills, chemical facilities, or other toxic sites, and determine if the degree of exposure people have to the site could potentially cause elevated levels of disease in the community. This includes determining the levels of chemicals released from the facilities, and assessing the effects each of these chemicals have on the human body. [31] Identifying sources of toxins and their effects is one of the most objective phases of this process, largely because it is more difficult to refute outside published research already completed on the subject. However, the most difficult portion of this process is to get an accurate estimation of the amount of toxins released into the local environment from one of the suspected hazardous sites. The companies in question will do everything they can to prevent being "blamed" for the existence of a disease cluster. Gathering data on the levels of toxins released requires cooperation on the part of the companies, and thus the company can alter their procedures during the time of investigation, or alter the equipment readings, in order to show a lower level of toxins released, skewing the data results.

[30] CDC
[31] ATSDR, pg. 12

Finally, the epidemiologists must create a hypothesis about the cause and nature of the disease cluster based on their research and scientific evidence. [32] This process involves evaluating patterns of exposure, including looking at proximity and the timeline of events, and identifying commonalities between those affected by the disease. This process differs from case to case, and thus does not have as specific of a set of guidelines. Epidemiologists must create the hypothesis based on their observations, and must investigate their suspicions to come to a conclusion. The findings of this research are the basis for what action a community with an identified disease cluster can take against the potentially responsible companies. If the epidemiologists cannot find conclusive evidence to suggest that one specific source of toxins is the cause of the disease cluster, then the process typically ends at this point. Unfortunately, this is one of the most common outcomes for any disease cluster investigation. Very rarely are epidemiologists able to prove causation between a facility and the incidence of disease in a community.

Although it may seem that unless epidemiologists can establish a connection between the disease cluster and a facility that is emitting toxins, the identification of a disease cluster is irrelevant. However, having a cluster publicly recognized has several benefits. As more disease clusters are identified, the process to have a potential cluster investigated becomes less and less difficult for communities with new cases. New communities trying to organize can look to the cases of established disease clusters to plan their course of action, including looking at where the other communities failed and triumphed. When a disease cluster is established, the discovery often gets national attention, which raises awareness about the existence of disease clusters and potential hazards that individuals must be aware of within their own communities. However, it is not correct to believe that the establishment of a disease cluster means that the community's

[32] ATSDR, pg. 13

troubles are solved. Despite the benefits of affecting some form of environmental justice, proving the existence of a disease cluster without being able to prove causation provides little help to the affected community.

It is clear that the process of proving the existence of a disease cluster is complicated and requires enormous amounts of research and intense work by a team of epidemiologists. Additionally, establishing a disease cluster is a highly subjective process. The proper execution of each step relies heavily on the assumption that the local health authorities and epidemiologists will conduct their work without bias or outside influence. However, even accurately identifying a disease cluster does not mean that causation can be established, and thus does not mean that members of the community will receive financial support or the ability to relocate. If causation is proved, the responsible companies are typically forced to spend millions of dollars to clean up or renovate their facilities, pay for relocation of affected citizens, and even pay for medical expenses or damages to those who were injured by the facility. As a result, the identification of disease clusters and the attempt to prove a correlation between a facility and the cluster are high contention issues.

But as we move toward a remedy phase, it should be noted that a significant amount of the power over this issue rests in the hands of these large corporations. Small communities have little chance of winning a case against such large corporations or getting the legislation changed to better protect small communities without outside help. In-order to make the process of identifying disease clusters more fair, and to make sure that those corporations responsible for creating environmental hazards are held accountable for their actions, the standards for establishing disease clusters need to be more objective. These standards need to take into account that human bias or outside influence have a major impact on the results of an investigation. If

thegoal is to create a system that is more just towards those communities affected by environmental hazards, then communities are going to need more assistance on the part of the government, legislation, and the local health departments to make their case more plausible. The manner in which these investigations are currently conducted leave several communities in a dire situation. The members of the community cannot move to a safer location, and the system is often appearing to work against their cause, while seemingly protecting the big companies who are jeopardizing the community's safety, and their future.

Possibly the greatest obstacle in proving a disease cluster is the stigma surrounding the existence of disease clusters in general. As previously explained, proving the existence of a cancer cluster involves proving that the number of residents with the disease is not higher than would be expected in a population of that size, and that the levels are not higher than could have occurred by chance. However, some still believe that even if the percentage of residents with the disease is higher than expected, this still may be entirely due to chance, rather than the result of some environmental factor. A well-known doctor and journalist named Atul Gawande argues that having statisticians and epidemiologists work through numerous data sets in-order to identify a disease cluster is not useful. In his article "The Cancer-Cluster Myth", he quotes Alan Bender, an epidemiologists with the Minnesota Department of Health saying, "The reality is they're an absolute, total, and complete waste of taxpayer dollars," in reference to the analysis of possible disease clusters.[33] Throughout his article, he argues that elevated levels of cancer or other non-communicable diseases in certain communities is to be expected when looking at the issue from the perspective of chance and probability. He only references one example where the levels of disease were extraordinarily high, that it could not possibly be due to chance. He cites the example of Karain, Turkey, where the number of people with mesothelioma was seven

[33] Gawande, pg. 37

thousand times the expected incidence of disease for the population. [34] The case in Karian, Turkey was one of the few examples where they were actually able to link the levels of mesothelioma to an environmental cause; they were able to prove the mesothelioma was caused by the mineral erionite, which was found in high concentrations in the soil. [35] His argument is that unless the levels of disease are so drastically elevated that it would be almost impossible for the numbers to have occurred by chance, spending time to research these cases is futile. The problem with this argument is that if the elevated levels of disease may have occurred purely by chance, based on a statistical analysis, the local health department then assumes that it has occurred by chance, without further investigation. Unfortunately, this means that the researchers stop their examination of the possibility that a toxin producing facility is causing the elevated levels of disease. Simply put, if there is a possibility that the elevated levels of disease are purely a result of chance, then researchers assume that it is in fact a result of chance, and disregard the possibility that a toxin producing facility is causing disease. This has been one of the primary counter-arguments against disease clusters used by skeptical scientists and by those companies or organizations that are being blamed for releasing toxins into the environment.

Despite these claims against disease clusters, this does not seem to be the common belief among policy makers and health officials. In September of 2010, Senator Barbara Boxer, Chairman of the Environment and Public Works Committee presented new legislation to strengthen the responses to suspected cancer clusters. [36] According to the U.S. Senate documents, the legislation introduced was created to, "strengthen Federal agency coordination and accountability when investigating these 'clusters' of disease; increase assistance to areas impacted by potential disease clusters; and authorize Federal agencies to form partnerships with

[34] Gawanda, pg. 37
[35] Gawande, pg. 35
[36] Congressional Documents and Publications

states and academic institutions to investigate and help address disease clusters." [37] In spite of the claims that disease clusters are not truly related to some underlying cause but are instead statistical anomalies, the government is still of the belief that disease clusters, particularly cancer clusters, are an issue worth investigating. Results always seem to be inconclusive, tending to portray clusters as innocent until proven guilty.

The government is allocating more funds and personnel to study the existence of disease clusters, and determine potential environmental causes of the elevated levels of disease. The government is beginning to acknowledge that disease clusters are a very real problem in this country, and have decided to work to better assist those communities that have been affected. This shift in attitude and policy runs counter to the arguments that disease clusters have been over exaggerated by the media and that further attention to disease clusters is a waste of time and money. This is also not the only example of governments making advancements in the field of disease cluster identification. In 1990, the very same time Gawanda wrote his article denying the claims of potential disease clusters, the United Kingdom created the UK Small Area Health Statistics Unit, which was created with the purpose of aiding the response to reported potential disease clusters in the UK.[38] The facility was created to build more useful, widespread, and detailed databases of the health data in the UK. The data routinely collected included morbidity, mortality and population data.[39] The data was collected to crease small scale area maps, which covers a greater amount of space, but in less detail. The purpose of this was to make better comparisons when trying to identify patterns of disease, and to create a database that allows the investigators to more easily and accurately establish a population denominator.[40] Despite the

[37] Congressional Documents and Publications
[38] Aylin, pg. 289
[39] Aylin, pg. 289
[40] Aylin, pg. 289

arguments that disease clusters are not something that we should be focusing on, governments around the world are taking steps to creating better databases, technologies, and protocols that are instrumental in the identification of true disease clusters. With continued strides to creating more efficient instructions on disease cluster identification, and advancements in technology that allow scientists to more easily identify possible sources of toxins, the process to identifying disease clusters has the potential to become a more just process, and bring meaningful assistance to communities that are threatened by disease.

The Center for Disease Control and Prevention published the original "Guidelines for Investigating Clusters of Health Events" in 1990.[41] As previously explained, these guidelines have been used as the basis for disease cluster investigations in the United States since they were published. In response to the rise in the number of reported suspected disease clusters, the CDC published Updates on Cancer Cluster Activities at the Centers for Disease Control and Prevention in 2007, outlining some of the technological advancements made and new methods developed since the publishing of the original guidelines to help with more successfully identifying disease clusters. One of the most important advancements that was included in this update was the improvement of the ability to assess exposure using biologic sampling (testing blood, tissue, urine, etc.), which contributed to the, "increased potential for detection of environment and disease relationships.[42] The new guidelines establish that scientists are now better able to make connections between exposure to certain toxins and certain diseases. This also confirms the notion that environmental hazards are still a major problem and factor when analyzing disease clusters. All of the mentioned advancements and policy changes are examples of a shift in the paradigm of the study and understanding of disease clusters. This shift shows that

[41] Kingsley, Schmeichel and Rubin, pg. 165
[42] Kingsley, Schmeichel and Rubin, pg. 165

governments are taking note of the higher number of reported and confirmed disease clusters, and feel that it is necessary to establish a more efficient way of handling these situations. These changes also show that the governmental bodies in charge of investigating disease clusters realize that we need a more scientifically accurate, and thus a more standardized method for studying and interpreting potential disease clusters.

Summary

Although the process of identifying a disease cluster seems straightforward at first reading, a more in-depth investigation of the process reveals that it is extraordinarily subjective, particularly considering the delicate nature of the subject, and the importance of the outcome for the communities in question. By far the most difficult aspect of proving the existence of a disease cluster is proving the connection between an environmental hazard, and the elevated incidence of disease in the community. Through policy changes, technological and scientific advancements, and enhanced databases, drawing these connections has become easier for the epidemiologists investigating the disease clusters. This is also a particularly subjective area, due to the fact that it is extraordinarily difficult to prove that one environmental factor caused a disease over another. Perhaps the most subjective aspect of the process, however, is determining the geographical boundaries for a disease cluster study. Where these boundaries are drawn drastically changes the outcome of an epidemiologist's study. The location of the boundary determines the population investigated, the number of people expected to have the illness within that population, how many with the disease will be included in the study, and drastically alters the ability for epidemiologists to identify patterns by which the potential toxins have spread. When confirming the existence of disease clusters, these are perhaps the most important factors to analyze. Without proper procedure for making these determinations, and without a

standardized method for gathering the necessary information, the outcome of these studies is entirely dependent on the choices made by the health department and epidemiologists involved in the study.

Chapter 4

Strategic Management as a Framework for Establishing Linkage

Basic strategy, whether at the corporate, business, or functional level, is an essential part of the success of any business or organization. Most think of the business-level of strategy when discussing strategy. A *business* strategy is meant to determine where a business is going, by defining a specific mission, looking at the long-term direction of the business, and giving the business a clear purpose. [43] This strategy is then used as a guideline for making decisions regarding potential markets, advertising tactics, and any major corporate changes that may be considered. In basic terms, a business strategy is meant to link the action of the firm (e.g. products, competencies, services, etc) to the markets and environments in which it will compete.

Creating a business strategy relies heavily upon having a clear understanding of the business, and answering questions about the supposed goals of the business. The three most important questions to ask are: 1) What need is the business trying to fulfill for the customer? 2) Who is the customer that the company is trying to serve? 3) What technologies are needed and what functions must be performed in-order to fulfill this need for the prospective customer? [44] Answering these questions is the first step to understanding the business, and thus creating a strategy. With these answers in mind, management can begin to make decisions that will help the business to better serve the needs of their potential customers, and enlist those technologies and functions that better serve those needs. Similar to attempts and methods used to link disease clusters to their causes, here questions define the basic direction used to link the firm to the environment.

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[43] DuPlessis, P. 215
[44] DuPlessis, P. 243

The first two key questions are really geared toward trying to anticipate change, identify new opportunities, and trying to create a meaningful direction for the firm's future. The third question (i.e. what technologies) is more of an execution question. However, technologies can also define opportunities. Part of determining what technologies are needed and what functions should be performed is making decisions about the production or sale of their product. [45] Businesses need to decide if they want to produce and sell their goods, find an outside supplier to handle production, or produce their own goods and use outside retailers to sell their products. Whether a business chooses to make or buy a product drastically changes the mission of the business. This decision can change the focus of the company from perhaps the quality of the product, to the quality of service a customer receives in a store.

All of these questions involve qualification and quantification methods to link internal to external environments. Some of these methods include environmental scan, interviewing key stakeholders, focus groups, large group "strategy sessions", Geography Information System (GIS) maps, and internal and external surveys.[46]

Environmental scans necessitate not only a large amount of information, but also the ability to understand what pieces of this information is essential to the development of the organization's strategy.[47] One of the biggest problems with an environmental scan is that there are massive quantities of data on the subject, much of which does not get included in the environmental scan. This is due to some missing criteria that prevents the information from directly being linked to the organization, or makes the information unreliable (as is often the case in disease cluster analysis).[48] In-order for this information to be used, there must be a direct link

[45] DuPlessis, P. 243
[46] Voorhees, p. 5
[47] Voorhees, p. 3
[48] Voorhees, p. 3

established between the information and the organization.[49] Additional research must be done to make this connection, including an understanding of the organization's operations, by speaking with members of management and staff.[50]

It is essential when conducting an environmental scan to conduct research and gather data within the scope of the organization's structure and culture.[51] Gathering this data also requires the use of qualitative research methods, such as individual and group interviews, and tabulating the data collected. [52] The results of this analysis should be used to create a structure that would be used to analyze and understand the organization's current strategies, and abilities to implement other strategies.[53] This form of analysis could be brought forward in a variation to disease cluster analysis, as detailed below.

Another method of strategic management analysis is interviewing key stakeholders. The interviewer should have a good understanding of the corporation going into the interview, because it allows them to ask more pertinent questions, allowing them to gather better data and information.[54] Qualitative information that is gathered in an interview gives even more formation about how the stakeholders feel an organization and the organization's strategy are working. [55] Having a thorough understanding of how stakeholders feel about the organization's strategy is essential since stakeholders are a key element in implementing new strategies (as well as the analysis associated with disease clusters). [56]

One of the most common methods of strategic management analysis (as well as market research) is conducting focus groups. A focus group is a planned gathering of a certain group or

[49] Voorhees, p. 3
[50] Voorhees, p. 3
[51] Voorhees, P. 3
[52] Voorhees, p. 3
[53] Voorhees, p. 3
[54] Voorhees, P. 3
[55] Voorhees, p. 3
[56] Voorhees, p. 3

demographic, with the intention of gathering specific information, using a specific agenda with planned questions.[57] Similar to the way that an interviewer must prepare for a one-on-one interview or a group interview, the focus group participants must be have a thorough understanding of what kinds of issues the interviewers are trying to understand and solve, and that their input is the first test for the success of new business models. [58] Separating each of the demographics into different focus groups may be problematic and counterproductive. It would probably best serve the intentions of the interviewer to conduct the focus group with all classifications of participants, since it also gives the participants an opportunity to understand each others' perspectives when giving responses.[59] This will help in the strategic planning process that the interviewer is trying to implement, much like disease cluster analysis. [60]

Another useful and effective method of strategic planning is large group "strategy sessions".[61] The purpose of these sessions is to allow different stakeholders the opportunity to exchange ideas with each other about different strategy problems and issues that the organization is currently dealing with.[62] Large group "strategy sessions" are led in a certain direction by the facilitator, as opposed to a focus group, which allows the participants to voice concerns or opinions on any topic they feel is important. [63] The facilitator guides the discussion to gather both quantitative and qualitative data about the organization's strategy and what the data means for the future of the company,[64] or, the present case, what is linked to the disease cluster under consideration. These strategy sessions are intentionally designed so that all participants have a

[57] Voorhees, p. 4
[58] Voorhees, p. 4
[59] Voorhees, p. 4
[60] Voorhees, p. 4
[61] Voorhees, p. 4
[62] Voorhees, p. 4
[63] Voorhees, p. 4
[64] Voorhees, p. 4

common knowledge base, so that the sessions become brainstorming sessions, using the processing techniques and intellect of each participant to develop new ideas.[65]

Geographic Information Systems (GIS) maps are created to give people a quick and easily understood medium to look at population changes over time, including changes in average income, minority populations, age, and property values.[66] Creating these maps involves gathering census level qualitative data, and using GIS software to create logical, clear maps. Looking at how a disease cluster has spread over time using this methodology is incredibly valuable in disease cluster analysis, as the connection may become clearer when looking at the problem from a visual perspective, as opposed to an easily manipulated statistical perspective.

Finally, internal and external surveys are essential to gathering data on specific questions about strategic planning from a large group of people. [67] Surveys cannot be supplemented by individual or group interviews, because while those allow for discussion on a large range of topics, questionnaires provide specific answers and insight on a particular issue from a large population. These surveys can take many different forms, ranging from the traditional pencil and paper surveys, to the now more common on-line surveys. [68] Creating surveys often requires both quantitative and qualitative analysis, while interpreting the results is primarily qualitative. [69] Researchers must work to create questions that have clear-cut answers, which make it easy for researchers to interpret and tabulate the results, which are both considered to be quantitative actions.[70] However, the process of coming up with the types of questions that the researchers want answered in the survey is considered primarily qualitative work. [71]

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[65] Voorhees, p. 4
[66] Voorhees, p. 5
[67] Voorhees, p. 6
[68] Voorhees, p. 6
[69] Voorhees, p. 6
[70] Voorhees, p. 6
[71] Voorhees, p. 6

Applying this array of methods allow a better understanding and hence helps managers to make better strategic decisions, particularly when the situations are very complex, and not much is known about the potential outcomes (not unlike disease cluster analysis). Non-programmed decisions are complex decisions with very uncertain outcomes, which are typically the kind of decisions that strategic managers must frequently make.[72] Understanding the mission of the company gives the manager a greater level of insight to what the business is trying to achieve through each step. There is a great deal of uncertainty in each of these non-programmed decisions, and the manager has a great deal of risk in making any decision. [73] However, the more that a manager understands about the goals of the business, the easier it becomes to make decisions that will benefit the company. It is for this reason that it is absolutely essential for a company to develop a business strategy to guide managers in their decision making process. It is proffered that this kind of philosophy is also essential for determining cause/effect linkage in disease cluster studies.

As previously stated, the purpose of creating a strategy is to determine the future of the business, and map out the direction that management wants to see the business move. Making these basic decisions about what potential customer needs the company is serving, how they are going to serve those needs, and what both the static and flexible strategy of the business are, together creates a company's strategic plan. [74] A company's strategic plan if often released on a yearly basis to inform the rest of management and many employees of the purposed direction for the next year. However, relying solely on this strategic plan in the face of change causes many problems for a company. Management must continue to alter the plan throughout the year to adapt to new changes, rather than wait until the following year's strategic plan is made to

[72] DuPlessis, P. 269
[73] DuPlessis, P. 270
[74] DuPlessis, P. 222

determine the new course of action. [75] Waiting for the next year to make changes will put the company behind of its competitors, and prevent further success. Part of having a good strategy is being flexible to the changing business environment, and adapting the strategic plan accordingly.

Transforming a basic business strategy into a form of applicable strategic management involves taking the strategy, thinking about three levels of concern for the business, and applying the strategy to all of the levels.[76] The goal of the first level is to achieve environmental adaptation, while focusing on the business environment, and the vision of the business. The goal of the second level is to achieve organizational transformation by focusing strategic and structural business choices. The goal of the third level is to reengineer the business to better understand the people, the processes involved, and the technology available.[77] Together, these three areas of focus allow for management to have a unified idea of what they should be doing to reach the goals of business. Strategic management is the process of management making decisions about future plans which are in line with the goals of the business. Thinking on all three levels helps to make these decisions much clearer for management and opens new lenses and cognitive maps for the epidemiologist.

[75] DuPlessis, P. 222
[76] Thomas, lecture.
[77] Thomas, lecture.

Chapter 5

Market Research as a Linkage Perspective

Market research involves collecting, recording and deciphering all available information that is useful to an organization in trying to understand the market, and the products it wishes to link to that market. [78] Market research gathers information in hopes of answering three basic questions: 1) Who makes up the target market? 2) When do they need the product? 3) How is the market changing?[79] In a business market, demand for products is constantly changing, and thus it is important to understand how the market on the whole is changing as well.[80] Market research requires particular techniques and expertise. Such skills are usual aimed at some form of data gathering, involving gathering as much available information as possible about the market in-order to make further decisions. [81] These decisions rely on information gathered through both desk research (i.e. data already collected), and field research (i.e. new data is needed).[82]

The field of marketing research primarily makes decisions by looking at all of the possibilities and all of the factors affecting these possibilities, and conducting an analysis using qualitative and quantitative methods. Marketing research seeks to understand, to the fullest extent possible, the implications of each decision, by investigating each individual aspect of each decision and outcome. Marketing analysis uses several different methods of understanding these choices to their fullest extent. These methods include conducting SWOT analyses, analysis of the "Four Ps", sampling surveys, questionnaires, interviews, and probability models.

While often used in strategic management analysis, one of the most commonly known marketing technique is called a SWOT analysis. SWOT analysis looks at the company or the

[78] The Times 100
[79] The Times 100
[80] The times 100
[81] The Times 100
[82] The Times 100

company's product in relation to its competitors, or its place in the market. The four components of SWOT analysis are Strength, Weakness, Opportunity, and Threat. Strengths identify the attributes of the business or of the product that make it competitive in the current market. Weakness identifies those attributes that make the business less competitive than other businesses. Opportunities identify places for the business to enter into a different market, or a place to introduce a new product into the market. Finally, Threats identify those things in the market that could potentially hinder the company's ability to enter a particular market, or introduce an item into a particular market. This analysis is the most basic level of Marketing analysis. This analysis seeks to identify all of the factors that identify a company or a product in relation to a market. This model can be used to make decisions about what market currently has a need or an opening for a product. This analysis also determines what kind of product the company should make, how they should position the product in the market, and what challenges the company is going to face making this product competitive in the market.

When trying to determine these same types of solutions, marketing also looks at the Marketing Mix, also known as the Four Ps. The Four Ps are Product, Price, Promotion, and Placement. This type of analysis looks at what situation is most ideal in each of these categories, and also what constraints may make the most ideal situation impossible. Product analysis what type of product the company could ideally make, and what technological, time, or financial constraints could prevent this. Price identifies what price the company can set that is both competitive and possible. Promotion determines how the product should be positioned in the market, and how it needs to be contrasted to other products to make it more viable. Finally, Placement, or Distribution, establishes the different elements of the supply chain that should be

used to most effectively get the product to the customer. The marketing mix also helps to make decisions about how the company should go about creating a selling a product.

Market research often uses sample surveys to gather information. This involves surveying a particular portion of the population, e.g. married working women in Pittsburg age 30-45 are used to represent all married, working women age 30-45 living in an urban area in Pennsylvania.[83] Another method of sampling is called convenience sampling, which includes gathering data from whoever is walking down the street.[84] Judgment sampling is a variation on convenience sampling, where the interviewer only asks certain people on the street to participate, based on whether or not he or she appears to fit into a certain category.[85] Finally, quota sampling targets an exact portion of the population, such as male students studying science at PSU. [86]

The most popular method of conducting market research is using questionnaires, which are typically conducting through mail, on the phone, or in person, and increasingly online.[87] Questionnaires are a simple market research tool to use because they are easy to administer, easy for respondents to understand, and yield very detailed information. [88] While questionnaires that are administered via mail are inexpensive, remove interviewer bias, and reach people who are otherwise unreachable, they often yield a very low response level, and thus are not used all that frequently. [89] One of the best ways to administer a questionnaire is online. One way to ensure a higher response level is to ask people to fill out the questionnaire as a part of registering for access to a website.[90] Unfortunately, questionnaires are easy to "cheat" on, so it is the job of a

[83] The Times 100
[84] The Times 100
[85] The Times 100
[86] The Times 100
[87] The Times 100
[88] The Times 100
[89] The Times 100
[90] The Times 100

market researcher to ensure that the questionnaire is designed in such a way to prevent this from happening. [91]

Interviews can also be used as a quick method to gather very specific information.[92] Unfortunately, many people choose not to participate in phone interviews, and thus there is a lower level of response.[93] Also, phone interviews make it difficult for the interviewer to know anything about the person who they are interviewing, perhaps jeopardizing the integrity of the interview data. [94] Another method of interviewing is personal interviews, which eliminates the concern about the integrity of the responses. In a structured personal interview, the interviewer follows a set list of questions, which he or she must ask in chronological order, and chose specific answers from a list of choices. [95] In a semi-structured interview, the interviewer may read the questions in whatever order, and the responses may be open ended.[96] Unstructured interviews consist of simply a prescribed topic, with open ended discussion about the topic. [97]

Market research also includes probability models, which determine the probability of certain outcomes based on different factors. The best tool for conducting a probability analysis is to use the multinomial logit model. [98] This model can be used to determine the probability of a certain outcome of a particular driving factor. [99] Using the multinomial probability model primarily allows marketing analysts to look at a particular driving factor, and determine how likely it is that each of the potential outcomes can occur. However, this model can also be used to

[91] The Times 100
[92] The Times 100
[93] The Times 100
[94] The Times 100
[95] The Times 100
[96] The Times 100
[97] The Times 100
[98] Cramer, p. 107
[99] Cramer, p. 107

calculate the probability that a certain factor in the driving decision will have an effect on the outcomes.

These methods could all be considered as data import devices for disease cluster analysis. With the proper use of each of these tools, market research methods could produce a better way to understand disease clusters, and the cause-effect relationship with toxin producing facilities.

Chapter 6

Applying Marketing and Strategic Management Tools to the Identification of Disease Clusters

The methodologies of strategic management can be applied to the problem of disease clusters, and issue of establishing cause and effect between a toxin producing facility and a community with elevated levels of diseases. Strategic management looks at a problem from three levels: Environmental Adaptation, Organizational Transformation and Competency Reengineering. When applied to disease clusters, this strategic management lens provides three parallel levels of concern; Corporation Action, Disease Center, and Individuals.

Corporate Action refers to the choices that corporations make concerning their production and facilities. This includes the choices to site and build a toxin producing facility, the degree of safety precautions the corporation wishes to take in the facility, the purpose for the facility, and under what conditions will the facility operate. Corporate Action also includes the effects the facility has on the surrounding environment, community, and business market.

Disease Center refers to the Center for Disease Control, and the local disease centers that conduct the preliminary analysis of a suspected disease cluster. This also includes the previously explained process of identifying a disease cluster. However, this new lens creates a change in the process. This level of concern changes the strategy of linking a disease cluster to a toxin producing facility, primarily by changing the starting point of the analysis. This strategy begins with the toxin producing facility, and looks to see how the facility will affect the company's corporate stakeholders.

Individuals are, of course, the affected group that comprises the disease cluster. By knowing more of the cause-effect involved in this type of analysis, we can begin to think of

ways to reengineer subsequent responses to disease clusters by thinking through how to educate stakeholders, benchmark local, parallel events, be able to establish the cost of response, and building better, indeed cost-effective, images for corporation, thereby influencing the quality of environmental l justice.

One tool that could be extremely useful in the problem of establishing cause-effect relationships in disease cluster analysis is conducting focus groups. These focus groups would consist of residents of the community, as well as doctors who practice in the area. These focus groups would look get gain detailed information on certain aspects of the spread of disease. This could include gathering information on when certain illnesses began to appear, what are some of the symptoms, what was the exposure of the sick to the facility like compared to those who are not sick and how low have people been exposed. These groups could also reveal clues as to how toxins may be reaching individuals, by finding information out about where different households water supplies are located, is there soil contamination, do certain part of the community experience more smog or pollution than others, etc., all which would help to draw conclusions about the potential cause-effect relationship between facilities and disease clusters.

Possibly the most useful technique used in strategic management that would assist in a disease cluster analysis is the use of Geographic Information Systems to create disease cluster maps. GIS maps are already sometimes used in the process of proving or disproving disease clusters. However, when used to disprove the existence of a cluster, researchers often only select a certain part of the community to map, to demonstrate that the incidence of disease is not as high as suspected. Strategic management methodology says that in-order to gain a true understanding of the situation, researchers must map the entire surrounding area. Mapping the entire surrounding area can serve two purposes. First, mapping a larger area allows researchers to

make better comparisons over time. When only a small area is mapped, individuals moving in and out of the community are more noticeable, and make the patterns over time more difficult to see. However, when a larger area is mapped, an individual relocating does not have as drastic of an impact on the overall patterns, and makes trends over time easier to identify. Mapping a larger area also allows researchers to gain a greater understanding of how the toxins may be spreading through the community, whether it is along a stream or river, or if there is a wind pattern that matches the disease pattern. Understanding how the toxins may be spreading also helps to explain why some of the statistical data may be so different from the observed incidence of disease.

Both of these methods provide a different way to understand and establish the cause and effect relationship between a disease cluster and a toxin producing facility. These methods both get at what elements of strategic management research can affect the way a disease center conducts its study of a disease cluster and its cause.

The marketing research lens can also be applied to the issue of disease clusters, and the process of proving a cause and effect relationship between a toxin producing facility and elevated disease level. This lens begins by looking at the probability that each of the different variables associated with the problem have a direct effect on the possible outcomes. In all likelihood, when the locations of these toxin producing facilities were decided, a team of marketing analysts completed this same process to identify a location with the least possible resistance. This process can again be used to identify a cause and effect relationship between the facility and the elevated levels of disease, as explained below.

The probability theory looks at the probability that the toxin producing facility is the cause of the elevated levels of disease in the surrounding community. The probability equation

is : ($0 \leq P \leq 1$), where P is the probability that the facility has caused the elevated level of disease, 0 means there is no correlation, and 1 means there is a strong correlation between the facility and the disease. This probability that the correlation exists is a function of the variables related to the problem. The marketing research lens helps to identify variables that will impact the probability of a correlation. This addition to the map permits insight and could lead to better validation of cause effect.

Several different variables are taken into account when determining whether or not the toxin producing facility is the cause of the elevated levels of disease. Using the marketing research lens, we can identify certain variables through the methods discussed earlier:

- Education level of the community
- Population
- Income level
- Plant or facility type
- Education on disease and prevention
- Medical Facilities and Access
- Company Marketing and Reputation

Each of these variables has an effect on the probably that the facility caused the elevated levels in disease. Marketing takes an in-depth look at each of these variables, and then plug them into a probability equation.

The education level of the community allows assessment of what level of schooling the community has received on average. This factor not only contributes to the likelihood that the site was intentionally sited in the community, but also the level of understanding the community may have about the connection between the diseases they are seeing in the community, and the pollutants and toxins the facility is producing. This goes hand-in-hand with the community's education about the diseases and toxins. This education about disease and toxins should theoretically be explained by the company which owns the facility. This education should

theoretically include explaining potential ways to avoid contact with the pollutants as much as possible, such as learning about water contamination, ground contamination, and other safety precautions.

The population is the primarily the only factor that the previous method of disease cluster analysis focused on. However, this is still an important factor in assessing the probability that the facility is causing the level of disease. Marketing would asses the population level, and factor in how much of the population has suffered some kind of illness. Unlike the previous methods, however, marketing takes a more comprehensive look at the prevalence of disease. This would include conducting focus groups to understand the type and extent of diseases, when the first symptoms of the disease begin to manifest and exposure to the facility and the toxins. These are many of the elements that Disease Centers typically ignore in their investigation of a disease cluster. However, marketing would say that all of these elements are extremely important in understanding the probability that a facility caused the elevated level of disease. Using marketing techniques such as focus groups and surveys, researchers can gain a clearer understanding of the full extent of the relationship between the population and the toxin producing facility.

Income levels and access to medical facilities have a similar impact on the probability that the disease levels were caused by a facility. The level of income in a given community affects a community's access to medical facilities. However, the income level also determines a community's ability to relocate to a safer community. The access to medical facilities and the level of medical care also have an impact on how accurately we can determine if the toxin producing facility is the cause of the elevated disease levels. Companies will often make the argument that a community's poor knowledge about healthy lifestyles and access to medical facilities are a major contribution to the elevated level of disease. However, a greater

understanding of the level of disease prior to the siting of the facility, and if the types of disease are generally caused by unhealthy habits is crucial to understanding this variable, and its impact on the probability equation.

Perhaps one of the most important variables is the type of facility that is located within the community. Each type of facility has its own set of dangers, and release a different type of toxin into the environment. When specifically analyzing the type of facility, and thus the type of toxin released, it is easier to identity if the observed type of disease is generally considered an effect of the particular toxin that the facility produces. If there is a well known correlation between the particular toxin, and the type of disease that is prevalent in the community, then this variable increases the probability that facility is causing the elevated levels of disease.

Finally, the issue of company reputation and marketing affect our understanding of the relationship between the facility and the elevated levels of disease. While the image of the company does not have a direct impact on the cause and effect relationship, the image does deeply impact our understanding of the connection. The company's choice to provide certain services to community members, such as education about the facility and toxins, medical care, employment opportunities, and holding open forums for the community to come and voice their concerns about the facility all change the way the company and researchers may view the facility. If the corporation has a strong relationship with the community, community members may see less of a connection between the facility and the elevated level of disease. However, a weak or hostile relationship often results in community members immediately placing the blame for all illness on the facility, even if the claims are not justified. Thus, as a part of understanding the probability that a facility has caused elevated levels of disease, it is important to understand

the perception of the company (e.g. positive or negative bias), and the effect it is having on the probability analysis.

Marketing research would look at all of these variables, and plug them into a probability equation, generating a number that represents the probability that the facility is the cause of the elevated level of disease. Applying the marketing lens to the issue of disease clusters creates a new type of analysis that takes into account all of the factors that may affect the relationship between a disease cluster and a toxin producing facility. This method is more comprehensive, and incorporates other elements of the issue that are essential to understanding the full extent of the cause and effect relationship.

Conclusion

Disease cluster analysis is subjective, inconsistent, and statistically driven. The narrow focus and simple "lens" used for establishing cause-effect linkages promotes unsupported and ambiguous conclusions.

To break out of this pattern of using constrained cognitive maps (and hence, constrained conclusions), this thesis introduced the concept of using "new" lenses drawn from two other disciplines (marketing research and strategic management). By breaking away from the currently used simple set of tools for determining cause-effect linkages in disease clusters, new insights and findings may be possible. The tools and perspectives of these disciplines provide clues as to how to make the cognitive shift that would be needed in disease cluster work to be more effective and consistent. The next step in this research is that the field needs to document the impact of using new lenses to validate the cause/effect relationships with disease clusters.

In the collective, these new ways of "seeing" the problem and making sense of each situation may have a profound effect on the field. It is recognized that there are many other ways, methods, tools, and philosophies that could also help. But these two disciplines are driven, indeed defined, by exploring cause-effect linkages -- linkages between products and markets, linkages between strategies and environments, linkages between action and performance. In this sense, they bring formidable insight to the problem of establishing linkages in disease cluster analyses. Work should continue to establish a formal toolbox of methods and perceptions. This thesis is a first step in that direction – a move down a path of new insights for not just indentifying linkages between toxin-producing plants and disease centers, but establishing a pattern that could prevent such disease clusters in the future.

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ACADEMIC VITA of Diana Lynne Reese

Diana L. Reese
25 High Mountain Drive
Boonton, NJ, 07005
Dreese331@gmail.com

Education:

Bachelor of Science Degree in Accounting, Penn State University, Spring 2011
Minor in Geography
Honors in Management
Thesis Title: Managerial Cognition and an Application to Disease Clusters
Thesis Supervisor: James B. Thomas

Related Experience:

Internship with Pricewaterhouse Coopers
Summer 2010

Awards:

Dean's List
Golden Key Honors Society
The National Scholars Honors Society

Activities:

Morale Captain, THON 2011, Penn State IFC/Panhellenic Dance Marathon