Cluster Evaluation Methodology:

I) Introduction

The purpose of this paper is to introduce a newly developed methodology for evaluating the attractiveness of industrial clusters and to make this evaluation a useful tool in regional economic development policy. The industrial cluster evaluations are intended to be used by regional economic development agencies, companies, and other interested parties in evaluating the viability of industrial clusters in specific geographic regions. Moreover, the analysis is intended to help the governmental agencies to better allocate their resources intended for regional economic development by channeling investment in local business activity toward viable industrial clusters and by enticing firms to locate in these regional clusters, thus improving the overall regional economic performance.

At the core of our analysis is the Cluster Theory which predicts many positive externalities for firms located in highly concentrated and viable industrial clusters. This theory is the driving force behind our research into the identification and evaluation of industrial clusters. It is our intention to use this analysis in improving the ability of regional economic development agencies to attract the right firms to their region by indicating the strengths of the existing clusters, improving upon the weaknesses of the clusters, and by suggesting areas of possible improvement for emerging clusters. Furthermore, it is our intention to help regional economic development agencies with increasing the performance of their region’s economy.
II) Methodology

a. The McKinsey Method

The methodology for the evaluation of industrial clusters in Northwest Ohio is largely based on the “Analysis of Market Attractiveness” developed by McKinsey & Company to improve the allocation of corporate funds toward investments in new markets. We will first discuss McKinsey & Co.’s methodology and then illustrate how it was adapted for our purposes.

A major goal of McKinsey & Co.’s analysis was to properly evaluate the attractiveness of a market using a multitude of indicators rather than to rely on the customary one-dimensional analysis such as the market growth rate or market share. McKinsey & Co. assumed that a multi-dimensional analysis better portrays the complexities of a market because it reflects the understanding that market attractiveness is a function of several components. Strategic decisions based on such analysis should prove to more sound as they are a better reflection of market realities.

Although the choice of the individual indicators of market attractiveness is somewhat subjective in nature, the indicators correspond to three major meta-categories that are descriptive of the market. The three meta-categories are market potential, market structure, and the external environment. In addition, several sub-categories fall under each respective meta-category. The market potential is assessed by estimating the market size, market saturation, and the market growth rate. Market structure is composed of suppliers, buyers, new entrants, substitute products, and intensity of rivalry. Finally, the
external environment comprises the general economic conditions, political situation, technology, and societal factors.

Each sub-category is assessed using a set of quantitative or qualitative data and given a score of attractiveness that ranges between 0 and 10. Once the assessment of all individual sub-categories is completed we have an approximate picture of the level of attractiveness for the analyzed market. To further clarify the evaluation, we weigh each sub-category score by its relative percentage importance to market attractiveness and sum all of the scores. The weights to each sub-category score are subjective, depending on their relative importance, but when summed they must add to 100 percent. The weighted scores are then summed to give a final score of market attractiveness that ranges from a least attractive score of 0 to a very attractive score of 10. Naturally, in nearly all market evaluations the score will fall somewhere in between this range.

Most of the sub-categories in the McKinsey & Co. analysis are evaluated based on quantitative data and tend to be free from subjective errors of the evaluator. However, some categories, especially those falling under external environment, may not be assessed using qualitative methods. Both the McKinsey and our evaluation contain sub-categories with quantitative and qualitative assessments. In case of the latter assessment, our evaluation contains methodology that tries to minimize the subjective nature of the assessments of external factors. The illustration below shows the method as applied by McKinsey & Company in real market evaluations:
<table>
<thead>
<tr>
<th>Indicators of Market Attractiveness</th>
<th>Assessment of Attractiveness</th>
<th>Weights</th>
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<tbody>
<tr>
<td>I) Market Potential</td>
<td>Low</td>
<td>Middle</td>
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<td>- Market Potential</td>
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<td>- Output Growth</td>
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<td>X</td>
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<tr>
<td>- Average Wages</td>
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<tr>
<td>II) Market Structure</td>
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<td>- Suppliers</td>
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<td>- Buyers</td>
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<td>- New Entrants</td>
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<td>- Substitute Products</td>
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<td>- Intensity of Rivalry</td>
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<tr>
<td>III) External Environment</td>
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<tr>
<td>- Economic Conditions</td>
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<tr>
<td>- Political situation</td>
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<td>- Technology</td>
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<td>- Societal Factors</td>
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<tr>
<td>IV) Total Score</td>
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<td>5.01</td>
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Source: Die Ansaezte der Grossen Unternehmensberater

As can be seen from the evaluation matrix, the McKinsey & Co. analysis can be applied to various markets of interest. The resulting evaluation score, shown in the last row, is an example of a market attractiveness score for a fictitious market. Of course, a real evaluation matrix would be accompanied by research data supporting each evaluation sub-category.

Another advantage of this method is the ability to consider several influential factors and to bring down the analysis to one common denominator, i.e. the final
tabulation of all the weighted scores. In addition, the methodology is flexible in that the categories can be changed depending on the characteristics of the evaluated markets. For instance, the weights can be reallocated to reflect the importance of different categories to various markets. For instance, external factors may have less relevance for markets characterized by high demand inelasticity. This characteristic would be reflected by giving less weight to the final assessment of this category. Furthermore, the categories can be changed if some of the sub-categories do not reflect any importance to the market being evaluated. This may include removing some of the sub-categories or replacing them with more relevant categories. Finally, the efficiency of the method calls for no more than 15 sub-categories. Clearly the more sub-categories that need to be included in the evaluation, the more diluted the weights for each respective category would become. Therefore, we observe that additional sub-categories would have diminishing usefulness for our purposes and would only prolong the task of gathering data and completing the evaluation.

b. The McKinsey Method Adapted

As mentioned earlier, our intention was to design a tool that would allow regional development agencies to develop a quick assessment of the needs of their economies. We believe that the Cluster Theory holds much promise for designing new regional growth strategies. Therefore, we are convinced that local economies can be strengthened and built around viable industrial clusters which offer firms positive external spillovers and various synergies. We will elaborate on this point later in the paper.

The final step of our analysis was to design a cluster evaluation tool that could clarify which local industries were strongly clustered, or had a strong potential to become
clustered, and therefore had to be focused upon. If a regional industry was not found to be strongly clustered, the method allows to pin-point the characteristics of these industries that need to be strengthened in order to fill the gaps in the cluster and allow regional firms to derive the benefits proposed by the Cluster Theory. The figure below demonstrates the adapted McKinsey methodology for the purposes of cluster evaluations.

**Evaluation of Cluster Attractiveness: Multi-Factor Approach**

**Transportation and Warehousing: NAICS 481,483,484,493**

<table>
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<tr>
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<td></td>
<td>Low</td>
<td>Middle</td>
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<td></td>
<td>1</td>
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<tr>
<td><strong>I) Cluster Potential</strong></td>
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<tr>
<td>Location Quotient</td>
<td></td>
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<tr>
<td>Number of Firms</td>
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<tr>
<td>Output Multiplier</td>
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<tr>
<td>Shift &amp; Share (Competitive Comp.)</td>
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<tr>
<td><strong>II) Cluster Industry Performance Characteristics</strong></td>
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<tr>
<td>Output/Worker</td>
<td></td>
<td></td>
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<tr>
<td>Total Value Added/Worker</td>
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<tr>
<td>Output Growth</td>
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<tr>
<td>Employment Growth</td>
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<td>Average Wages</td>
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<tr>
<td>Percent of Local Demand met by Local Suppliers.</td>
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<tr>
<td><strong>III) External Environment</strong></td>
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<tr>
<td>Supporting Industries</td>
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<td>Labor and human resource pooling</td>
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*NAICS 481,483,484,493*
Note that the cluster evaluation matrix differs from that of McKinsey only in a couple of respects. Foremost, the matrix is used to evaluate the attractiveness of an industrial cluster vs. not a particular market. As a result the measured sub-categories are different and are more numerous. The scale of possible scores also ranges from 1 to 10 and there are two additional sub-categories.

The next section will give a description of each sub-category included in the evaluation, give justification for the inclusion of a particular sub-category, and provide the method and source of data gathering for each respective sub-category.

c. Descriptions of the sub-categories

a. Location quotient

The location quotient is a method used by urban economists to determine the relative concentration of an industry within a region. The location quotient allows us to make sense of the relevance of an industry in the scope of the national economy or any benchmark region with which we wish to compare the regional industry. Although there are two basic types of location quotients, based on employment and output, we will utilize the employment location quotient in our analysis.

The employment location quotient is composed of two factors. In the numerator we have the percentage employment in an industry within a given area, in the denominator the percentage of national employment in the industry. Other benchmark

| Access to information and performance measures | X |   |   |   |   |   |   |   |   |
| Access to inputs and infrastructure | X |   |   |   |   |   |   |   |   |
| **IV) Total Score** |   |   |   |   |   |   |   |   | 100% |
comparisons may include the state, region, nation, or even a wider geographical area. Likewise, the output location quotient contains the percentage industrial output in a given area and compares that with the industrial output in the benchmark area. The industrial output is defined as employment or output in a given group/s of firms as outlined by the North American Industrial Classification System (NAICS). Equation 1 demonstrates the formula used in the calculation of a location quotient:

\[
LQ_i = \left( \frac{e_i}{e_t} \right) \div \left( \frac{US_i}{US_t} \right)
\]

Where:

- \( LQ_i \) = Location quotient for industry \( i \)
- \( e_i \) = Local employment in industry \( i \)
- \( e_t \) = Total local employment
- \( US_i \) = National employment for industry \( i \), and
- \( US_t \) = Total national employment

We have included the location quotient in our analysis because it is a primary indicator of industrial clustering. A location quotient of less than 1 indicates that the regional economy has a smaller share of output or employment for a particular industry than the national average. A location quotient of 1 indicates that regional industrial concentration averages that of the nation. Finally, a location quotient above 1 shows that the regional industrial concentration exceeds that of the national average. Again, it must be mentioned that the location quotient comparison is not strictly confined to that of a regional economy vs. the national economy, but it can be made with any other economic region.

The location quotient analysis can be carried out on multiple levels of industrial detail and can aid in pin-pointing the missing gaps in a cluster. We may start our analysis
by concentrating on two-digit NAICS code data to analyze the concentration of a regional industry. This analysis would reveal the industrial concentration of a region at super-category level such as that of the mining or the manufacturing sector. However, when we perform the analysis at a more detailed level, we may find that not all NAICS codes falling under the definition of the super-category are as concentrated as the more broad definition. In fact, some of the three or four-digit NAICS codes may have location quotients that are much different that the location quotient of the super-category. Other industries falling under the super-sector may be missing altogether in the region; this would be an indicator of missing gaps in the cluster. Weaker location quotients would be good indicators of weak links in the cluster. (Urban & Regional Economics, page 121-122).

Finally, a location quotient can also confirm existing competitive advantages or disadvantage in a region. A high location quotient for a regional industry can be explained using one of the four elements of Porter’s diamond. For instance, many information technology clusters tend to form in regions where factor conditions have formed a strong human and knowledge capital pool. As a result we may be able to explain high location quotients for the IT industry in regions where the formation of human capital is especially evident.

The location quotients calculated for our analysis are based on employment data. The employment data used in calculating the location quotients was obtained from the 11 county and the USA output models built in IMPLAN Professional. It is important to point out that the data for the numerator and denominator came from a single source. Because methods of accounting for employment differ depending on the source, using
data from two or more sources might not reflect the true proportion of the employment in
the region and the nation. Hence, the location quotient calculated in such a manner may
not be correct.

**a. Number of firms**

The number of firms indicates the competitive structure of the regional industry. While it is possible that a regional industry may have a high location quotient, if most of the employment and output is being produced by a single or a few firms, the external spillovers and synergies predicted by the Cluster Theory will not occur. The interaction and competitive pressures that are associated with clustered industries are predicted to occur in a competitive environment where there is a significant number of firms in the area and when those firms have an opportunity to interact with each other. Thus, our evaluation places more emphasis on highly concentrated industries with a significant number of firms.

Furthermore, if the number of firms in the region is growing there is an indication of vitality of the regional industry which signals possible location advantages to potential newcomers. Our analysis assigned a higher score on this category for those clusters where there is a **significant number of firms** and if the number of firms increased during our period of observation.

The number of firms was obtained at the specific NAICS code for all 11 counties making up our cluster model. The data on number of establishment is available at the County Business Patterns which is provided as a part of the United States Census. This database provides a number of firms at a county level for a specific NAICS code. The number of firms was determined for the years 1998 and 2001.
d. **Output Multiplier**

The output multiplier estimates the direct and indirect effects on regional industrial output by output produced by the cluster members. A high output multiplier indicates that an increase in output by the cluster members has a large impact on the spending of other regional industries. For instance, an output multiplier of 1.8 indicates that for every dollar of output increase by the clustered industry X, spending by all other firms in the region will increase by 1.8. An output multiplier, however, will not capture those effects resulting from output increase by one industry on those industries that are located outside of a modeled area. Thus, an industry may have a low output multiplier because its output increases have effects outside of the model area. The output multiplier used in our analysis is a Type I multiplier, meaning that it does not include effects on household spending.

The output multiplier data was obtained from the 11 county model built in IMPLAN professional 2001. Our analysis assigns a higher score to clustered industries with a high output multiplier due to larger economic impact that such an industry would have on its region.

e. **Shift & Share (Competitive Component)**

Shift-and-Share analysis provides an insight into the causes of regional economic growth. The shift-and-share analysis divides an area’s economic growth into three components. The first component is called the Share Component. This component indicates how many jobs should have been created in regional cluster if it grew at the average national rate. The second component is called the Mix Component. The Mix
Component indicates growth that differs from the national growth rate because of industrial composition of an area. An area with a disproportionate employment in a declining industry would have a negative mix component to reflect the fact that job growth, or decline, was far below the average national job growth. The third component of the shift-and-share analysis is the Competitive Component. This component indicates whether the regional cluster grew more or less rapidly than the national average growth for that industry.

Our analysis focuses only on the Competitive Component of the shift-and-share analysis as it is the only element which compares regional industrial growth with the industry’s growth in a wider geographic area. The Share and Mix Components only benchmark the job growth with the average national growth. Because there is no indication that a regional industry employment should grow above or at par with the national employment growth, we find such comparisons not helpful. Instead, we believe that regional industrial clusters may have potential advantages when their employment growth exceeds the growth of the industry in a wider geographical area. When a regional cluster expands above the national average for a period of several years, there is a strong indication that the region has potential advantage for firms in this industry to locate there. To exclude the possibility of measuring spontaneous short-term growth due to various factors such as poor managerial decisions or short-term government incentives, the period of analysis spans several years. Equation 2 demonstrates the method of calculation for the shift-and-share analysis and its three main components:
\[ \Delta e_i = e_i((US^*/US) - 1) + e_i((US^*_i/US_i)) + e_i((e_i^*/e_i) - (US^*_i/US_i)) \]

*Where:*

- \( \Delta e_i \) = The change in local employment in industry \( i \)
- \( e_i \) = Local employment in industry \( i \) at the beginning of the period
- \( e_i^* \) = Local employment in industry \( i \) at the end of the period
- \( US^* \) = Total U.S. employment in industry \( i \) at the end of the period
- \( US \) = Total U.S. employment at the beginning of the period, and
- \( i \) = indicates a reference to a specific industry \( i \)

The employment data used in calculation of the three components of the shift-and-share analysis is derived from the County Business Patterns database. The beginning year for the analysis is 1998 and the ending year 2001.

These four sub-categories comprise the major category of Cluster Potential. They give us a basic picture of the potential for the regional industry to derive the benefits predicted by Cluster Theory. These sub-categories are not necessarily indicators of industry performance in the future, but rather they exemplify the industry structure in the region. However, because regional industry performance is definitely related to these factors, a strong Cluster Potential may be reflected by the cumulative effect of past industry performance. (expand on this)

**f. Output per Worker**

This next set of sub-categories falls under the Cluster Industry Performance Characteristics. This major category tries to capture the picture of the competitive advantages enjoyed by the regional clusters. High performance of the regional firms in this category indicates advantages of locating within the potential cluster. Firms that tend to be competitive and lead in their will often serve as a performance benchmark for the remaining members of the cluster. In addition, they will entice newcomers to locate in
the area to benefit from these advantages. Furthermore, a competitive regional industry will allow regional firms to learn from each other and will further strengthen the competitiveness of the region. (expand on this…)

The output per worker sub-category measures the efficiency with which the regional industry is able to produce its output. The output per worker in the regional cluster is compared with the output per worker that is produced in the industry nationwide. Generally, the higher the output per worker in the regional cluster, the better the efficiency of the regional firms. Such efficiencies are usually indicative of superior management performance in value chain activities of the regional firms. In addition, for the manufacturing sector a high output per worker may also indicate that on the average the regional industry is more capital intensive than the industry nationwide.

The output per worker was calculated based on the 11 county output model built in IMPLAN Professional 2001. The calculation was performed by dividing total cluster industry output in the 11 county region by the number of workers employed.

g. Total value added per worker

This sub-category is a similar measure to the one discussed previously. It measures how much value was added by each worker in the cluster and compares that to the average for the nation.

To obtain the total value added per worker in the region, the total value added in the regional cluster was divided by the total number of employees. The total value added per worker in the national industry was calculated in a similar manner. The two figures were then compared.
h. Output Growth

Output growth is the primary measure of the rate of expansion of the regional cluster. This sub-category measures the vitality of the regional cluster over a period of several years. A comparison is also made between the regional cluster expansion and the general expansion of the industry in the nation. In general, the higher the output growth the more attractive the regional cluster. This holds especially true if the regional cluster performance is above that of the national industry.

Due to the lack of output data at the county level for 1998, we were not able to determine output growth using output data. Instead, we utilized employee payroll dollars available at the Business County Patterns as a proxy for output and measured the change from 1998 to 2001. When the data for the 2001 Economic Census becomes available in the middle of 2005, it will be possible to utilize this data set with the 1997 Economic Census data which is available at the county level to directly measure the growth in output. Output growth was measured by determining the percentage change in regional cluster output from 1998 to 2001. Additionally, the output growth in the national industry was measured during the same time period to provide a benchmark.

i. Employment Growth

Employment growth has a similar purpose in our analysis as output growth. The employment growth indicates the vitality of a regional cluster and compares its growth with the average for the national industry. It is assumed that regional clusters displaying employment growth exceeding that of the nation hold special competitive advantages that
allow them to outperform average industrial growth rates. The higher the employment growth in a region as compared with the nation, the higher is the score on for the cluster in this criterion.

The employment data was collected at the county level from the County Business Patterns database and was measured from 1998 to 2001.

j. Average Wages

Average wages represent the cost attractiveness of a regional cluster. While high-wage jobs are preferred by regional development agencies, they may be a deterrent to firms wishing to remain in the region and those which consider entering the region due to concerns over cost concerns. Capital intensive industries whose labor costs often constitute a small percentage of value added may not view average wages as a major determinant of cluster attractiveness. However, labor intensive industries whose wage costs do represent a significant percent of total value added will likely place significant emphasis on their labor costs when determining their location.

Our analysis assigned higher scores to clusters whose average wages were below those of the national industry. Average wages were calculated using the 11 county and USA models built in IMPLAN Professional. The wages were determined by dividing the total payroll numbers by the number of employees working in a given industry.
**k. Percent of Demand Met by Local Suppliers**

The final sub-category of the Cluster Industry Performance Characteristics measures the ability of the regional cluster to source the inputs to its production inputs locally rather than having to get these inputs from other geographic regions or having to vertically integrate. The percent of demand met by local suppliers is an important indicator of the level of development of the supplier industries located in the region which are ready to serve the needs of the regional cluster. These supplier networks are important to the proper functioning of a cluster and often determine the strength of a cluster. A better developed supplier network means lower costs of production for the cluster and higher responsiveness of the suppliers to the needs of the regional cluster. This translates into cost advantages for the cluster and better quality products and services. In his book “On Competition”, Michael Porter agrees by stating that “Access to inputs within a cluster can also be more efficient or effective than vertical integration. Outside specialists are often more cost effective and responsive than in-house units, not only in component production but also in areas such as training… Proximity of vendors allows efficient quasi-vertical integration while preserving strong incentives.” (On Competition, page 215) Examples of supplier networks include providers of automotive parts for auto manufacturing clusters or beef ranchers supplying the meat processing industry.

The data for this sub-category was obtained directly from the 11 county model built in IMPLAN Professional. A higher score was assigned to regional clusters whose business needs could be satisfied to a high degree in their region of operations.
1. Supporting industries

Is this the same category as the previous one???

m. Labor and human resource pooling

The sub-categories falling under the External Environment category measure the favorability of the external factors with respect to a particular cluster. Conditions in the general environment will often times have a significant impact on the operations of a cluster within a region even when these conditions are not in the control of the firms in the regional clusters. A large part of the external environment is impacted by the actions of governmental entities and other organizations operating on government funds such as universities or research centers. As an example, the Federal and State governments influence the competitiveness of a region through their fiscal policies. In addition, law and regulations determine the scope of the operations of a cluster.

The first sub-category falling under the External Environment is labor and human resources pooling. This sub-category measures the regional availability of a qualified labor force to supply the human resources needs of the cluster. The higher the availability of such a labor force in the region, the lesser the transactional costs associated with attracting and hiring the labor force. (On Competition, 216) This also offers the firms a much better pool of qualified candidates from which the clustered firms can choose. Thus, favorable labor and human resources pooling can serve to lower firm costs and improve the quality of a firm’s processes through a superior workforce.

The labor and human resources pool availability in a region can be ascertained by measuring two factors. Foremost, we need to answer the question of what is the current
skill level of the region’s workforce. In other words, what is the average educational attainment of the workforce as compared with the average educational attainment in the clustered industry. This comparison reflects whether the education level of a workforce in a particular region is at the minimum at par with the requirements of the industry. Educational attainment of the regional workforce that is close to that of an industry, indicates more favorable pool of qualified candidates. To make the comparison between educational attainment in the region and in the clustered industry, we utilized county census data and educational attainment data listed by NAICS code and calculated the average years of education for the two groups. We then compared the average years of education of these two groups.

Secondly, we developed a picture of the ongoing educational and vocational efforts in regional institutions that provide potential future labor force for a regional cluster. We looked specifically for vocational programs and college degree programs that trained potential future employees for the cluster. Specifically, we looked at the educational programs at levels available at the three major educational institutions in Northwest Ohio, Bowling Green State University, University of Toledo, and Owens Community College. We felt that a greater number of degree programs geared towards a particular cluster, was an advantage to the clustered firms located in the region.

Overall, we gave a higher score to those clusters whose human and labor resources pooling needs were being met by educational institutions in the region.
n. Access to Information and Performance Measures

This next category represents the more subjective part of our analysis. It tries to capture the regional availability of specialized information needed for the continual evolution of firms to produce more efficiently and to innovate. Our analysis tried to establish the existence of a number of private