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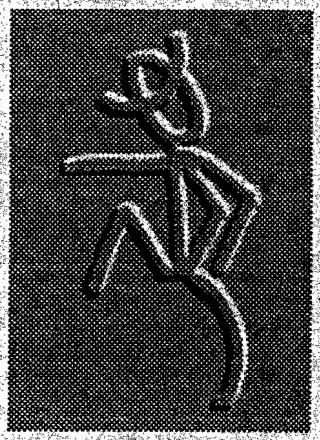

# Interregional competitiveness and diversification*

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SCHNORBUS, R.H. AND DAVID D. WEISS. 1996. Interregional competitiveness and diversification, **Urbana** III (1): 3-19. The Great Lakes economy has been strengthened in the 1980s by the reemergence of manufacturing as a driving force in the U.S. economy and by the increasing competitiveness of those industries in the Great Lakes, relative to other regions. In the process of becoming more competitive, the structure of the Great Lakes economy has evolved into a more diversified economy than existed in prior years. Yet, compared to other regions, the Great Lakes remains the least diversified of any regional economy.

## I. Presentation

The role of the Great Lakes region as the industrial heartland of the nation has been diminishing at an alarming rate for many years. Since the beginning of the 1970s, the region has lost nearly one-quarter of its once commanding 37 percent share of the nation's production of goods. Even within the Great Lakes economy, the importance of manufacturing to the total output of goods and services has been declining in every state except Wisconsin (Figure 1). This trend toward deindustrialization whether measured by the importance of the region's manufacturing sector to the nation or to the regional economy, is a serious concern to policy makers responsible for stimulating regional industrial growth. At a time when the Free Trade Agreement will be opening the Great Lakes to increased competition from Canadian manufacturers, policy makers must weigh the merits of attempting to expand the region's dependence on manufacturing against nurturing new industries outside of the manufacturing sector. If the right choices are made, the region's slow spiraling decline may finally end. Unfortunately, policy makers seldom have an analytical framework on which to base their choices.

Some insights into how the Great Lakes economy is changing and, thus, how policy makers might shape development strategies can be gained by comparing structural change and diversification of the Great Lakes economy relative to other regions of the nation. The Great Lakes is not alone in experiencing deindustrialization. New England and the Mideast regions have also shared in a trend away from a manufacturing-based economy. However, even regions that are industrializing their economies share one thing in common with the Great Lakes—their industrial structures over time are becoming more like the

* Reprinted from Testa, William A. (Ed.). 1991. *The Great Lakes Economy. Looking North and South.* Chicago, Ill.: Federal Reserve Bank and the Great Lakes Commission, with permission of the Federal Reserve Bank.

nation's. While each region has a distinctive economy, regions are diversifying their economies. How have the Great Lakes' industrial structure and competitiveness of individual sector shaped the direction and pace of structural change and diversification?

ferences among regions can be identified. Regional specialization of a sector occurs when the share of a particular sector in a regional economy is greater than that sector's share of the national economy.

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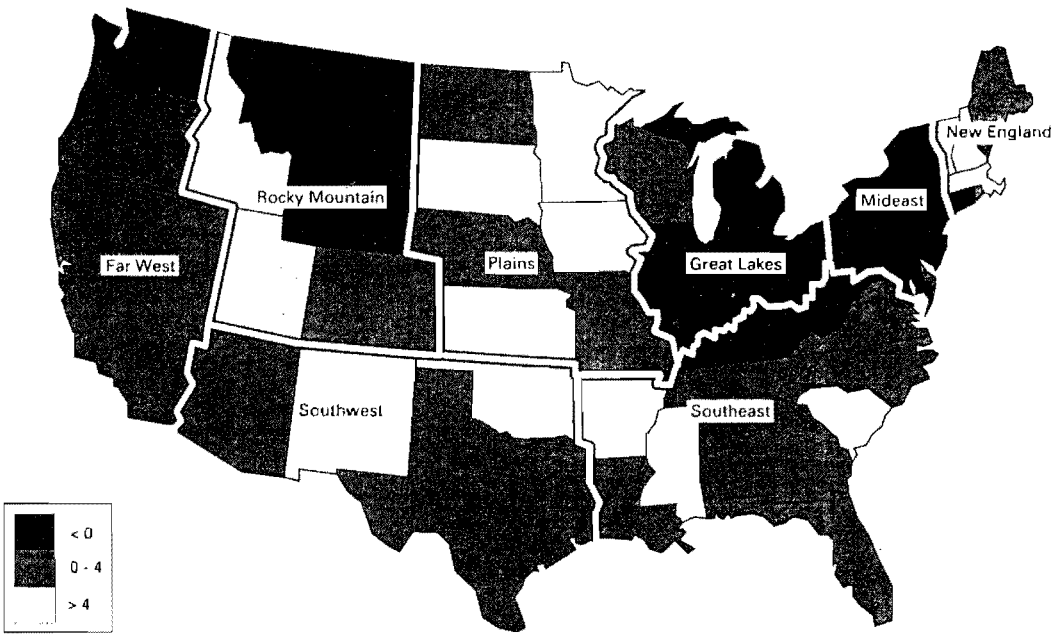
FIGURE 1. Percent change in manufacturing share of income, 1969-88




## II. Structural differences among regions

As the image of an "industrial heartland" would suggest, the structure of the Great Lakes economy has been dominated by manufacturing activity. Although this concentration in manufacturing conceals a diversity of economies among the states within the region, there is far greater diversity among regions. Using nonfarm income shares income shares of the eleven major industrial sectors in 1988 (most recent data available), structural differences among regions can be identified. Regional specialization of a sector occurs when the share of a particular sector in a regional economy is greater than that sector's share of the national economy.

The Great Lakes economy is currently specialized in two major sectors durable and nondurable goods manufacturing. Both sectors might be characterized as representing a high degree of specialization, that is, the shares of income in these two regional sectors are more than 10 percent higher than the sector's share for the nation as a whole. Of the two sectors, durable goods manufacturing is by far the most important. For example, over 20 percent of the region's income is derived from this sector, compared to only 13 percent nationwide. Put in a somewhat different perspective, 13 percent of the

region's income comes from producing the durable goods needed by the region (using the nation as the norm). Thus, the difference between what is consumed internally and produced in total (i.e., the remaining 7 percent) can be attributed to producing durable goods that are exported to other regions and nations. The 7 percent coming from exports is larger than the share of income derived from half of the remaining sectors in the region and almost as large as the total share of the nondurable goods sector. Manufacturing activity, especially in the production of steel, autos, and capital goods, clearly defines the Great Lakes economy.

TABLE 1. Sectors of specialization by state

| 1970 | Illinois | Indiana | Michigan | Ohio | Wisconsin |
|---|---|---|---|---|---|
| Agricultural services | | | | | |
| Mining | | | | | |
| Construction | | | | | |
| Nondurable goods | S | | | S | HS |
| Durable goods | HS | HS | HS | HS | HS |
| Transportation and public utilities | S | | | | |
| Wholesale trade | HS | | | | |
| Retail trade | | | | | S |
| Finance, insurance and real estate | S | | | | |
| Services | | | | | |
| Government | | | | | |
| **1988** | **Illinois** | **Indiana** | **Michigan** | **Ohio** | **Wisconsin** |
| Agricultural services | | | | | |
| Mining | | | | | |
| Construction | | | | | |
| Nondurable goods | S | HS | | HS | HS |
| Durable goods | S | HS | HS | HS | HS |
| Transportation and public utilities | HS | S | | | |
| Wholesale trade | HS | | | | |
| Retail trade | | | | | |
| Finance, insurance and real estate | HS | | | | |
| Services | | | | | |
| Government | | | | | |

Key: S= less than 10% above U.S. average. HS= 10% or more above U.S.

With the exception of Illinois, industrial structures of the Great Lakes states deviate little from the regional average (Table 1). Led by Michigan, with 28 percent of its income generated in that sector alone, each of the five states displays a specialization in durable goods manufacturing. Michigan's high degree of concentration in durable goods leaves little room for the state to be specialized in any other sector. The other four states show additional specialization in nondurable manufacturing, but surprisingly little else. Among the five states, only Illinois has managed to develop an economic specialization outside of manufacturing.

Illinois has an economic specialization in transportation and public utilities, wholesale trade, and finance, insurance and real estate. Largely due to its transportation network, warehousing infrastructure, and commodity markets, Chicago serves the role of "merchant" to the rest of the region, exporting its business-related services throughout the Great Lakes states. Indeed, Illinois has an industrial structure more similar to New England—the epitome of the Yankee trader—than to the Great Lakes region.

In fact, every other region of the nation has a broader base of specialization than the Great Lakes (as shown in Table 2). Each region of the nation has at least two industries in which it is highly specialized, and each has two or more additional industries in which it has at least some degree of specialization. For example, both New England and the Southeast have a high degree of specialization in four industries and a low degree of specialization in three additional industries. Even the sparsely populated Plains and Rocky Mountain regions have avoided having

their economic fortunes concentrated in such a narrow range of industries as the Great Lakes.

TABLE 2. Sectors of specialization by region

| 1970 | New England | Mideast | GreaL Lakes | Plains | Southeast | Southwest | Rocky Mountain | Far West |
|---|---|---|---|---|---|---|---|---|
| Agricultural services | | | | HS | HS | HS | HS | HS |
| Mining | | | | | HS | HS | HS | |
| Construction | S | | | S | S | HS | HS | |
| Nondurable goods | S | HS | | | HS | | | |
| Durable goods | HS | | HS | | | | | |
| Transportation and public utiilities | | S | | HS | | S | HS | |
| Wholesale trade | | S | | HS | | HS | S | |
| Retail trade | | | | HS | S | S | HS | S |
| Finance, insurance and real estate | S | S | | | | | | |
| Services | HS | HS | | | | | | HS |
| Government | | | | | HS | HS | HS | HS |

| 1988 | New England | Mideast | Great Lakes | Plains | Southeast | Soulhwest | Rocky Mountain | Far West |
|---|---|---|---|---|---|---|---|---|
| Agricultural services | HS | | | S | S | | S | HS |
| Mining | | | | | HS | HS | HS | |
| Construction | HS | | | | S | S | | S |
| Nondurable goods | | S | HS | HS | HS | | | |
| Durable goods | HS | | HS | | | | | S |
| Transportation and public utilities | | | | HS | HS | S | HS | |
| Wholesale trade | S | S | | HS | | | | |
| Retail trade | S | | | S | S | S | S | S |
| Finance, insurance and real estate | HS | HS | | | | | | |
| Services | S | HS | | | | | | HS |
| Government | | | | | HS | HS | S | |

Key: S= less than 10% above U.S. average. HS=10% or more above U.S.

Despite greater diversity than the Great Lakes, all regions have retained distinctive economies. The Mideast, reflecting the dominance of New York City and (to a lesser extent) Philadelphia, is clearly a service economy, with a high degree of specialization in financial institutions and services industries. Still the Mideast retains some specialization in nondurables and wholesale trade. The Far West has a high degree of specialization in sectors on both the goods and the service-producing sides of its economy, as well as two sectors with low levels of specialization. Both New England and the Southeast have above-average concentrations of income in seven of the eleven industrial sectors. However, New England has more sectors with specialization in the service-producing side of its economy, while the Southeast has more specialization on the goods-producing side of its economy. The Plains tends to be linked to agriculturally related activities, ranging from agricultural services to food processing. Finally, the Southwest and Rocky Mountains reflect both region' rich oil and other mineral resources.

The specialization at the sector level fails to reveal the scope of diversity that exists among regions at the more detailed industry level. The durable goods sector in the Great Lakes, for example, is entirely different from the durable goods sector in New England. Yet, one need not display a mountain of detail in order to identify a region's key industries. By going down to the two-digit level of industrial classification, the regions can be well defined by their top five industries of specialization (Table 3). In the Great Lakes region four of its top five specialties can be found in durable goods manufacturing, which essentially defines its industrial complex of steel, autos, and machine

tools. The Far West's distinct association with Holly-wood, Boeing, and mineral resources can also easily be identified in this fashion. The Plains' resources are di-rected towards the processing and handling of food. Both the Southwest and the Rocky Mountain regions are heavily focused on natural resources, reflected in their specialization in min-ing. The Southeast centers on the nation's tobacco, textile, and furniture industries. And the Presence of Wall Street and Washington, D.C. is reflected in the Mideast specialization in security brokers and museums. Only New England, which hosts so many specialized sectors, fails to be suitably represented by its top five industries (however, the presence of Hartford, Connecticut emerges with the region's sixth most specialized industry—insurance carriers).

TABLE 3. Industrial specialization by region: Top 5 rankings

| New England | Southeast |
|---|---|
| Fisheries | Tobacco manufacturers |
| Leather and leather products | Textile mill products |
| Misc. manufacturing | Coal mining |
| Instruments and related products | Forestry |
| Educational services | Furniture and fixtures |
| **Mideast** | **Southwest** |
| Securities & commodities brokers and services | Oil and gas extraction |
| Local and interurban passenger transit | Pipelines except natural gas |
| Educational services | Metal mining |
| Museums, botanical, zoological gardens | Petroleum and coal products |
| Other financial, insurance, & real state | Heavy construction contractors |
| **Great Lakes** | **Rocky Mountains** |
| Motor vehicles and equipment | Metal mining |
| Primary metals | Coal mining |
| Fabricated metal | Nonmetallic minerals except fuels |
| Rubber and misc. plastics | Oil and gas extraction |
| Machinery except electrical | Railroad transportation |
| **Plains** | **Far West** |
| Pipelines except natural gas | Motion pictures |
| Railroad transportation | Transportation equipment except motor vehicles |
| Metal mining | Fisheries |
| Leather and leather products | Forestry |
| Food and kindred products | Lumber and wood products |

For virtually every region, the top five industries have dominated since at least the beginning of the 1970s. If regions have not lost their historical identity, how have they been changing over time? Have they been building on their economic strengths and becoming more specialized, or have they moved toward a more balanced economy?

## III. Structural change in the 1970s and 1980s

Industrial structures of regions are not etched in stone; economic forces from within and from outside the region change how the region's resources are allocated in the production of goods and services for both internal consumption and for export. Fundamental changes to structure can take decades or more to occur. But minor shifts are continuously occurring as an essential part of the evolutionary process of change. Patterns of change among regions provide some insights into the future structure of regions.

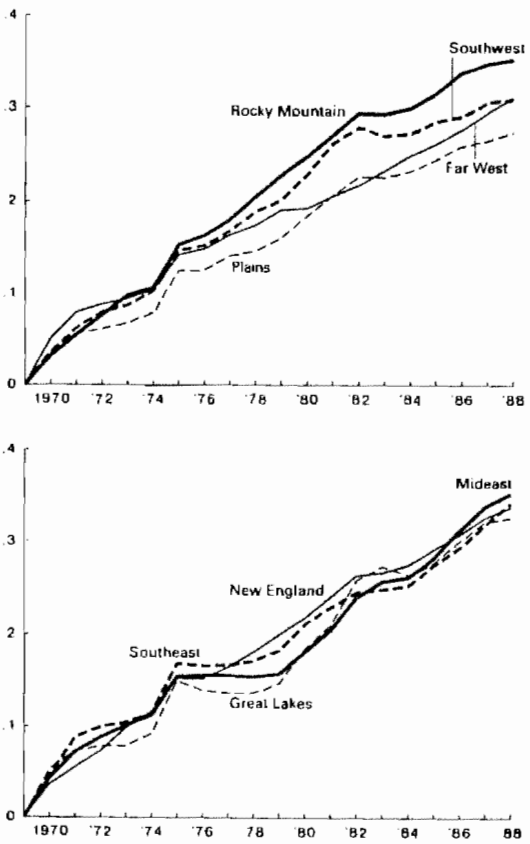
The structure of the Great Lakes economy has hardly gone untouched by the forces of change. In some respects, the region has been following a pattern similar to all regions. Consider, for example, how the Great Lakes' industrial structure of 1970 differs from what it is today. Twenty years ago, durable goods manufacturing was not

only the largest sector in the Great Lakes region, but the only sector in which it held any kind of economic specialization. Even now that the services industry has surpassed durable goods manufacturing as a share of total income, the region is still no specialized in services. However, the region has seen the emergence of its second sector of specialization—nondurable goods manufacturing.

A broadening specialization of the region's industrial base to include both durable and nondurables would seem an obvious direction for the Great Lakes region to take—the region has built upon its historic strengths. But, while some regions have followed a similar pattern of altering their structures by building on their strengths, others have changed in entirely different ways. For example, while the Great Lakes was expanding within manufacturing, the Southeast was adding a new specialization in transportation and public utilities, perhaps reflecting the emergence of Atlanta as a major airline hub. At the same time, the Far West was shifting from service-related sectors to goods-producing sectors. As the Far West has grown rapidly (it now represents roughly one-sixth of the national economy), it appears to have become less dependent on government services, while developing a specialization in construction and durable goods production in the 1980s compared to the 1970s. New England made the biggest adjustment, however, developing new specializations in both manufacturing and service-related sectors. In 1970, New England was highly specialized in only two sectors (durables and services) and had some degree of specialization in three other sectors. But by 1988, New England was highly specialized in four sectors and had some degree of specialization in three others.

Among the four remaining regions, two-the Rocky Mountains and the Southwest—substantially reduced the number of sectors in which they had previously developed specializations. In 1970, the Rocky Mountains had a high degree of specialization in six sectors—three in both goods-producing and service-producing activities. By 1988, the region had lost its specialization in nondurable goods manufacturing and wholesale trade. And

FIGURE 2. Index of structural change trends by region



of the remaining five sectors, it was reduced to only two (mining and transportation) that qualified as highly specialized sectors. The Southwest also began 1970 with specialization in seven of the eleven sectors, with five having a high degree of specialization. By 1988, the region had lost two of its specialized sectors (one in both the goods-producing and service-producing activities), and of its five remaining sectors only two were highly specialized. In both cases, the high-growth years during the "energy boom" of the 1970s appear to have given way to the "energy bust" years of the 1980s, accompanied by a decline in resources devoted to construction and trade activities relative to the nation.

## IV. The pace of structural change

Industrial transformation among regions proceeded at different rates, which seems to bear little relationship to their structures in 1970 (Figure 2). For example, the two fastest changing regions, Mideast and Rocky Mountains, could not have been more different in their structural makeup. The Mideast region in 1970 was highly specialized in nondurable goods manufacturing and services, while the Rocky Mountains specialized in natural resources. The slowest changing region, the Plains, would seen to have far more in common with the Rocky Mountains region than with the Southwest region, which had the second slowest rate of change over the period. The Great Lakes ranked about in the middle (fifth out of eight regions). Interestingly, however, much of its structural change occurred in the 1980s, which was a period that began with two severe back-to-back recessions. Indeed, recessions have always been a catalyst for change.

Three regions experienced marked accelerations in their rates of structural change in the 1980s, relative to their rates in the 1970s—the Great Lakes, New England, and Mideast regions (Table 4). Among these three, New England's ranking shifted the least, moving from fifth in the 1970s to third in the 1980s, while the Great Lakes and Mideast regions shifted the most, moving from the bottom two positions to second and first places respectively among the eight regions.

TABLE 4. Rate of structural change-ranking by regions

| | 1969-79 | 1979-88 | 1969-88 |
|---|---|---|---|
| New England | 5 | 3 | 3 |
| Mideast | 7 | 1 | 1 |
| Plains | 6 | 7 | 8 |
| Southeast | 3 | 4 | 4 |
| Southwest | 2 | 8 | 7 |
| Rocky mountains | 1 | 5 | 2 |
| Far West | 4 | 6 | 6 |

In general, the more mature and recession-vulnerable regions of the nation generated the greatest amount of internal change during the last decade. New England's sensitivity to recession was less obvious than in the Great Lakes because of its rapid growth in the "high-tech" industries, where cyclical factors were swamped by a strong growth trend derived partly from the federal policy to re-arm the military.

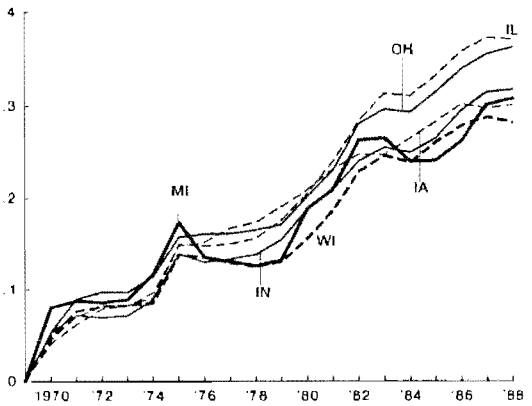
These three regions were also the same regions that were undergoing deindustrialization within their own economies. In contrast, those regions that were in the process of industrializing appear to have slowed their rate of change during that decade. Moreover,

the rate of change seems to be independent of the degree or type of economic specialization in the region at the beginning of the 1970s. In general, it would appear that industrialization is a much slower process than deindustrialization, and recessions could retard the one and accelerate the other.

At the more disaggregated industry level of activity, the underlying sources of structural change are surprisingly similar among regions. In virtually every state, the share of income from business services and health services made the greatest absolute contribution to structural change, increasing in every region between 1970 and 1988. Beyond those two industries, most regions altered their industrial structures by lowering their concentrations in their industries of specialization. The Great Lakes region, for example, sharply decreased its concentration in the industries that comprise its durable goods sector. A similar pattern was followed by each of the states in the Great Lakes region and by other regions as slow growing manufacturing industries were supplanted by faster growing service-related industries. Thus, while some regions have been able to build on past strengths, most regions were experiencing the same forces of economic change that have been shifting the national economy away from manufacturing and towards service-related industries over time.

Structural change within the Great Lakes region shows almost as much variety as the comparison among regions(Figure 3). Illinois and Ohio underwent the most structural change since 1970, well ahead of the other three states. But it was Illinois and Michigan, two states with different

FIGURE 3. BEA personal income structural change




industrial structure, that showed the most acceleration in the rate of change from the 1970s to the 1980s. Wisconsin and Indiana, both of which typically had the strongest growth in employment and output among the Great Lakes states, experienced the least amount of structural change. In contrast, Illinois and Michigan were the two states with the weakest overall employment and output performance in the Great Lakes (and even the nation), particularly in the 1980s.

Structural change seems to be more a condition of economic weakness and decline than of economic vitality. But to what end is all this structural change directed? Clearly, from the above data, regional economies are not falling back on their historical strengths but are developing new specializations. But is this broader specialization making each region uniquely different in terms of its industrial structure, or is it making regions more homogeneous?

## V. Diversification trends among regions

Diversification is a measure of income distribution relative to a national norm. The more like the nation the region is, the more diversified its economy is considered to be. The underlying assumption here is that the national economy has a "perfect" balance of industries in order to meet all its internal needs for goods and services. Diversification measures the difference between an industry's share of a regional economy and the national economy—the bigger the difference summed over all industries, the less diversified the region.

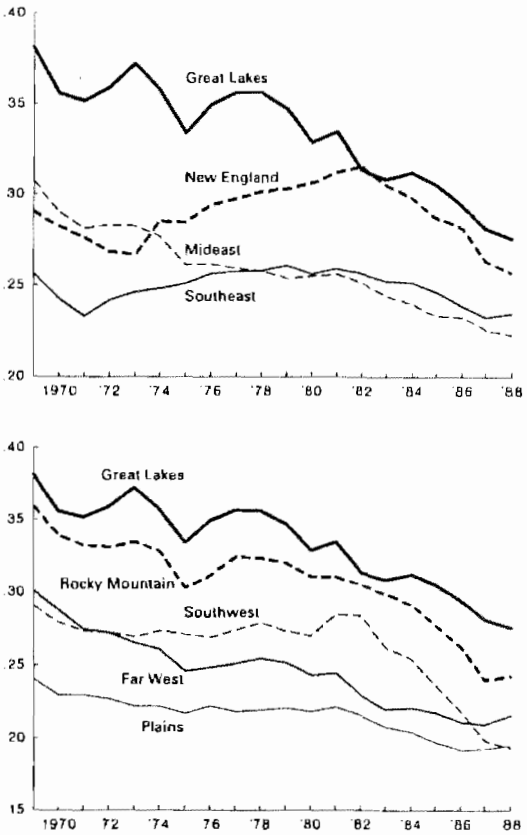
TABLE 5. Comparisons of diversification ranking by region*

| | Degrees of diversification 1969 | 1988 | Rate of diversification 1969-88 |
|---|---|---|---|
| New England | 5 | 2 | 2 |
| Mideast | 7 | 4 | 1 |
| Great Lakes | 1 | 1 | 7 |
| Plains | 8 | 7 | 3 |
| Southeast | 3 | 5 | 4 |
| Southwest | 6 | 8 | 6 |
| Rocky Mountain | 2 | 3 | 8 |
| Far West | 4 | 6 | 5 |

*1 represents the least diversified or the least change in diversification

The single most striking feature among all the regions of the nation is their persistent trend toward diversification (as shown by the downward trend in the index of diversification, Figure 4). All eight regions ended the 1980s with more diversified economies than the ones they started with in 1970s. The Great Lakes region began the 1970s as the least diversified economy in the nation and remained the least diversified throughout the 1970s and 1980s (Table 5). However, the Great Lakes region had the distinction of undergoing among the most diversification of any region. The Plains started the 1970s as the most diversified regional economy, but underwent the least amount of diversification of any region over the entire period of the 1970s and 1980s. The Southwest ended the 1980s with the most diversified regional economy. Although the Great Lakes underwent about as much diversification as the Southwest over the period, the Great Lakes region started with the least amount of diversification and thus remained less diversified than most other regions.

FIGURE 4. Index of diversification-trends by region



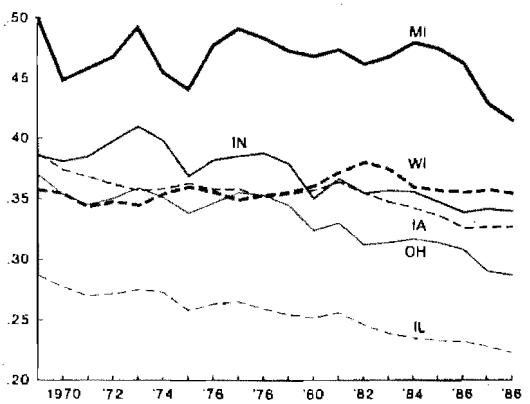

While the trend among regions was definitely toward diversification,

three different patterns were followed. Some regions, such as the Great Lakes, followed a fairly steady trend toward greater diversification. Some regions, notably the Southwest and Plains, seem to have flattened out during the late 1970s and early 1980s, but these were regions that began with relatively more diversification than most other regions. Finally, some regions, particularly New England and the Mideast, were actually moving towards less diversified economies for an extended period in the late 1970s and the early 1980s.

New England was perhaps an anomaly from the general trend toward diversification. The industries that appear to be contributing the most to the move toward increased specialization during the early 1980s were concentrated in construction and government. Given the rapid growth that New England was experiencing during that period, the growth in these two sectors may represent unbalanced or excessive growth. The demand for construction and greater government services may have been generated by real economic growth, but its rapid pace was not sustainable. Many of the current problems in the region may have begun during this period. Weakening property values in the 1970s may be the result of overbuilding and unsustainable levels of government spending in the 1980s.

The source of much of the Great Lakes' diversification can be found in two states—Ohio and Michigan (Figure 5). Michigan began the 1970s with by far the least diversified economy in the region While it also ended the 1980s with the least diversified economy within the region, Michigan had moved most rapidly toward diversification. Michigan's high degree of specialization in durable goods manufacturing would seem to make it a logical candidate for substantial diversification. But Michigan

FIGURE 5. Index of diversification-trends by state




is interesting because its rate of structural change was not that distinctive. What change did occur was in the right industries to generate diversification in the region, relative to the structural changes that were occurring at the national level.

Although much less extreme than Michigan, Ohio was a major contributor to the region's diversification. Ohio was about average for a Great Lakes state with respect to its degree of diversification in 1970. By the end of the 1980s, the state had moved toward the lower end of the ranking in terms of diversification. Thus, while it was less heavily specialized in manufacturing industries than Michigan, Ohio was able to accomplish as much improvement in its diversity as Michigan.

At the other extreme, Wisconsin started the 1970s with an economy almost as diversified as Ohio's, but retained the same degree of diversity throughout the 1970s and 1980s. Its structural change was slow, changing in lock step with changes in industrial mix at the national level. Structural change had a neutral effect on the Wisconsin economy, leaving it as much different than the nation as in 1970.

Of the final two states, Illinois remained highly diversified and Indiana remained relatively specialized. That Illinois should retain its broad base of specialized industries over the period is less surprising than the fact that Indiana has failed to diversified away from its historic specializations of steelmaking and auto parts supplier. Despite impressive growth of service-related industries in the Indianapolis area, Indiana has made little progress in diversifying its economy relative to the nation. Part of the reason may be found in the decision to invest heavily in modernizing steel mills in the Gary area, thereby concentrating the industry's production capacity in the central part of the nation. Whether Indiana will be better off being tied to the steel and auto industries than by being more broadly diversified will depend on how successful those industries are in capturing market share against global competitors. If these industries fail to keep pace with market growth, their importance to the state economy will fade and other more competitive industries will take their place. Ultimately, it is the competitive advantages that determine how much and how quickly a state or regional economy will diversify over time.

## VI. Competitive advantage and the diversification process

In order for structural change to lead to diversification in every region, some movement away from historical specializations must occur. The income growth from service-related industries in regions with below-average concentrations in service-related industries must grow at faster rates than in regions with high income concentrations in service-related industries. Similarly, regions with high concentrations of income from manufacturing industries, as in the case of the Great Lakes, must have lower rates of growth in their industries of specialization than in regions that are not specialized in manufacturing industries. Thus, some regions must be industrializing while others are deindustrializing—which is exactly what has been happening in the last two decades.

The key to a regional industry's growth performance relative to its national counterpart is its competitive advantage. Historically, competitive advantage in manufacturing has been associated with such factors as location of natural resources an high transportation costs. Such locational advantages explain much of the Great Lakes specialization in the durable goods industry, especially steel with its access to iron ore in Minnesota and coal in West Virginia and Pennsylvania. Over a shorter time horizon, competitive advantage may be associated with relatively low labor costs or high productivity, access to expanding markets, and desirable amenities (such as warm climate, good schools, and cultural activities). Agglomerations of manufacturing industries lowered the transpor-

tation costs of acquiring intermediate components and basic materials.

Both long-term and short-term competitive advantages can gradually deteriorate. While low labor costs may have at one tie attracted manufacturing industries to the Great Lakes, high labor costs today are contributing to the decline in the region's manufacturing sectors. Similarly, the introduction of new technologies can weaken historical competitive advantages. For example, the introduction of cheaper forms of transportation, such as interstate highway systems, can reduce the advantage of locating near markets or natural resources. Less is known about competitive advantages among services. Certainly, climate has benefited the development of retirement centers in Florida and the growth of the health and personal service industries to serve that population. But service-related industries, such as insurance and banking, have also sprung up in Indianapolis, Indiana, and Columbus, Ohio, which offer no self-evident advantage over a host of comparably sized cities around the nation. Nevertheless, above-average growth itself can serve as a measure of competitive advantage of a region and can serve as a guide to how competitiveness is contributing to diversification. Identifying the net contributions of competitive advantage from all industries to a region's growth, as distinct from industrial mix, reveals a pattern of negative contributions in the deindustrializing parts of the nation and positive contributions in the industrializing parts of the nation (Table 6).

In the Great Lakes region, a lack of competitiveness has been detrimental to the growth of income. On average, over 80 percent of its industries were growing more slowly than their industry counterparts in other regions both in the 1970s and 1980s. In 1970s, income losses due to competitive disadvantages offset the gains from having a favorable industrial structure. This cost the region $21 billion (not adjusted for inflation) in income that could have been earned in 1979 if only the region's industries had grown at the same rate as their counterparts nationally. Income would have been 6 percent higher than it was actually was in 1979 with the shortfall attributed to competitive disadvantages. Somewhat surprising, however, was the fact that primary metals and transportation equipment other than motor vehicles showed competitive strength during this period. By 1988, competitive disadvantages over the previous eight years cost the Great Lakes $57 billion (not adjusted for inflation). Otherwise, income would have been 11 percent higher than it was in 1988. The only industry to retain its competitive advantage from the 1970s was the relatively small apparel

TABLE 6. Net contributions to regional growth

| | 1970s | | 1980s | |
|---|---|---|---|---|
| | Competitive Effects | Industrial mix effects | Competitive effects | Industrial mix effects |
| New England | -- | - | ++ | + |
| Mideast | - | + | + | + |
| Great Lakes | - | + | - | - |
| Plains | + | - | - | - |
| Southeast | ++ | - | ++ | - |
| Southwest | ++ | + | - | - |
| Rocky Mountain | ++ | + | - | - |
| Far West | ++ | + | ++ | + |

Key: +,- = Net contribution (positive or negative) less than 10%.
++,-- = Net contribution 10% or more.

industry. Most of the other industries with a competitive advantage in the 1980s were linked to transportation services.

During the 1970s, only two other regions experienced income losses due to competitive disadvantages—New England and the Mideast. Both regions share with the Great Lakes some of the heaviest deindustrialization in the nation during the 1970s. The Mideast region was hardest hit, with income in 1979 20 percent below what it would have been if the region's industries had grown at the same pace as their national counterparts. Certainly, part of that loss was the rapid decline of the steel industry in Pennsylvania (particularly Pittsburgh) and its supporting industries, such as fabricated metals, machinery, and mining. In contrast to the Great Lakes, however, only about half of the industries in the Mideast region were hurt by competitiveness factors. Many industries on the service side of its economy managed to equal or exceed the growth achieved nationally by those industries. A good example may be the transformation of the Pittsburgh economy from a steel town to a regional financial center. While not as large as it once was relative to other cities in the nation, Pittsburgh has found a way to offset some of the loss of its steel exports by exporting financial services.

New England was an exception during the 1970s in that its overall competitive disadvantages were amplified by an unfavorable mix of industries. New England's income in 1979 would have been about 10 percent higher without it competitive problems and another 1 percent higher if its mix of industries had not been weighted towards the more mature, slow growing industries nationally. With over 75 percent of its industries suffering competitive problems, it is interesting to note the major sources of competitive strength in the New England economy—insurance carriers, instruments, electronic components, and transportation equipment excluding motor vehicles. The insurance carrier industry has been the traditional strength of the region. But in the remaining three industries were the underpinnings of the "Massachusetts Miracle"—the emergence of the defense and "high-tech" industries. Even in these industries, the contribution of the region's competitive advantage was small compared to the contribution that industrial mix made. In other words, much of the industries' growth in New England must be attributed simply to the fact that those industries were growing rapidly in the nation and New England was able to keep up with that growth.

TABLE 7. Proportion of regional industries with competitive advantage

| | 1970s | 1980s |
|---|---|---|
| New England | 21% | 70% |
| Mideast | 4 | 50 |
| Great Lakes | 18 | 17 |
| Planes | 49 | 24 |
| Southeast | 84 | 30 |
| Southwest | 88 | 43 |
| Rocky Mountain | 89 | 36 |
| Far West | 79 | 24 |

As the nation took on the image of a bi-coastal economy in the 1980s, the Plains and Rocky Mountains regions joined the Great Lakes as the only net losers from competitive disadvantage. However, the role of competitiveness diminished substantially from the 1970s for most regions

(Table 7). For example, the Rocky Mountain region had nearly 90 percent of its industries growing faster than their national counterparts in the 1970s, but less than 40 percent in the 1980s. The exceptions were the New England and the Mideast regions, which went from among the weakest in overall competitiveness to the strongest.

TABLE 8. Net contributions to state growth

| | 1970s | | 1980s | |
|---|---|---|---|---|
| | Competitive Effects | Industrial mix effects | Competitive effects | Industrial mix effects |
| Illinois | – | + | – | + |
| Indiana | - | - | - | – |
| Michigan | - | + | – | – |
| Ohio | – | + | - | + |
| Wisconsin | + | + | - | - |

Key: +, - = Net contribution (positive or negative) less than 10%.
++, – = Net contribution 10% or more.

For the Great Lakes, virtually all of the industries that were competitively weak in the 1970s continued to be weak in the 1980s (Table 8). Among the industries that were competitively strong in the 1970s, only apparel in the nondurables sector and transportation services continued to show competitive strength in the 1980s. Other industries that emerged with competitive strengths were concentrated in two sectors: first, the nondurables sector, with lumber, leather, textiles, and furniture (consistent with the rise of the nondurables sector as an area of specialization) and second, the transportation sector, with air, water, and pipelines. In contrast, industries that lost their competitive advantage in the 1980s were from virtually every sector of the region's economy—from health services to primary metals.

Within the Great Lakes region, Wisconsin was a notable exception to the dominance of competitive disadvantage among industries. Half of all of its industries were growing faster than their national counterparts during the 1970s and one-third were competitively strong in the 1980s. Moreover, one-third of the competitively strong industries in the 1980s carried their competitive strength over from the 1970s. Indeed, during the 1970s, Wisconsin was the only Great Lakes state where competitiveness made a positive contribution to economic growth.

## VII. Linking diversification with regional policy making

The role of a region's industrial competitiveness in diversifying its economy is intuitively straightforward. Holding everything else constant, if an industry in which the region is specialized is growing slower than its national counterpart, its share of the regional economy would decline relative to the industry's share of the national economy resulting in the region's economy being more diversified. Eventually, if the poor competitive performance continued, the industry could lose its specialization status. Similarly, if the region is nonspecialized in a particular industry that is growing faster in the region than in the nation, its share of the regional economy would rise relative to the nation. As the industry's share of the regional economy rises, it would also have the effect of diversifying the regional economy.

The process is more complex than suggested because both competi-

tiveness and industrial mix interact to determine what industries contribute the most to a region's overall growth performance. In the case of the 1970s, the distribution of competitive advantages among regions was so skewed toward southern and western regions that competitive advantages *per se* could play only a minor role in regional diversification. That is, in the northeast quadrant of the nation, most industries were growing slower that their national counterparts. Whether an industry was highly specialized or highly nonspecialized, it was likely to be growing slower than the same industry in other regions. While below-average industry growth among specialized industries would move the region's industrial structure toward diversification, its nonspecialized industries, also with below-average growth, would be moving away from diversification. Regardless, whether the region achieved a more diversified economy would depend on relative competitive performance, that is, whether the slow- growing specialized industries were contributing less growth to the region than the slow-growing nonspecialized industries.

For policy makers seeking to diversify their regional economies, the primary objective is straightforward. Find ways to improve the competitive strengths of regional industries. The improvement can come from a direct subsidy that reduces operating costs, such as tax breaks or low-interest loans. Or, the improvement can come from an indirect subsidy, such as better roads and other infrastructure improvements. Although in both instances higher taxes to finance the subsidy can be detrimental to all firms in the region, the second case has the potential advantage of being accessible to many firms. Essentially, a competitive environment is created for everyone in the region. However, the benefits created by such a policy in terms of additional jobs and earnings become difficult, if not impossible, to measure. The first case has the advantage of being delivered only to selected firms where the returns to the policy can be measured in terms of additional jobs and earnings. The problem is to determine how to choose what firms are to receive the targeted benefits, or perhaps to find better ways of measuring indirect benefits.

To many regional policy makers, the widely touted goal of diversification means to move away from declining industries of the past and toward high-growth industries of the future. What can easily be lost in the process is the possibility that future growth industries may not have a competitive advantage in a particular region an will require heavy subsidization to survive, much less attain a competitive advantage against regions with a natural competitive advantage. And even that assumes that the policy makers are successful at forecasting what the high-growth industries of the future are going to be.

The goal of diversification itself is debatable. In its truest sense, diversification improves the chances of the region to grow at the national average. If a region already has a favorable mix of industries that on average are growing faster than the nation, diversification will mean moving toward slow-growth industries and slower overall growth for the region. Even regions with an unfavorable mix of industries may find high-

growth industries bring undesirable traits with them, such as higher cyclical vulnerability for the region.

Thus, the objective of the policy maker must be shaped by multiple criteria that can rank the attractiveness of an industry. National growth rates of industries is one criterion by which industries can be ranked. Cyclical sensitivity is another criterion. Relative competitiveness within the region is a third possibility. Other criteria exist, but these three can illustrate how the selection process can work. Suppose that the policy maker wants to maximize growth, but also wants to minimize cyclical swings in the region's economy. The best combination of industries to target will be determined by a new ranking of industries derived from a weighted combination of each industry's rank by growth and cyclical sensitivity. The weights can vary subjectively, according to how much importance the policy maker places on a "recession-proof" economy. Or a policy maker can try to select competitively strong industries that are relatively cycle free. Again, it would be some weighted average of industries in the region with competitive strength and low cyclical sensitivity. Any number of separate criteria can be used to make the final selection of industries that will best meet the long-term objectives of the policy maker.

The structural change and diversification of a regional economy is a complex process with limited opportunities for intervention by policy makers. Each region is unique, undergoing its own internal changes leading to a common end—more balanced and self-sufficient regional economies. In the process of structural change and diversification, competitiveness is a critical element that must be factored into any policy consideration. The key to successful policy making is identifying and understanding a region's competitive advantages and trying to build upon those advantages.

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APPENDIX I

## Diversification index

This is an annual income based diversification index. There are three subscripts, representing, location, industry and time:

$$\Sigma_i \left| (INC_{ri}/INC_{rT}) - ((INC_{USi} - INC_{ri})/(INC_{USTt} - INC_{rTt})) \right|$$

Where INC = Income
r = region
US = United States
i = 2 digit SIC industry
T = total nonagricultural sector
t = year

The region is subtracted from the United States numbers so as not to bias the index towards large regions.
This index relates each industry's share of income to the national average. Having a share 1% below the industry's national average has an equivalent effect on the index as a share 1% above the national average. So if many of a region's industries are highly specialized or non specialized, then the index will be large. If most of a region's industries have a share of income close to the national average, then the index will be small. The possible range of the index is zero to two.

## Location quotient

The location quotient is an annual measure of the concentration of a region's income relative to the United States. The three subsripts identify region, industry and time.

$$(INC_{ri}/INC_{rT})/(INC_{USi}/INC_{USTt})$$

Where INC = Income
r = region
US = United States
i = industry
T = Total nonagricultural sector
t = year

If an industry's share of income is equivalent to the national share then the location quotient is equal to one. If an industry is concentrated in a region, its share of income in the region is larger than the industry's share of national income, then the location quotient is greater than one. If the industry is not concentrated in the region, then the location quotient is between zero and one.

## Shift share analysis

Relative gain or loss is the actual change in jobs for an industry within a region minus the change that would have occurred if the industry had the same share of income and same growth rate as it did at the national level.

$$\text{Relative Loss} = GR_{ri} * INC_{ri1} - GR_{USi} * INCH_{ri0}$$

Where INC = Income
GR = growth
r = region
US = United States
i = industry
T = total
0 = beginning of period
1 = end of period
INCH = hypothetical income
$INCH_{ri0} = INC_{USi0} * (INC_{rT0}/INC_{UST0})$

Relative loss can be divided into three categories, competitive effect, industry mix effect and allocative effect, which sum to relative loss.

Competitive effects = $(GR_{ri} - GR_{USi})\ INCH_{ri0}$
Mix effect = $(INC_{ri0} - INCH_{ri0}) * GR_{USi}$
Allocative effects = $(GR_{ri} - GR_{USi}) * (INC_{ri0} - INCH_{ri0})$

In percentage growth rate terms

Relative loss = $GR_{ri} - INCH_{ri0}/INC_{ri0}$
Competitive effect = $(GR_{ri} - GR_{USi})\ INCH_{ri0}/INC_{ri0}$
Mix effect = $(INC_{ri0} - INCH_{ri0}) * GR_{USi}/INC_{ri0}$
Allocative effect = $(GR_{ri} - GR_{USi}) * (1 - INCH_{ri0}/INC_{ri0})$

## Index of structural change

The structural change index is a cumulative measure of change based on 2 digit SIC income. The index is region specific and has two subscripts, the industry and year.

$$\Sigma_i \left| (INC_{it}/INC_{Tt}) - (INC_{i69}/INC_{T69}) \right|$$

Where INC = Income for the region
i = 2 digit SIC industry
T = total nonagricultural sector
t = year
69 = base year

This index compares an industry's share of total income to its share at the beginning of the period (1969). The larger the absolute change in the share of income, the larger will be the industry's effect on the index. Both increases and decreases in the share increase the index.

# Urban design and the use of descriptive research measures to determine community needs and preferences

Jimmie L. King

KING, JIMMIE L. 1996. Urban design and the use of descriptive research measures to determine community needs and preferences. **Urbana** III (1): 20-27. Descriptive research techniques were used to determine the needs and preferences of the people as a basis for the development of urban conservation plans for two communities in Mexico. This article provides an overview of the investigative process used.

## I. Presentation

> Good design is simply finding the most appropriate solution to a problem (Hanks, Beliston, Edwards, 1978).

Urban design is a continuos and dynamic process that assists a community in the achievement of physical development goals that are important to both the individual and the community at large. These goals become translated into physical, architectural expressions; parks, plazas. public housing, central city redevelopment projects and infrastructure development. All too often urban design occurs without the direct collaboration of the people of the community. However, *the global realignment of political thought regarding the demographic rights and responsibilities of man, coupled with* (1) **the redirection of financial resources**, (2) **demographic shifts**, and (3) **declining natural resources** suggest that contemporary urban design processes must consider the user as a participative client which makes direct input and contributions to urban design programs as they direct the communities growth and character. Thus, if urban design is to successfully guide the transformation of our cities into *people places* then it is necessary and fitting that we view the people who work and live in the urban centers as both *stakeholders* (those with and intrinsic interest in the events taking place) and as *clients* (those who pay for services or goods rendered or delivered).

What is required is a design methodology in which architects and planners involve the people of the community in every phase of the urban design process. Seeking their opinions, insight, and ideas as a means of responding to the needs, desires, and preferences of the community. A participative design strategy is essential when one considers that:

1. Changing the fundamental character of a cityscape is difficult and members of the community will be more inclined to give moral and financial support and even their time and labor if asked, if they are included in the decision making process.

2. The individual and collective members of a sector or community are more

familiar with the specific problems with which they are faced with daily and can provide meaningful insight into the solution of those problems.

3. From a purely moral point of view, the people who are most affected by those decisions which so closely affect their lives should be included in the mechanism of urban change and development.

4. An urban design project may win many international awards for design excellence, however the history of our cities is replete with examples of such projects which failed to fully understand and respond to the social, cultural, and/or physical needs of the inhabitants. The outcome often produces waste inefficiency, inconvenience, and even in some instances has been disastrous and harmful to the welfare of man.

## II. Methodology

> Methodology is the way in which we approach problems and seek answers (Huck, Cormier, Bounds, 1974).

With the aforementioned principals in mind, 9th semester architecture students of the *Universidad de Monterrey* have produced comprehensive and partial urban development plans for two communities in *Nuevo León, México: La Fama* and *Villa de García* as well as an urban open space plan for downtown *Monterrey*. In order to provide (a) consensus as to community needs and concerns and (b) a projection of possible outcomes which may occur as a result of development, it was determined that a "descriptive research methodology" would be the most objective method of discerning the desired information.

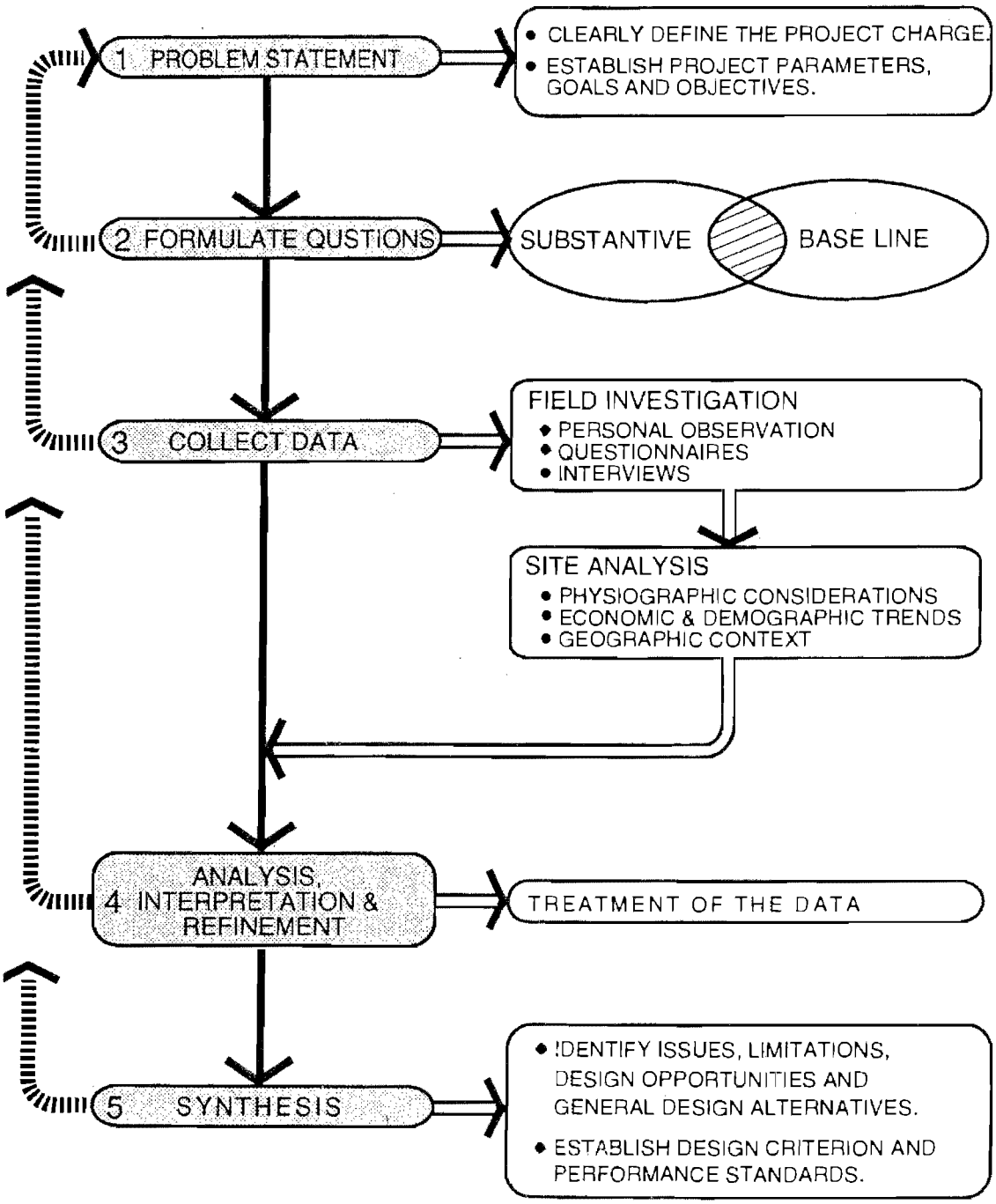
Descriptive research methods of investigation are simply a particular approach to understanding problems and determining what are the most appropriate solutions through (a) the use of descriptive observations of the empirical world and (b) personal interviews (Ary, Cormier, Bounds, 1984). With descriptive research methods the urban designer looks at settings and people in a holistic manner; people and their environmental setting are viewed together as a whole not as separate entities. The people must be understood from their own frames of reference without the injection of bias on the part of the urban designer. The urban designer seeks not to impose his or her own set of values and truths upon others, but rather attempts to understand the perspectives of all; the local judge, barber, butcher, policeman, as well as the poor, the homeless, and the child playing in the street.

The descriptive research procedure must be systematic, but at the same time, must remain flexible throughout the investigation in order to accommodate the specific needs of the study. The emphasis is thus upon validity, rather than reliability or replicability (Sandoff, 1991).

### Case study examples

As described below and outlined in Figure 1, the descriptive research progression used in the *La Fama* and *Villa de García* case study examples, was linear in sequence and circular in performance. At each stage of the research progression you must re-enter the loop to refine and review the infor-

Figure 1. Process model for conducting descriptive Research Studies in urban design



be readily articulated. The descriptive data may also be statistically treated in a quantitative manner in order to determine simple rankings and significant differences.

6. **Synthesis.** The information gathered is synthesized and used in the final articulation of community issues, conflicts, priorities, limitations and opportunities as they relate to urban design and the development of short, intermediate and long term goals.

## III. The survey instrument

The survey instrument (partially presented in Figures 2 and 3) was randomly administered to 300 residents in the García case study or about 2 percent of the total population. The instrument itself was designed to measure opinions about the status quo. In so doing it was desired that the instrument be graphically appealing, official looking, as short as possible and be understandable by those with limited reading abilities. As such, extensive use of graphic icons was made in attempt to add visual interest and topic identification. It was important to represent the graphics in a neutral manner and of equal graphic weight so as not to bias or direct the respondent.

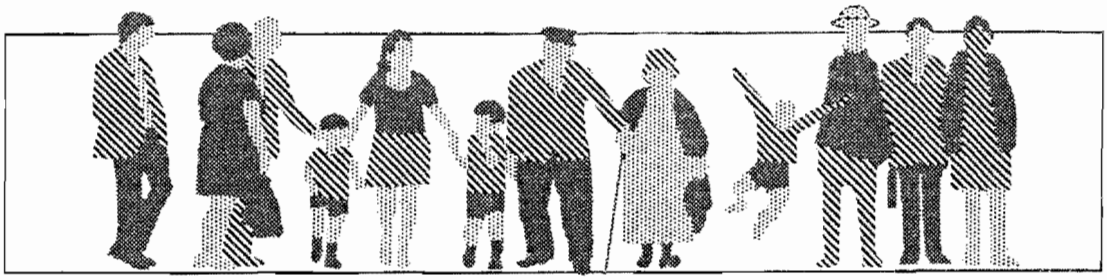
## IV. Treatment of the data

A semantic differential scale was used to give quantitative value to the items presented. Mean values were used to establish a relative, ranked order within each of the survey categories: satisfaction with public services, community concerns, recreational preferences and architectural and landscape preferences. Other measures of central tendency; mode and median were calculated as well. Finally, a *t*-test was used to compare the means of the survey categories to establish significant differences. Thus it was possible to translate levels of perceived preference and satisfaction; high, moderate and low.

## V. Conclusion

Urban design is concerned with the overall organization of neighborhoods, districts and communities into a coherent urban tapestry. For a city to survive it must nourish the spirit of the people who live and work there. The city cannot be interpreted by architects and planners as simply a structural network of buildings and roads with inflexible meanings and interpretations. In order to accomplish this end, urban design must understand and embrace the various social phenomena which connect people and the urban *genius loci* (spirit of place). The use of descriptive research measures is one tool which can facilitate the return of the concept of *community* to the urban complex. Through descriptive research techniques urban design is better able to give a voice to those who are all too often not heard.

Figure 2. Page 3 of the survey instrument: What are you most concerned with the *Community of García*?



**G E N E R A L**

**Estado Civil:** Soltero Casado Otro
**Sexo:** Masculino Femenino
**Ocupación:** _____
**Dentro o Fuera de Garcia**

**Edad:**
6-12 13-19 20-30 31-40 41-50
51-60 61-70 71-80 81 o más

## ¿ QUE TE PREOCUPA MAS ACERCA DE GARCIA ?

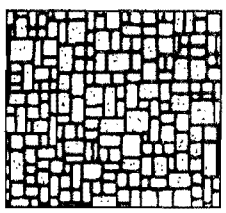
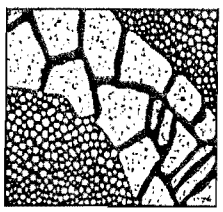
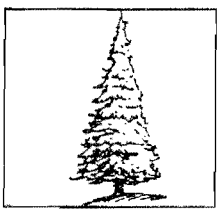
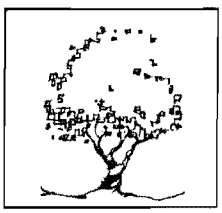
| | NO ME PREOCUPA | | | | | ME PREOCUPA MUCHO |
|---|---|---|---|---|---|---|
| ACTIVIDADES CULTURALES | 0 | 1 | 2 | 3 | 4 | 5 |
| RUIDO | 0 | 1 | 2 | 3 | 4 | 5 |
| SEGURIDAD PUBLICA | 0 | 1 | 2 | 3 | 4 | 5 |
| VANDALISMO | 0 | 1 | 2 | 3 | 4 | 5 |
| ROBO | 0 | 1 | 2 | 3 | 4 | 5 |
| PAVIMENTACION | 0 | 1 | 2 | 3 | 4 | 5 |
| CALIDAD DE EDUCACION | 0 | 1 | 2 | 3 | 4 | 5 |
| ATENCION MEDICA | 0 | 1 | 2 | 3 | 4 | 5 |
| INDUSTRIA | 0 | 1 | 2 | 3 | 4 | 5 |
| CONSERVACION DEL TRABAJO | 0 | 1 | 2 | 3 | 4 | 5 |
| ALCOHOLISMO | 0 | 1 | 2 | 3 | 4 | 5 |
| DROGADICCION | 0 | 1 | 2 | 3 | 4 | 5 |
| PRESERVACION DE LA IMAGEN HISTORICA DE GARCIA | 0 | 1 | 2 | 3 | 4 | 5 |
| OTROS | 0 | 1 | 2 | 3 | 4 | 5 |

**COMENTARIOS Y OPINIONES**

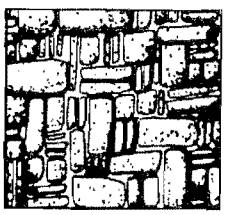
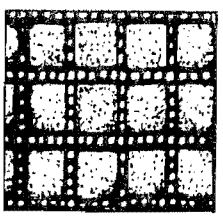
Figure 3. Page 5 of the survey instrument: *Plants, forms and textures; What is your preference?*

**FORMAS, TEXTURAS Y PAISAJE**

**¿QUE ES LO QUE TU PREFIERES?**

NO ME GUSTA — ME GUSTA MUCHO
0 1 2 3 4 5

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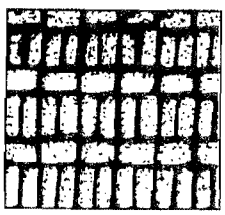

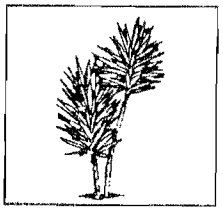


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# THE VIABILITY OF MEXICAN PRODUCTION SHARING: ASSESSING THE FOUR Cs OF STRATEGIC FIT

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FAWCETT, STANLEY E. AND ANTHONY S. ROATH. 1996. The viability of Mexican production sharing: assessing the four Cs of strategic fit, **Urbana** III (1): 28-42. This article presents a perspective based on how firms view the competitive influence of Mexican production on their manufacturing and marketing strategies. The study presents an approach to evaluating foreign direct investment opportunities based on their impact on global operating performance. This evaluation considers the compatibility between the host country's advantages with the foreign firm's investment rationale. The attactiveness of a country as an investment location is determined by assessing how manufacturing operations will complement existing worldwide operations (configuration) as well as how easily they can be integrated into the firm's overall global value-added system (coordination) on a day-to-day producing basis (control). The viability of Mexico as an investment location is examined using this framework. The study finds that firms that carefully consider the issues of compatibility, configuration, coordination and control tend to achieve satisfactory levels of performance in Mexico. By contrast, firms that leave one or more of this issues unexamined often close down operations within the first three years.

## I. Introduction

Coordinated global manufacturing has become an important strategic issue for companies throughout the industrialized world. By taking advantage of worldwide resources —particularly inexpensive labor— firms in Europe, Japan, and the U.S. are able to compensate for high domestic wage rates and improve their overall cost position (Roth, 1994; Sapsford, 1994). Among the many locations used in these international division-of-labor strategies, Mexico has received much attention over the past 15 years because of its low wage rates and its proximity to the large U.S. consumer market (Nichols 1993). More recently, the negotiation of the North American Free Trade Agreement brought increased worldwide visibility to Mexico and its potential as a production location. As NAFTA became a reality, formalizing the trading relationship between the U.S. and Mexico, opportunities for manufacturing investment in Mexico looked very favorable. Indeed, the first six months following the initiation of NAFTA in January of 1994 witnessed a 16.4 percent increase in U.S. exports to Mexico while Mexican exports to the U.S. rose by 21 percent (Lucey 1994). Unfortunately, the subsequent peso crisis of December 1994 altered the trading relationship between the two countries, damaging U.S. investor confidence and greatly reducing the purchasing power of Mexican consumers.

Passing through this relatively turbulent period, many U.S. manufacturers were forced to re-evaluate the attractiveness of Mexican manufacturing operations. A new perspective regarding not only Mexican manufacturing but all foreign manufacturing investment is beginning to emerge from this reevalua-

tion process. This new perspective is based on how firms view the competitive influence of Mexican production on their manufacturing and marketing strategies. That is, more than in the past, firms are finding that they must consider foreign manufacturing investment from a perspective of strategic fit. In other words, firms must seriously evaluate how a specific investment fits within an overall global competitive strategy as well as how it impacts the global operating network. Mexico will be seen as an attractive investment option if firms determine that they can enhance their competitive position by operating in Mexico. This paper presents a straightforward approach to evaluating foreign direct investment opportunities based on their impact on global operating performance. The viability of Mexico as an investment location is then examined using this framework.

## II. The Four Cs of Global Manufacturing Fit

The success of coordinated global manufacturing strategies depends on the effective rationalization of productive activities. Rationalization is quite simply the assignment of each value-added activity to the appropriate area of the world so that the greatest cumulative competitive advantage is achieved. The appropriate area of the world can be defined in terms of either comparative advantage or market access. The fact that very different and distinct factors often motivate the decision to rationalize operations raises the first issue that should be evaluated to assess the attractiveness of a given country for manufacturing investment. This initial issue is the compatibility of the country's inherent advantage with the firm's rationale for making the manufacturing investment. For instance, if the firm is seeking enhanced comparative advantage in the form of reduced manufacturing costs, then a country that offers abundant low-cost, semi-skilled labor would pass the initial test of compatibility. Likewise, a firm seeking greater worldwide market share would emphasize market potential, which is typically measured in terms of population size and wealth per capita. Strategic compatibility thus represents the first test of viability.

If strategic compatibility exists, the assessment of manufacturing fit turns to focus on the actual design of the value-added network. Because facility network design determines the deployment and productivity of a firm's value-adding resources, establishing a well-designed network is critical to global manufacturing success. Two issues — configuration and coordination— are of particular importance in the development of a competitive global facility network (Porter 1986). Configuration deals with the location of facilities and the allocation of productive activities among the facilities. Coordination involves the linking or integration of activities into a unified system. It is critical to note that configuration and coordination issues should be considered simultaneously for the firm to achieve true global synergies. This contrasts with traditional practice, in which configuration issues typically have dominated international network design. Unfortunately, experience has shown that network performance declines when configuration issues take precedence in the design process (Fawcett, 1990; McDonald 1986).

More to the point, relatively few factors have been considered during the configuration of global networks. In in-

ternational location decisions, the greatest emphasis has been on financial considerations and labor costs. When these important but narrow issues dominate the decision-making process, productive activities are often located in diverse and remote or comparatively "less developed" regions of the world in such a way that it is very difficult to coordinate the geographically dispersed operations.That is, the basic and necessary coordinating processes of sharing information and transporting goods among worldwide facilities can be hindered by decisions made in the initial configuration of international networks. Part of the challenge stems from the fact that these basic coordinating processes are often taken for granted in domestic operations; yet, they can present serious impediments to the effective integration of global operations. Without adequate coordination, substantial performance tradeoffs result among the global operations and overall firm performance suffers. Assessing how manufacturing operations in a country will complement existing worldwide operations (configuration) as well as how easily they can be integrated into the firm's overall global value-added system (coordination) is thus vital to determining a country's attractiveness as an investment option.

A final issue that merits consideration as a firm evaluates diverse production sharing locations is that of day-to-day operating control. Indeed, the ultimate success of a firm's international operations is heavily dependent on its ability to obtain high levels of operational performance on a daily basis. That is, even when strategic compatibility exists and the operation is well positioned from a configuration and coordination perspective, poor on-site control can lead to disappointing results. Moreover, international operations are generally more difficult to manage than domestic operations because of cultural and other environmental differences. For instance, differences in language, measurement and reward systems, workforce relations, and infrastructure are among the many challenges firms must deal with daily to achieve sustainable competitive advantage. For this reason, firms should aggressively assess the challenges inherent in managing the day-to-day operations that they are likely to encounter in a specific country.

To summarize, by systematically assessing the issues associated with the four Cs of compatibility, configuration, coordination, and control, a firm gains the understanding necessary to design and manage its global operations for competitive success. The next section presents the study's methodology and is followed by an examination of the four Cs as they relate to Mexican manufacturing operations. The paper concludes with a discussion of relevant managerial and research implications.

## III. The Study

An empirical study using a survey methodology was used to collect the appropriate strategic and operating information (Flynn *et al.* 1990). Because a primary objective of the study was to evaluate the performance experience of Mexican operations, the research sample frame consisted of senior level managers directly responsible for their strategic business unit's Mexican production sharing operations. The study mailing list was compiled from three directories: *America's Corporate Families and International Affiliates* (Dun's Marketing

Service 1991), *Directory of American Firms Operating in Foreign Countries* (Uniworld Business Publications 1991), and *International Directory of Corporate Affiliations* (National Register Publishing 1991). After eliminating duplicate listings and clearly incomplete addresses, 633 names remained on the mailing list. However, 109 surveys were returned as undeliverable because of incorrect address information, leaving an adjusted sample size of 524 managers.

To increase the response rate and ensure the meaningfulness of the collected data, several steps were taken to make both the survey instrument and the survey process as user-friendly as possible. To assure the internal validity of the constructs used in the analysis, an extensive review of the literature and several interviews with managers involved in their firm's international operations preceded the survey development. After initial survey development, several phases of pre-testing were performed to modify question content and survey structure. The final instrument was a six-page survey that consisted primarily of seven-point, interval scales (existing constructs were used wherever possible). The actual survey process involved a modification of Dillman's Total Design Method (Dillman 1978). Overall, 131 usable surveys were returned, providing a response rate of 25 percent. Respondents were largely division and corporate managers with manufacturing and materials management experience.

Analysis of the responses across the different mailings showed that no significant differences in the responses existed. Also, the demographic stratifying variables were compared to previously published data concerning Mexican production sharing operations. This comparison revealed that the respondent group was representative of the overall production sharing population. Thus, the analysis of responses indicated that no response bias was present.

To better understand the results of the survey, 27 follow-up interviews were conducted. These interviews were on-site in Mexico and focused on five cities: Aguascalientes, Guadalajara, Juárez, Mexico City, and Tiajuana. By selecting both border and interior cities, a better understanding of the overall manufacturing environment was gained. Firms from several industries were also included in the sample. Industries included automobile assembly and component parts, heavy transportation equipment, transportation service providers, plastics, metals, apparel, food products, electronic, and appliances. An interview guide that focused on collecting data regarding the manufacturing environment and basic manufacturing practice and strategy was used to standardize the interview process.

## IV. Mexico's Fit in Coordinated Global Manufacturing

The Border Industrialization Program, which was launched in 1965 with only 12 production facilities, provided the foundation for modern manufacturing investment in Mexico. Today, more than 2,000 Mexican manufacturing facilities are operated by U.S. companies. These operations employ over half a million workers, technicians, and managers, accounting for Mexico's second largest source of foreign exchange. The rapid growth in manufacturing investment from 1965 to the early 1990s highlights the

fact that many U.S. companies have considered Mexico to offer a highly attractive manufacturing environment. However, the historical operating experience of firms manufacturing in Mexico has been highly disparate with some firms reporting tremendous success while other firms have abandoned their Mexican operations. The fact that many firms have struggled to survive in Mexico while others have prospered points to the need to more clearly understand of the relationship between the firm's strategic intent and Mexico's comparative and competitive advantages. The analysis in the following paragraphs provides perspective that can be used to help firms assess whether it makes sense for them to manufacture in Mexico as part of their overall global competitive strategy.

Specifically, issues related to the fours Cs of compatibility, configuration, coordination, and control are examined. First, the emphasis placed on different competitive priorities is evaluated to determine whether or not Mexican manufacturing is compatible with the firm's strategic direction. Second, the nature of the planning process surrounding the decision to establish Mexican production operations is analyzed to provide a better understanding of basic configuration and coordination issues. Third, the availability of useful information needed to manage the day-to-day operations which fundamentally contribute to competitive success is considered. By looking at the forces that drive competitive strategy, the sophistication of the planning used to design and coordinate the operating network, and the information used to manage continuing operations, greater insight regarding the ability of Mexican production to enhance the firm's value-added capability is obtained.

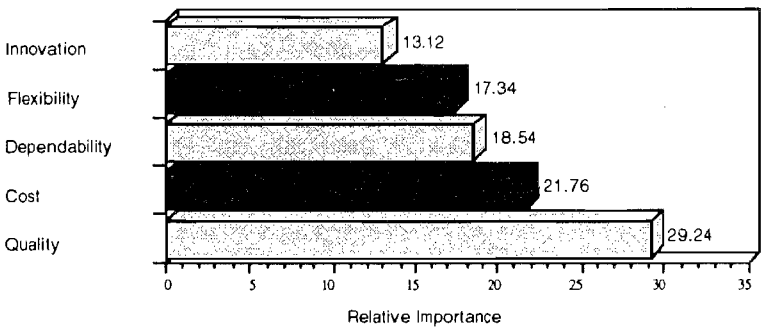
## V. Compatibility

Traditionally, innovative, high-margin products are produced close to home where capital and technology are easily accessed while standardized, labor-intensive products —where cost is critical to success— are produced in countries that possess abundant, low-cost labor. From this perspective, the competitive priorities a firm pursues should influence the firm's configuration decisions. In short, given the strategic objectives of the firm as expressed by its emphasis of manufacturing priorities, the question of interest is, does it make competitive sense to locate a manufacturing facility in Mexico?

Five competitive priorities — cost, quality, delivery, flexibility, and innovation— have been identified as the primary drivers of manufacturing strategy and performance (Hayes, Wheelwright, and Clark 1988). Survey respondents evaluated the importance of each of these priorities by allocating 100 points among them. High-quality production was rated the most important priority followed by low-cost production and delivery dependability (see Figure 1). The emphasis on quality is significantly greater than the emphasis on the other priorities ($p=.10$ compared to cost, $p=.05$ for delivery and flexibility, and $p=.01$ for innovation). During the interviews, managers consistently affirmed that high levels of quality are mandatory regardless of where a production facility is located. Simply stated, firms cannot trade off quality to achieve cost reductions because quality is viewed as an order winner whereas cost is an order qualifier.

Of note, several managers also emphasized that when provided with the appropriate training, Mexican workers produce world-class quality products.

FIGURE 1. Relative Importance of Manufacturing-Related Priorities




Specific Importance Distributions:

| Competitive priorities | Percent of Firms Reporting Importance Levels | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61+ |
| High-quality production | 3.1 | 23.6 | 48.9 | 16.0 | 5.3 | 2.3 | 0.8 |
| Low-cost production | 19.8 | 40.5 | 29.0 | 6.9 | 2.3 | 0.8 | 0.8 |
| Dependability (due-date performance) | 26.7 | 46.6 | 23.6 | 3.1 | --- | --- | --- |
| Flexible/Responsive Production | 30.5 | 51.2 | 14.5 | 3.8 | --- | --- | --- |
| Innovation | 55.7 | 34.4 | 7.6 | 2.3 | --- | --- | --- |

Cost's position as the second most important priority matches closely the rationale of using Mexican manuacturing to reduce production costs. Mexican wages continue to be competitive on a worldwide basis, and managers consistently praised Mexican workers as highly productive. Several managers emphasized that when trained, Mexican workers are often more productive than U.S. and Pacific Rim employees. The relative importance of delivery also favors Mexico as a low-cost production location. Mexico shares a two-thousand-mile-long border with the U.S. that includes numerous, if often congested, crossing points. The interviews revealed that while shipping goods across the border can at times be "bothersome," the process of moving goods into and out of Mexico is generally manageable and seldom the "nightmare" portrayed in the popular press. Overall, the Mexican production sharing environment is consistent with the relative emphasis firms place on the different competitive priorities.

It is important to point out that the role of Mexican production sharing operations is changing. While most of the goods made in Mexican production sharing operations have historically been re-exported to the U.S. for final processing and sale, greater emphasis is now being placed on capturing a larger share of the domestic Mexican market. In effect, companies now recognize that Mexico's population of approximately 90 million people represent an important emerging market, especially given the recent emergence of a Mexican middle class and the fact that over 50 percent of the population is under 20 years old and yet to reach peak spending age (Rapoport and Martin 1995). Thus, the traditional goal of using production sharing to improve firm competitiveness has been broadened to include the building of a market presence in Mexico. This increasingly important objective of targeting the Mexican domestic market was highly visible among the respondent

firms. That is, while the U.S. remained the largest target market —receiving almost 51 percent of the total production— over 42 percent of the output was produced for sale in Mexico (see Table 1). This finding demonstrates that the nature of production sharing in Mexico is evolving to be an integral part of many firm's North American and global competitive strategies.

TABLE 1. Percent of Production Sold in U.S. and Mexican Markets

| Percent Sold in U.S. | Percent of Firms | Percent Sold in Mexico | Percent of Firms |
|---|---|---|---|
| no U.S. sales | 22.3 | no Mexican sales | 30.8 |
| 1 to 20 | 16.9 | 1 to 20 | 21.5 |
| 21 to 40 | 7.0 | 21 to 40 | 3.1 |
| 41 to 60 | 3.8 | 41 to 60 | 3.8 |
| 61 to 80 | 12.3 | 61 to 80 | 12.3 |
| 81 to 100 | 37.7 | 81 to 100 | 33.8 |

## VI. Configuration and Coordination

Once a company determines that Mexican manufacturing is compatible with the firm's strategic priorities, issues regarding network design become extremely important. As previously suggested, achieving seamless performance in a global network requires that configuration and coordination issues be examined concurrently. To better understand the nature of these related decisions, respondent managers were asked to 1) indicate how well their firm's information system provides useful information for a variety of country selection criteria and 2) evaluate the sophistication of the initial planning process. Because firms tend to design their information systems to collect and disseminate the information that is perceived to be important, the data in Table 2 provide an indication of the value firms place on different country selection criteria. From this data, we see that financial issues such as exchange rates and tax concerns clearly dominate network design decisions. Traditional configuration considerations including cross-national labor rates, materials costs, resource availability, and production quality also receive considerable emphasis. By contrast, useful information regarding technology developments and logistics costs is comparatively unavailable. With an availability score of 4.37, global transportation rates are particularly overlooked. These findings indicate that coordination issues continue to be viewed as secondary in importance. As a result, firms might encounter greater coordination challenges as they manage the day-to-day operations of their global networks.

TABLE 2. Availability of Information Used in Global Configuration Decisions

| Information Item | Information Availability |
|---|---|
| Exchange rates | 5.55 |
| Tax issues | 5.35 |
| Currency convertibility | 5.27 |
| Foreign ownership laws | 5.18 |
| Tariffs/quotas | 5.16 |
| Domestic content laws | 5.10 |
| Cross-national labor rates | 4.98 |
| Production quality across countries | 4.92 |
| Cross-national materials input costs | 4.91 |
| Cross-national resource availability | 4.87 |
| Competitor's strategies | 4.83 |
| Potential sales in foreign markets | 4.80 |
| Labor unionization | 4.77 |
| Political stability | 4.71 |
| Cross-national economic conditions | 4.68 |
| Global technology developments | 4.67 |
| Cross-national productivity | 4.64 |
| Global transportation rates (logistics costs) | 4.37 |

The second design issue of interest focused on the actual planning process for the implementation of a production sharing strategy. A meas-

ure of planning sophistication was developed to indicate how much up-front attention was devoted to seven important areas during the design of the firm's North American operations, especially as the design effort considered the role and positioning of Mexican manufacturing. Planning sophistication was defined as "extensive analysis of risks and benefits, documentation of alternatives, and communication of the firm's objectives and strategy implementation process to all relevant management levels." The seven areas considered are listed in Table 3. These seven areas were addressed because decisions regarding facility location, distribution options, type of technology, product mix, supply base, and workforce level and training substantially impact the competitive performance of the production sharing operation.

TABLE 3. Planning Formalization Ratings

| Planning Activity | Level of Planning | p-value* |
|---|---|---|
| Planning for financial performance evaluation | 5.45 | ns |
| Planning for production and manufacturing planning control system | 5.26 | --- |
| Overall level of strategic planning | 5.12 | ns |
| Planning for purchasing and materials management system | 5.00 | .10 |
| Planning for country choice —facility location | 4.94 | .05 |
| Planning for marketing system | 4.79 | .01 |
| Planning for logistics and physical distribution system | 4.69 | .01 |

*significant difference in emphasis compared to planning for production and manufacturing control system

The data in Table 3 reveal that next to planning for the evaluation of financial performance, manufacturing issues consistently received the highest planning sophistication ratings. The amount of attention given to these two issues was significantly greater than for the following four activities: 1) the purchasing and materials system, 2) the facility location decision, 3) the marketing system, and 4) the logistics and physical distribution system. This finding reveals is consistent with the emphasis placed on the different country selection criteria. Unfortunately, this finding confirms the fact that firms have not emphasized an integrated planning framework that evaluates configuration and coordination issues simultaneously. The lack of an integrative approach portends greater coordination challenges and diminished network performance (Fawcett 1990; McGrath and Hoole 1992; Porter 1986). Indeed, several managers expressed considerable frustration that critical logistical issues were not adequately considered in the network design, resulting in inefficient operations and a disadvantageous competitive position.

## VII. Control

Even for well-designed networks, the bottom-line efficacy of operations rests on the day-to-day control of the value-added process (Kaplan 1991; Porter 1986). Just as accurate, relevant, and timely information is needed to make good configuration and coordination decisions, useful information is critical to controling operations for consistent value addition (Eccles 1991). Information's role is to 1) improve management's understanding of manufacturing and logistics activities, 2) facilitate the decision-making process, and 3) modify behavior throughout the organization. When quality information is widely available and used to fulfill these vital

roles, firm performance improves (Smith and Fawcett 1992).

fifteen items —three items related to each competitive priority— for both manufacturing and logistics activities (see Tables 4 & 5). Data for three separate

Table 4. The Collection of Useful Manufacturing Operating Information

| Information Area | Usefulness Rating | Chronbach's Alpha |
|---|---|---|
| **Cost:** | | .83 |
| Changes in important production costs including labor and materials | 5.20 | |
| Product costing (labor, materials, and overhead for items produced in Mexico) | 5.55 | |
| Total labor costs | 5.50 | |
| | 5.42 | |
| **Quality:** | | .79 |
| Process control (information used to identify problems in the production process) | 4.93 | |
| Production Defect rates | 5.26 | |
| Cost of quality (includes cost of poor quality and cost of improving quality) | 4.91 | |
| | 5.03 | |
| **Dependability:** | | .74 |
| Backorder performance (e.g. number of days to fill backorders) | 5.23 | |
| Due-date performance (e.g. percent of due dates met) | 5.24 | |
| Costs of missing promised production due dates | 4.42 | |
| | 4.96 | |
| **Flexibility:** | | .80 |
| Actual changeover times to different products | 4.85 | |
| Manufacturing cycle times | 5.20 | |
| Cost of manufacturing system flexibility | 4.71 | |
| | 4.92 | |
| **Innovation:** | | .83 |
| R&D effectiveness | 4.06 | |
| Time-to-market performance (product development lead times) | 4.32 | |
| Costs of product and process innovation | 4.52 | |
| | 4.30 | |
| **Overall Manufacturing Information:** | 4.93 | |

Because of information's important role in making good day-to-day control decisions, managers were asked to indicate the usefulness of the information captured and reported by the firm's information system. Useful information was defined as information that "enables managers to make operating decisions that will lead to long-term competitive success." Data regarding information availability was collected for

items for each priority were collected to assure that a reliable perception was obtained. Reliability was measured using Chronbach's Alpha, which measures the internal consistency of a set of measurement items. For manufacturing, the alpha scores ranged from .74 to .83. For logistics, the alpha scores ranged from .86 to .91. These alpha scores indicate that the measures are reliable. Looking at the actual availability ratings

Table 5. The Collection of Useful Logistics Operating Information

| Information Area | Usefulness Rating | Chronbach's Alpha |
|---|---|---|
| **Delivery:** | | .88 |
| Delivery performance (viz. percent of orders delivered on time) | 5.38 | |
| Expediting performance (viz. length of time to deliver expedited items) | 4.93 | |
| Cost of rapid and reliable delivery | 4.65 | |
| | 4.99 | |
| **Cost:** | | .87 |
| Transportation costs | 4.84 | |
| Total logistics cost information for items to and from Mexico | 4.57 | |
| Order system costs (viz. costs per order; order costs as a percent of sales) | 4.43 | |
| | 4.62 | |
| **Flexibility:** | | .90 |
| Quick response (viz. length of time to respond to customer inquiries) | 4.97 | |
| Logistics service customization (viz. number and type of special requests handled) | 4.45 | |
| Cost of flexible and responsive logistics system | 4.39 | |
| | 4.60 | |
| **Quality:** | | .86 |
| Logistics-related customer complaints | 4.70 | |
| Logistics impact on customer (information collected directly from the customer) | 4.45 | |
| Cost of quality logistics customer service | 4.35 | |
| | 4.50 | |
| **Innovation:** | | .91 |
| Logistics cycle time analysis (information used to reduce order cycle times) | 4.37 | |
| Value analysis (information used to increase the value added by logistics services) | 4.33 | |
| Cost of logistics service innovation | 4.17 | |
| | 4.29 | |
| **Overall Logistics Information:** | 4.60 | |

reveals that the respondent companies' information systems do a much better job of capturing and communicating manufacturing-related information. In fact, the manufacturing information availability for cost, quality, and flexibility was significantly better than the comparable logistics information availability. No statistical differences existed for dependability/delivery or for innovation. This finding points out that the tendency to overlook coordination issues in the design of global networks extends to day-to-day operating decisions.

With an overall mean availability rating of 5.42, production cost information is by far the most frequently available ($p=.01$ for the difference between the means for cost and the other priorities). The emphasis on manufacturing cost data is logical given that the opportunity to reduce costs is the single most important reason driving the decision to operate in Mexico. We should point out that while direct manufacturing cost information is aggressively collected and generally available, several managers noted the need to do a much

better job of collecting indirect cost information. Interestingly, among the other manufacturing-based priorities, information availability depends largely the degree of item objectivity and the scope of the desired information. In effect, the more objective the measure and the more narrow the scope, the better the information availability. Thus, information regarding defect rates, percent of due dates met, number of days to fill backorders, and manufacturing cycle times is widely available. Less traditional measures such as the total cost of poor quality, the cost of missing promised due dates, and the cost of system flexibility are both less well defined and less widely available.

With a mean availability rating of 4.99, delivery performance information is the most frequently disseminated to manage the logistics activities that support Mexican production sharing (p.=.05 for the difference between the means for delivery and the next highest-rated priority). This emphasis makes sense given the need to manage more complex international supply lines where disruptions occur more often than in a purely domestic environment. Cost and flexibility information were collected at about the same level (availability scores were 4.62 and 4.60 respectively). Within these two areas, transportation costs and lead times are monitored most closely. Overall, adequate operating information is available to help firms achieve control of their Mexican production sharing operations so that they contribute to overall firm competitiveness.

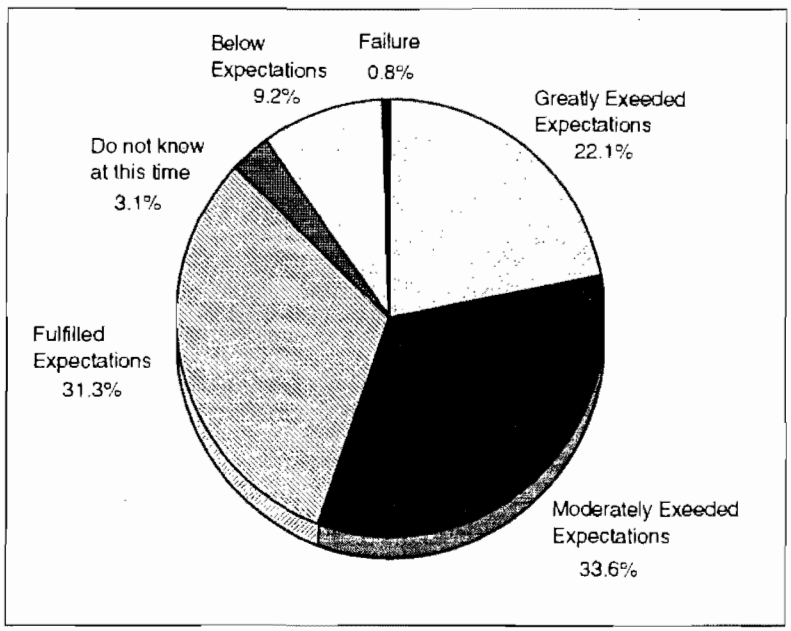
## VIII. Managerial and Theoretical Implications

Perhaps the best assessment of the viability of Mexican manufacturing occurs by looking at the performance impact of Mexican production sharing operations on the firm's overall competitive strategy. If the actual performance of these production-sharing operations is not adequate, low-cost labor —Mexico's historic draw— will not attract manufacturing investment in the long run, especially in light of the numerous low-cost locations now open to investment. Indeed, in the absence of high levels of manufacturing performance, declining tariff and technical barriers promise to influence U.S. firms to move production back to the U.S. or, more likely, to other low-cost production regions such as China and India. Therefore, continued manufacturing investment in Mexico depends on the ability of Mexican production sharing operations to help the firm deliver high-quality, low-cost products to not only U.S. and Mexican consumers but to markets worldwide. The key to making this happen is to carefully assess the fit between the inherent advantages offered by Mexico and the firm's strategic objectives and existing network structure.

We have outlined a straightforward approach to facilitate this assessment of global production sharing options. Four important issues —compatibility, configuration, coordination, and control— were discussed to frame the analysis of manufacturing fit. These issues all focused on assessing the design and management of Mexican manufacturing within the broader context of a global operating network. Unfortunately, the dynamic nature of not only the Mexican but also the global operating environment complicates the assessment process, requiring more sophisticated up-front

planning, better information systems, and continued review of operations. Despite these complexities and the difficulties encountered in integrating Mexican operations into existing competitive strategies, many firms have experienced tremendous success with their Mexican operations. Among the respondents, 86 percent reported that their Mexican production operations had met or exceeded initial expectations (see Figure 2). When these Mexican operations were analyzed using the proposed framework, several important insights emerged.

FIGURE 2. Perceived Success of Manufacturing Operations




- First, the majority of the companies that have set up operations in Mexico have done a decent job of assessing compatibility and matching their competitive needs with the opportunities available in Mexico. Most companies have sought low-cost manufacturing with ready access to the U.S. market and have found that Mexico provides both. More companies are now seeking to establish a local market presence; a strategy that matches the development of an increasingly attractive consumer market. Indeed, the opportunity to sell in Mexico was consistently cited during the interviews as the major attraction for future investment in Mexico. However, some companies continue to fail to evaluate seriously why they are establishing Mexican operations. For example, one of the firms that was visited located in Mexico largely because a senior manager had a dinner-party discussion with a friend who had just set up operations in Mexico for his company. When such informal approaches are coupled with inadequate information in the design of the manufacturing operation, the probability of failure increases dramatically. These firms often fail to survive beyond the first couple of years in Mexico.

- Second, configuration decisions receive much greater attention than coordination decisions during the actual design of the international facility network. Moreover, financial issues tend to take precedence throughout the configuration

evaluation. Fortunately, manufacturing performance issues also receive a high degree of emphasis, suggesting that firms are taking the rationalization decision quite seriously. This emphasis on manufacturing issues was found to greatly help firms establish high-quality and productive operations. Of course, contradictory examples were found in which manufacturing systems were poorly designed and performance levels languished.

- Third, the fact that coordination issues were relegated to second their status during the planning and design for establishment of Mexican operations demonstrates that the notion of integrated global operations remains more rhetoric than reality. On-site interviews combined with a review of the performance of coordinating mechanisms reveal that more thoroughly integrated and seamless North American and global operations are needed to take advantage of the promise of enhanced scale economies and increased global market penetration. The need for more sophisticated logistics systems planning, which was rated by the respondent managers as the least sophisticated of the planning areas, was particularly pronounced. Without a high level of logistics coordination, truly integrated operations are not viable. Likewise, now that emphasis is being placed on Mexico as an emerging consumer market, greater emphasis needs to be focused on the marketing systems and strategies that will be used to penetrate and cultivate a Mexican market position.

- Fourth, regardless of the emphasis placed on assessing compatibility and planning for configuration and coordination, tremendous effort and preparation is needed to successfully control the firm's day-to-day value-added activities. In general, on-site information systems have been developed to help achieve the necessary control. However, the interviews consistently pointed out that in addition to having good information for decision making, managers also needed better incentive systems and greater cultural awareness to be effective. Managers emphasized that when appropriate equipment, measurement, and training are combined, productivity and quality levels equal or exceed —by as much as 5 to 20 percent— similar operations in the U.S. and Pacific Basin.

- Finally, good management of daily operations can overcome many of the challenges created through poor configuration decisions; however, poor operating control can totally offset good strategic decisions. One control problem frequently encountered involved the management of indirect labor costs. In fact, several companies noted that indirect labor costs had initially offset the savings accrued from low-cost direct labor. Firms that fail to get their indirect labor costs under control often leave Mexico.

To summarize, firms that carefully consider the issues of compatibility, configuration, coordina-

tion, and control tend to achieve satisfactory levels of performance. By contrast, firms that leave one or more of these issues unexamined face greater "unexpected" challenges and often fail to achieve established targets. These firms often close down their Mexican operations within the first three years. The area where greatest improvement in assessment and planning was found to be needed involved planning for the development of coordinating or integrating mechanisms. This need is particularly acute since global competition has made poorly coordinated international operations obsolete. Independent or multidomestic operations lack the agility, productivity, and synergies that are being achieved by highly integrated global operations. The simple existence of comparative advantages promises a short-term, transitory competitive advantage; however, true integration can provide a sustainable and hard-to-replicate competitive advantage.

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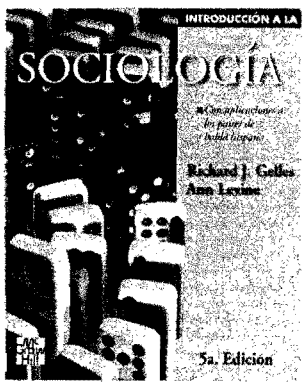
## Colaboradores de la UDEM en McGraw Hill




GELLES, RICHARD J. Y ANN LEVINE. 1996. *Introducción a la Sociología.* 5 a. Edición. México. Mc Graw Hill.

Gelles y Levine presentan los conceptos básicos de sociología y los desarrollan en el estudio de temas clásicos y de actualidad (cultura, etnicidad, familia, SIDA, ONGs, urbanización en la perspectiva global, entre otros). La obra incluye colaboraciones afines a la realidad de los países de habla hispana (partidos políticos, bandas juveniles, familia, educación a discapacitados, cultura política, *El Barzón*). Por parte de la UDEM participan Ma. Teresa Celestino, Ma. Antonieta Gutiérrez, Roberto Rebolloso y Rebeca Moreno.

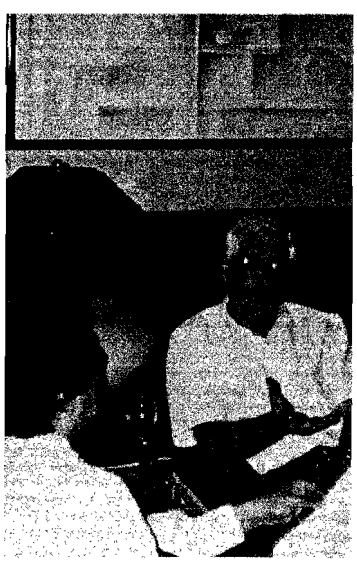
# Peter Dicken

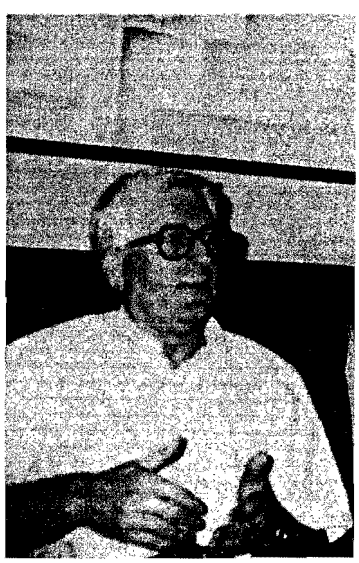
Jesús A. Treviño*
Roberto Rebolloso

TREVIÑO, J.A. AND ROBERTO REBOLLOSO. 1996. Interview with Peter Dicken. **Urbana** III (1): 43-53. Peter Dicken is a product of Manchester. He was born there on March 5, 1938. He studied in this city and he still lives and works there. His first book, *Location in Space* (1972), jointly written with Peter Lloyd, has been widely recognized for having brought the behavioral approach to geography. This research interest and collaboration with Lloyd continued during the 1970s; the result was published in *Modern Western Society* (1981).

In the mid eighties, working on his own, Dicken published *Global Shift* (1986). This work, almost ready for the third edition in 1997, is used as a textbook in several disciplines such as political science, geography, economics, international sociology and international business.

Although Dicken's research interest ranges widely, his work always has a concise and strict structure. Having a long teaching experience, Peter Dicken is also a good expositor. In this interview, he effortlessly combines theoretical knowledge and experience in a clear and pleasant conversational style.





* We want to thank Carlo Brumat, academic director of DUXX (formerly INTEGER), for facilitating our meetings with Peter Dicken.

*Q*. Where do you work?

*A*. I work in the Department of Geography at the University of Manchester. The university is a good place to work; it is big, it has much variety and a lot of colleagues in the social sciences and business. It is in a city I like very much. Manchester is also an easy city to get out of! It has a good airport and good connections.

*Q*. What was your first academic interest?

*A*. I did my first degree in Geography. In this field, I was influenced particularly by David Smith. I was his first graduate student. He had just started his academic career. David came to the Department at the end of my first year. I did his courses and we got on extremely well. When he left for the United States in 1966, I was appointed to replace him in the same Department. Actually Peter Lloyd and I shared his course.

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*Q*. What influence did you have from David Smith?

*A*. Through him I became very interested in the classic locational theories of Lösch, Weber, Isard, Von Thünen. I found it very exciting because it was so different from the old style in regional geography, from the old empirical style. Until then, I was very keen on physical geography. I had done some geology and geography courses, but I got entirely switched on by this new perspective; it was new for us in 1964 or 1965.

*Q*. Did David Smith have a particular research interest at Manchester?

*A*. Yes. He was very interested in regional change, sub-regional change, change in employment; his initial interest was in social indicators. He spent quite a lot of the time collecting data within the North-West region, where Manchester is located, in looking at various indicators of sub-regional variation.

*Q*. What were your first steps in research?

*A*. I had a conventional geographic education, then I became very involved in the locational theoretic material. And the research I did, my first grade research, was on the garment industry in greater Manchester. I was very interested in firms by then, in decision making. I was very swept up by the kind of early behavioral phase in geography by the works of Herbert Simon, Richard M. Cyert and James G. March. The study of this industry was a mix of quantitative and qualitative analysis. Subsequently, I became interested in firm ownership, in what happen with firms that associate together. For a long time this was one of the major contrasts I had with Peter Lloyd; he did work mainly on individual plants, establishments.

*Q*. When did you have your first professional contact with North America?

*A*. In 1969. I was at Queen's University, in Kingston, Ontario. That was for four months. It was very influential for me because it was the first time I had been outside the UK as

a university teacher in a different system. I found the students very different from ours. I found them more inclined to question the grades, and, once in a while, to ask why this has got to be. This is good, I think. That was not usual in England. It was a great shock; I grew up very quickly. I had to teach a class which combined undergraduate and graduate students. Master's students took the course as well with an additional seminar. This combination of students covered an enormous range of ability. It was an economic geography course. I was brought in because somebody had left early, and they had a gap they had to fill. So I filled it for four months. I learned a huge amount out of that experience. When I was back in the UK in the Spring of 1969, I had a letter from Brock University in St. Catharines, Ontario. It was not a well known university; it was very new and small one. Somebody was going on sabbatical for a year, and they were looking for a replacement, so I said, "I will go." Thus, I went back to Canada again in 1970. This time I spent 14 months there. I spent the academic year at St. Catharines, and I had the time to go back to Queen's in Kingston and to teach in the summer school there and in UBC (University of British Columbia), in Vancouver, again accumulating experiences.

That was also the first time I made real contacts with US geographers. I went to my first AAG (Association of American Geographers) meeting in 1971, in Boston. I was very taken by that. It just seemed everything was excellent; it was, in a way. American geography, particularly then, was very liberated, very much leading edge. Being trained in the sixties, I certainly was very influenced by spatial analysis, location analysis and the like. And that was the time when we, Lloyd and I, were writing *Location in Space.*

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*Q.* What did you do after *Location in Space*?

*A.* We started a research unit based in Manchester, specifically looking into industrial change in the Northwest region of Britain. For most of the 70s I was working primarily within the local region, looking in a lot of detail at the dynamics of industrial change. My interest was looking at the firm and at firms within the region: ownership characteristics, sectoral characteristics, clustering and so on. We did a lot of work. We got a big grant from the Social Science Research Council. We produced the most detailed analysis of the region at that time. Towards the end of the 70s we had quite a lot of research money from the government. The government in Britain at that time had started to become interested in the cities, the problems of declining manufacturing cities; so they started an inner cities program in the late 70s. Each of the old industrial cities in Britain was losing manufacturing jobs quite dramatically. The inner cities program began about 1976 or 77. Among other things, the government also established a large research program. It invited academics and consultants to

bid for the contracts. We had a contract for two years to study the small firm, the new small firms, their formation and change in the two big metropolitan areas of the Northwest, Greater Manchester and Liverpool. We produced the report towards the end of the 1970s. Also I had become very involved individually in looking at American investment in Britain. I found that looking at the changes in the region we discovered that a lot of the firms were owned by Americans. I started tracing that. We did a paper about it in 1976, which is probably one of the earlier ones that geographers did on foreign ownership, in our region particularly. I realized these were things I wanted to develop further. I felt I had to move outside the region. I was beginning to get interested in things more global. That was a rather unformed, very provisional sort of interest. In 1980, I decided to pull out of the collaboration with Lloyd. At that time, in order to maintain the research unit we had to go looking for more money. If I had gone down that route I would have found myself in it for another two or three years. The timing was determined by the end of one research contract. I did not want to get myself in it again. Around that time we also published *Modern Western Society*. It was a difficult birth. We decided to do it on a broader human social topic. We had different kinds of problems. We did not know what it was. I think, we became involved in other things. We had a contract to publish the book, and we didn't have anything written. We persuaded the publisher, Harper and Row in London, to do first a second edition of *Location in Space*. We did it in 1976. This second edition was quite substantial and a much bigger book than the first edition. It was exactly the same structure and format. After that we continued the book that we had to finish.

**Q.** Why do you say that Modern Western Society had a hard birth?

*A.* We did not show through it precisely what we wanted to do. We both drew drafts of chapters and that sort of thing. But it did not fit together. It was not satisfying. It is quite clear it is not a well focused, a clearly thought out piece of work, but I am not ashamed. It has good things. The structure is OK, but it lacks a conceptual base.

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**Q.** What do you think about collaboration between colleagues doing research?

*A.* When Peter Lloyd and I began working together in 1966, we collaborated very well. Around 1968, we decided to write the first edition of *Location in Space*. I was 31. The book was published in 1972 in the States. That was a really good collaboration because we, I think, sparked each other off. It is very good because with very different people you work in very different ways. It was a very complementary symbiotic relationship. We each contributed something which the

other didn't have. That was good. In 1980, we stopped working together, We moved further apart academically, and we both had our own agendas of what we wanted to do. Peter was developing the research unit very successfully into a much bigger operation, which continued until he left Manchester in 1988. He is now in Liverpool. And I wanted to develop my own thing, my global interest and so on. I have increasingly felt over the years that I, in general, like to work on my own. I do not mind collaborating. I do collaborate with people still, but especially for book writing projects. I feel the benefits of being in control of the whole thing and not having to guess what the other person might be doing.

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*Q*. While you are working with somebody else, you already remarked on the advantage of sharing knowledge and sparking each other off. But how to deal with the inherent tension that it is in the same package? Don't you think that researching collaborative efforts are joint ventures of intelligence and dullness at the same time?

*A*. I think it is true. I can mention three things about collaboration. First, if collaboration does not work, you waste a lot of time. If it works, you gain some large benefits, there is no doubt: the ability to share ideas to spark each other off; you think of something and . . . "I tell you," "That is really good," or "I never thought that at all," or "Let's develop it in that way." That is great. That is the really nice part of collaboration, and I think that worked well in that first book we did, Lloyd and I, for the first edition of *Location in Space*. I think it was because we both were young, we both were starting out; neither one of us had many other academic commitments. That was everything we did, and it was great. As we got more involved in other things, and our agendas began to be diverge, the collaboration became more artificial in a way. Exactly as you say would happen: we spent hours some times, . . . "We must do this thing," we had the board, wrote them down . . . and we did not have a significant result. In this case it is better you go away to get things on paper. No way you put them on a board in a brainstorm; you put them on paper, as a draft, and that is a big discipline. The second thing with collaborations is corresponsibility. Unless you work exactly in the same way, it can be a problem. If I am spending, say, a month working on my part of this project and you are working on something else, I will get resentful, because you should be working in this project. And then, at another time, you are working on this project and I am working in something else, you will get resentful. That becomes a very, very delicate operation. It really does. I just began to feel that, I am sure Peter felt the same. The stresses were becoming greater and the benefits were becoming on the whole less and much harder to achieve. I certainly was going to pull out, but I wanted to pull out in the right circumstances, without acrimony.

We remain good friends and meet up regularly for a beer. Fortunately, even when we were collaborating, I was also publishing papers and the like under my own name. Finally, my third comment on collaboration, specially a long established collaboration, is that you lose your identity. In our case, we both have the same first name, we both are called Peter. You would be amazed how many times we were confused one for the other. So you would go to a conference or whatever, one of us, or he would go perhaps, and the chair of the session would say, "I would like introduce Peter Dicken" . . . and he was Peter Lloyd. Some times we both were a bit distressed: who am I, do I exist as an individual? or are we simply two parts of the same animal, some kind of weird mythical creature?.

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*Q*. Let's talk about the recent material you have been working on for FDI (Foreign Direct Investment). Don't you think that FDI literature is behind the reality, lagged behind?

*A*. Yes. I have made the same comment. The literature in economics and the like on FDI is all the way behind reality, in almost every way. It was not until 1960 that there was a systematic attempt to explain FDI. But Stephen Hymer's primary work was not published in 1960. It was not published until he had already died in the 1970s. All his ideas came out through other people. Most literature that attempted to understand the FDI and MNCs or whatever was heavily influenced by the work from one place: Harvard. The Harvard Business School had the multinational enterprise project with Raymond Vernon as Director. It started in the 1960s; they built a database of the biggest multinational firms. The main criteria for inclusion of these multinational firms was that they had to have operations in more than six countries. So, they selected the biggest firms, mostly American firms. It was a very good work, but it was the only available database for a long time on MNCs. It became the basis on which theoretical formulations were founded.

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The theoretical literature that developed was for a long time very country-specific (the USA) and dominated by very large firms. It was very useful, but

it was very one sided. It took a long time to realize the diversity in the population of TNCs.

*Q.* Do you mean that the database determined the theoretical approach?

*A.* Yes, I really do believe that.

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John Dunning has been incredibly influential. He developed his own particular framework back in the 70s. He did a tremendous job in building a conceptual framework on the internationalization of production. Even though his eclectic paradigm is essentially a set of boxes, I have very high regard for what he did

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*Q.* What about Ronald Coase's influence?

*A.* He did not work on multinationals. He did a short paper when he was quite young. In "The Nature of the Firm" in *Economica*, he founded the basis of what became much of the analysis on internalization and transaction costs and the like. In fact, he does not mention internalization at all. He wrote on risk, uncertainty, and so on. It is interesting how influential it was a long time after he wrote the paper. It was picked up mainly by some writers on TNCs who were searching for theory, such as the notion of internalization in Alan Rugman, Peter Buckley and Mark Casson and others. In this particular area of work John Dunning has been incredibly influential. He developed his own particular framework back in the 70s. He did a tremendous job in building a conceptual framework on the internationalization of production. Even though his eclectic paradigm is essentially a set of boxes, I have very high regard for what he did.

*Q.* I think Dunning's contribution is very useful. Do you think so?

*A.* That is quite right. The reason I find Dunning's work useful is that he has the courage, particularly as an economist, to go outside the boundaries of his discipline. Because the existing body of theories was not satisfactory, he drew upon work in a variety of different areas. So, he drew upon international trade theory, industrial organization theory, locational theory, and other fields. He did it at a time when it was not fashionable at all, especially in economics. The main problem in Dunning's model, I think, is that you can put everything into it. But it does not tell you much about how they connect together; it does not tell you much about the interrelationships between its elements. At the very end, Dunning is a great pragmatist.

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*Q.* Referring to your book *Global Shift*, what chapters would your recommend for a course on TNCs?

*A.* I think that there are three or four core chapters for a course on international businesses. They are the chapters on technology, on the political system, and on the TNCs. At the moment, there is a chapter which summarizes

the theories on TNCs; it is separated from the discussion of global organization and reorganization of economic activity by the chapter on the political dimension. I am going to change that in the third edition of *Global Shift*, which is in the next year, 1997. I want to make things tighter, especially those that are the conceptual core of the book.

*Q.* Would you mind providing more detail on changes to the third edition of *Global Shift*?

*A.* It is a large book. The publishers do not want it to be bigger. At the moment, I am rethinking the next edition and a number of things to reorganize. One of the things that I have become more and more interested in is the interrelationship between firms and states. However, the broad frame will stay very much the same. I will make much more explicit how the TNC-states interdependency shapes the global economy and to stress more the interaction elements within the context of technology. I will also rethink the issue of bargaining, which is more important than the credit I gave it. I would certainly relocate that in a different part of the book, much more in the context of the firm-state interactions, about the middle part of the book. The strong empirical chapters, two and three, one is on trade and the other on investment, I am going to compress into one chapter and I am going to summarize them a lot more. I can make more room elsewhere for additional material. I want to put in other parts of the book things other than simply moving things around. The structure will remain the same; it works. So I am going to change the order of those conceptual core chapters, as I said before, take some things out and writing some more things in.

*Q.* *Global Shift* covers a wide range of topics. How did you prepare yourself for such a broad intellectual task?

*A.* When I stopped working on the local material in 1980, I had a couple of years where I did not do anything much more than read and think; I did not write very much. I worked a little, just trying to reorient myself. That preparation was not particularly directed; I just was aware that I needed to collect data, obviously, that is straightforward. The main problem was trying to develop an explanatory framework. I spent a lot of time on that. I spent four more time trying to develop the structure than I probably did in writing the book. Once the empirical data were collected (it took a lot of time) and I had the framework, I could write it relatively quickly. The frame was the problem. It was trial and error, without any doubt at all.

When I decided to do the book, I did not have any conception of the risk I was taking. I knew what I wanted to do, but I really did not grasp the scale. If you start writing something with "global" in the title, you suffer to produce such immense scope. In the first edition, I did not really fully appreciate what I had done at the end of it. I will tell you what I mean by that. Occasionally people tell me about things I wrote, and I think "Did I really say that, did I really make these points?" So I learned quite a lot from what people said I had done . . . Sometimes the best person to judge is

not yourself, but somebody from outside.

*Q*. Do you remember which chapters came first?

*A*. I think I wrote it through more or less consecutively, more or less. I am sure I did.

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I spent four more time trying to develop the structure than I probably did in writing the book (*Global Shift*)

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*Q*. Do you find different the Peter Dicken in 1996 from that writing *Location in Space* in 1972?

*A*. I can recognize myself in the 1970s. I do not think I have changed that much in the way I think. I like to believe I continue to develop intellectually; I like to think I continue to be open to ideas, be responsive to change. At the same time, I also like to think that I have pursued, at the core of what I do, a fairly consistent line: this particular interest in firms. When I see many people moving away from what they were doing, I think "Maybe they are right," but I feel encouraged by the kind of things I always I have been interested in for 25 years or more. My interest is much broader than before, for sure. But I can recognize the central thread. If you put it the other way around, if you had asked me in 1972 where I thought I was going academically, what I would do in the next ten years, I would probably have said: publishing a book on the Northwest of England.

*Q*. Are you now less ambitious than in 1972?

*A*. I was never ambitious, honestly. Partly because I came into academic life older than most teachers in England. I came into it by accident; I never intended to have an academic life. I came into the system in 1966 when in Britain there was a sudden opening up of job opportunities in universities. There was a whole number of universities being formed; the system was expanding. I had offers of three jobs. I went back to Manchester. I was very lucky, I got into the system really by accident; I did not see myself as being driven by such thoughts as, "I must achieve this," "I must achieve that." I just came into it, I liked it, I enjoyed what I did. I really enjoyed researching and writing. I have never been ambitious in the sense of deliberately seeking out promotional things; I *have* been ambitious in the sense of wanting what I do to be respected. My ambitions are to do what I have been doing, to interact with people in different environments and to gain all the benefits of an academic existence without being a closet academician.

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*Q*. What is your daily work routine?

*A*. I am a creature of habit and routine,

a fact which amuses many of my colleagues. I have a very clear routine. I go into the Department every day, partly because I am chairman, head of the Department, so I need to be there anyway. But I probably will do the same in the future. I get into the Department about 7:15- 7:20 a.m. I am the only person there at that time, usually. I make myself some fresh made coffee, very strong, I get out my *Financial Times*, I put on Radio 3, which is the classical music channel, and I drink my coffee. I read through the *Financial Times*, and I clip out material I am interested in, while I am listening to music. There is no telephone. That occupies me that part of the morning. I file my *Financial Times* within a huge system with material from it and the *Economist*. Then, either I continue reading or I write in the mornings as a rule. I have found the mornings up to lunch time the most productive. I have found it much harder to write creatively in the afternoons. I eat a banana about 10:20 a.m. I probably would have a cup of tea with colleagues at the Department by 11:00. Then, I have an early lunch by 12:15. Since I have a very early breakfast, by 12:15 I am hungry. I only eat a light lunch; I do not have a big lunch as you do. Then, I often spend an hour reading some newspapers. I go back and do most of the routine things in the afternoons. I have tended to do routine things in the afternoons: collect some data I need from the libraries, maybe read some academic papers, or just revise material I have read in the mornings. I do not do many new things in the afternoons. Sometimes when I am under pressure I do. I find I need a very clear, systematic way of working. You have to find the way that works for you. I have a colleague who starts working at 10 o'clock at night and works until 3:00-4:00 am. I cannot do that at all. I finish my working day about 6:30 p.m. and get home by 7:00. Nowadays, I rarely work in the evenings. I used to work in the evenings. I still do some work on Sunday mornings, but I do not work on Saturdays, ever. I like to have a day with nothing at all. I do not do as much on the weekends as I used to do. Now I begin to feel "If I work a pretty long day from Monday to Friday, if I am working efficiently, I should have enough done by that time." If you do this kind of work seriously, you will find a system that works for you. And that works for me.

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*Q*. Do you have a specific place and methodology to get your ideas?

*A*. There are all kinds of different places. While I am shaving; very rarely during the night. I do not often wake up. I know people that, in the middle of the night, get a pad and write down ideas. I do not have wake ups, so I do not do that. When I am driving from work. It is kind of random. What I do find is that with the usual problem of dealing with a blank sheet of paper (which I still find very hard), I pretend that I am not really starting. I just

scribble a few things down. Sometimes you already write a page and you think "Well, I have stuff that is working." It is awful if I have to sit down and start a paper or chapter *now*. I cannot easily do that. I am a creature of the precomputer age. I only recently got to the stage of writing directly on the screen. Of course, I have some previous drafts. Whatever I do, I spend a lot of time planning. It reduces the blockage. If you produce a very detailed plan, you are a long way along the road to producing the essence. All you have to do is fill in the details. Maybe I have planning blocks more than I have "writing blocks".When that happens, I do something else; that usually helps.

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## Correo de publicaciones


USITC. 1996. *Production sharing: use of U.S. components and materials in foreign assembly operations, 1991-1994.* Washington: USITC (May).


GONZÁLEZ, LUIS. 1988. *El oficio de historiar.* Zamora, Mich.: El Colegio de Michoacán.

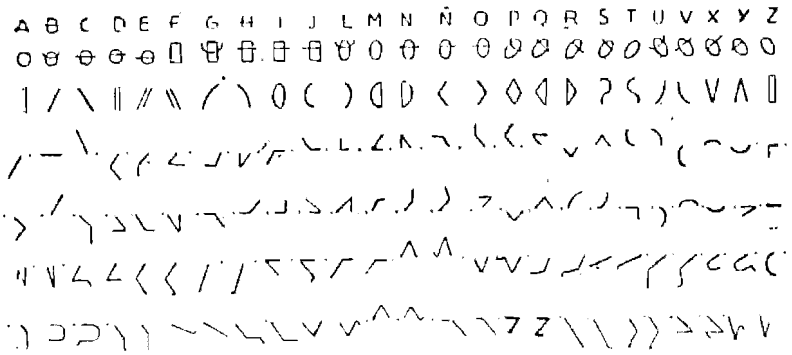

STAHRINGER, OFELIA. 1996. *El MERCOSUR en el nuevo orden mundial.* Buenos Aires: Ediciones Ciudad Argentina.

# Trivia

## Centro AREA

### Criptografía en el diseño de portada*

El detective Sherlock Holmes, en una de las historias creadas por Conan Doyle, solucionaba el misterio de un crimen descifrando el valor esteganográfico de unos muñecos que aparecían en los muros de la casa en donde ocurría el suceso.



El procedimiento ingenioso del autor presentó en aquellos tiempos una novedad en la materia, pues aquellos muñecos, en apariencia infantiles, contenían la clave para solucionar el misterio.

El significado gráfico de los muñecos era el disfraz de mayor habilidad conocido hasta la fecha. Cada muñeco era una figura criptográfica en la que la cabeza, tronco y cada una de las extremidades correspondían a una letra del alfabeto.

Dado lo ingenioso del procedimiento y puesto que ya fué publicado en su día por el autor, damos a continuación un esteganograma a base de transposiciones regulares que formado por una vertical y dos horizontales; distribuyen el cuerpo humano en seis partes, cada una de las cuales se sirve de un alfabeto autónomo; según se ve en la tabla que se acompaña.

Disponiendo de los alfabetos convenidos vamos a criptografiar: "No te fíes de las apariencias, que cuando menos lo piensas salta la liebre". Y aplicaremos las letras por el siguiente orden numérico: 1 y 2 vertical; 3 y 4 horizontal; 5 y 6 horizontal inferior.

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   1
3  2  4
5     6
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Y el texto quedará repartido en tres líneas, de la siguiente forma:

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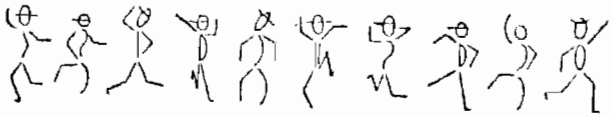
N  E  S  E  Q  N  O  E  A  L
TOE DSE PAA CNI EUC ODM LSO SNA TLA EIB
F  I  L  A  R  I  A  S  U  A  E  N  P  I  S  S  L  A  R  E
```

* Tomado de Jacinto Ventura Pagés, *Criptografía* (Buenos Aires: Ed. Molino, 1947).

para ser representado por esta sucesión de muñecos.



Energy and speed**

## I. Decibels

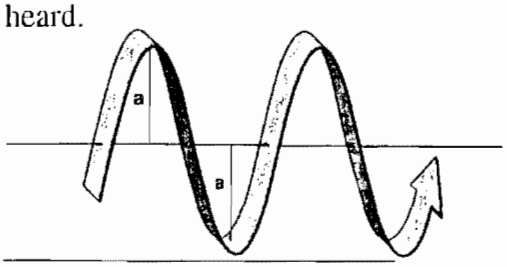
The loudness of a sound is measured by the size of its vibrations; this is measured in decibels (dB).

## II.Decibel scale

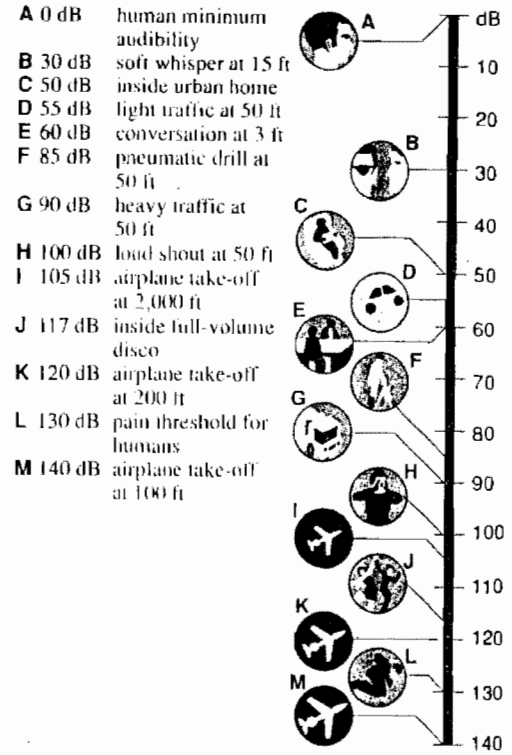
The dB scale is relative and increases exponentially, beginning with the smallest sound change that can be heard by humans (0-1 dB). A 20 dB sound is 10 times louder than a 10 dB sound; a 30 is 100 times as loud as that. Noises at the level of 120-130 dB can cause pain in humans; higher levels can cause permanent ear damage. The dB ratings (at certain distances) of some common noises are listed below.

## III. Wave amplitude

Amplitude (a) is the distance between a wave peak or trough and an intermediate line of equilibrium. The greater the amount of energy transmitted in a sound wave, the greater is the wave's amplitude and the louder the sound heard.

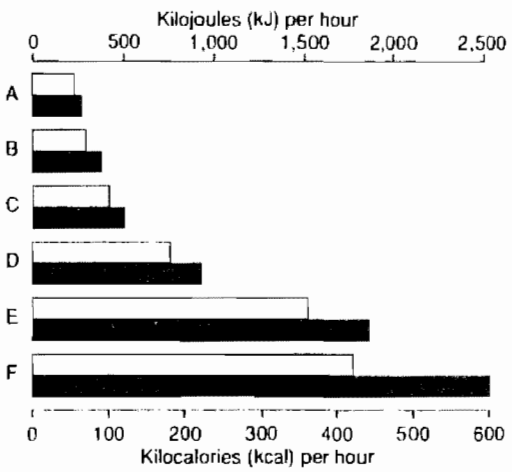



** Reprinted from The Diagram Group, *Measurements & Conversions* (U.S.A.: Ed. Running Press, 1994).




## IV. Energy needs by activity

| | Activity | ☐ Women | ■ Men |
|---|---|---|---|
| A | Sleeping | 230 kJ; 55 kcal | 272 kJ; 65 kcal |
| B | Sitting | 293 kJ; 70 kcal | 377 kJ; 90 kcal |
| C | Standing | 419 kJ; 100 kcal | 502 kJ; 120 kcal |
| D | Walking | 754 kJ; 180 kcal | 921 kJ; 220 kcal |
| E | Walking (uphill) | 1,507 kJ; 360 kcal | 1,842 kJ; 440 kcal |
| F | Runing | 1,759 kJ; 420 kcal | 2,512 kJ; 600 kcal |



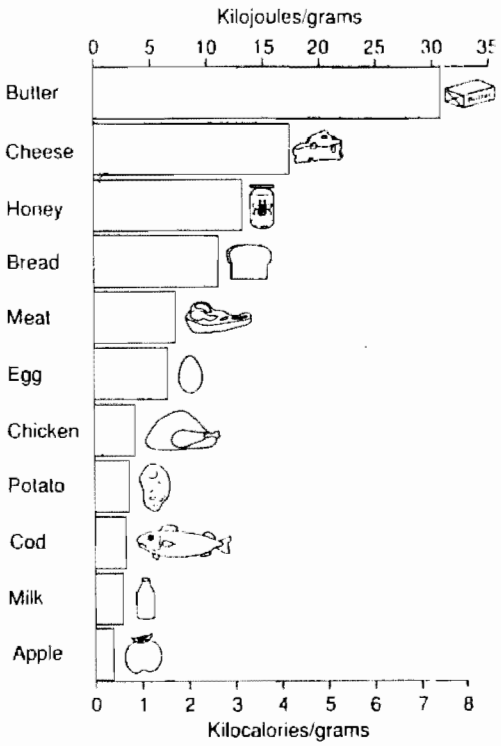
Men use more kilocalories than women for all activities around, and because women usually have more body fat and so need less energy to retain body heat.

## V. The Beaufort scale

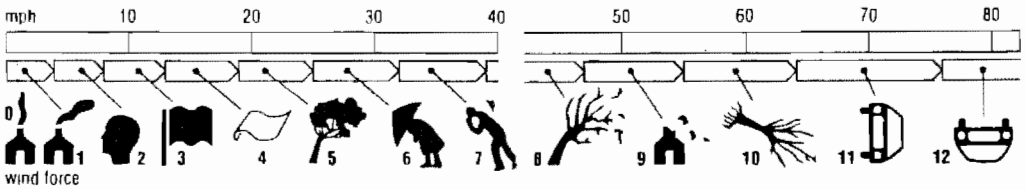
The speed of wind is measured by using the *Beaufort Scale*, based on easily observable factors such as tree movement, smoke behavior, and damage incurred. It was devised by a 19th-century British admiral, Sir Francis Beaufort.

As air moves across the surface of the Earth, its direction is determined by such factors as the Earth's rotation, variations in temperature, air pressure, and land features such as mountains. Listed below are examples showing the effects of wind as measured on the *Beaufort Scale*, the variety of winds that are measured, and the range of speeds to which they apply.

## VI. Energy values of selected foods




- The effects of wind considering its variety and range of speeds




| Number | Description | Speed range mph |
|---|---|---|
| Force 0 | Calm | Below 1 |
| Force 1 | Light air | 1–3 |
| Force 2 | Light breeze | 4–7 |
| Force 3 | Gentle breeze | 8–12 |
| Force 4 | Moderate breeze | 13–18 |
| Force 5 | Fresh breeze | 19–24 |
| Force 6 | Strong breeze | 25–31 |
| Force 7 | Moderate gale | 32–38 |
| Force 8 | Fresh gale | 39–46 |
| Force 9 | Strong gale | 47–54 |
| Force 10 | Whole gale | 55–63 |
| Force 11 | Storm | 64–75 |
| Force 12 | Hurricane | Over 75 |

| Number | Characteristics |
|---|---|
| Force 0 | Smoke rises straight up |
| Force 1 | Smoke shows wind direction |
| Force 2 | Wind felt on face |
| Force 3 | Flag extends |
| Force 4 | Dust and paper blow in wind |
| Force 5 | Small trees sway in wind |
| Force 6 | Umbrellas are difficult to use |
| Force 7 | Difficult to stand up in wind |
| Force 8 | Twigs break off trees |
| Force 9 | Chimney tops and tiles are dislodged |
| Force 10 | Trees are uprooted |
| Force 11 | Extensive damage |
| Force 12 | Extremely violent |