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AN ALLIANCE OF UNIVERSITIES AS AN AGENT OF KNOWLEDGE TRANSFER TO SMALL FIRMS

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An alliance of universities as an agent of knowledge transfer to small firms

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This paper describes and assesses a regionally focused strategy of industry modernization that is being launched by a consortium of research universities located in the western region of New York State, USA. This nationally funded demonstration program is designed to upgrade the competitive advantages of small manufacturing firms that are presently financially stable, but are experiencing increasing competition from foreign manufacturers because of inferior products and/or process technologies. The analysis identifies both the advantages and difficulties that arise when four schools of engineering attempt to work together to deliver new technologies and engineering know-how to small firms. When compared to state-level programs that have been designated as "best" and "most promising" in providing assistance to small firms, the design of this demonstration program is rated quite effective as an initiative that can be employed by universities to upgrade the knowledge infrastructure and competitive posture of their local region and industries.

Keywords: small manufacturing firms; consortium of universities; innovative milieu; university-to-private sector transfer of engineering technology and know-how.

1. The challenge

A region's economic growth and development potential is closely tied to the national and international competitive strength of its

industries. In fact, Harvard economist Michael Porter asserts that the only way for a region to be competitive is to make certain that its industries are competitive. More specifically, Porter argues that the competitive advantage of industry sectors grows fundamentally out of innovation, change, and improvement of individual companies within these clusters (Porter 1990: 578).

This strong link between the characteristics of a particular region and the competitive advantages of its manufacturing establishments is also demonstrated in AnnaLee Saxenian's comparison of the Silicon Valley and Route 128 industrial complexes. The central theme of her research is that regions make the difference, and that a strong connection exists between the internal structure of firms and the broader structure of the region in which they are located (Saxenian 1994: 5-6). In other words, important regional sources of competitive advantage exist, and variations in local institutions, such as universities, and corporate forms, shape the region's capacities for innovation.

The challenge then for economic development policymakers within a particular region is to focus attention upon ways in which the competitive advantage of key industry sectors can be upgraded. As Rosenfeld puts it, the emphasis must be given to the various ways in which manufacturing firms in particular regions and within specific industry sectors "process material, organize people, use information, integrate systems, and accommodate innovation" (Rosenfeld 1992: 3). Georgia Tech professor Philip Shapira adds that creating an environment for industrial competitiveness means

"the application of upgraded technologies, design, manufacturing, and marketing methods, improved quality control systems, and enhanced management and training to raise productivity, quality, product performance, workforce skills, and company manufacturing capabilities to best practice international levels" (Rosenfeld 1992: 3-4).

To acquire this competitive edge, Cooke (1994), Maillat (1995), and others argue that strong regions must build an innovation infrastructure through which local firms have easy and affordable access to a wide array of technical services and new knowledge that enables them to upgrade their product and process technologies. In short, regions must strive to create and maintain what Camagni refers to as a vibrant and sustained "innovative milieu" in which small and medium-sized firms (SMEs) are assisted in reducing their cost disadvantage and increasing their innovation adoption process vis-a-vis larger firms, in which they have reduced "transaction costs" in securing new knowledge and technology, and in which innovations can occur as a result of close interactions between various local research centers and potential adopters of inventions (Camagni 1995: 318).

The question, then, is how best can this regional transformation process--or what Rosenfeld (1992: 3) refers to as a "modernization" process--be accomplished? The purpose of this paper is to describe and assess one such regionally focused strategy of industry modernization that is being launched by a consortium of research universities located in the western region

of New York State. This two-year demonstration project, which is funded by the U.S. Small Business Administration, is designed to upgrade the competitive advantages of a set of small manufacturing firms, and to further the region's economic growth and development prospects.

2. Expectations

At the outset, one might ask what positive roles a consortium of universities could play in upgrading the competitive advantages of SMEs and in contributing to economic growth and development within a particular region. Porter, for one, argues that policies to encourage corporate competitiveness should be focused at the regional and local levels upon universities because they represent the core of the American public R&D system, and because they can diffuse new knowledge and process technologies at a faster rate compared to research in federal laboratories (Porter 1990: 622 and 726). Moreover, empirical research in the United States and elsewhere demonstrates that the knowledge production of universities significantly and positively influences regional production and economic growth (Florax 1992, Andersson *et al.* 1990).

It might also be assumed that research universities within a local region are generally familiar with the diversity of the region's industrial base, presumably have a vested interest in the economic welfare of the region, and thus may be motivated to

provide whatever assistance they can to enhance the competitive posture of the local manufacturing enterprises. In his study of the impact of universities upon local regions, Florax notes that the nearness to knowledge infrastructure is increasingly incorporated into the set of variables found to account statistically for spatial differences in the adoption of innovations, the locational decisions of firms, and patterns of economic growth (Florax 1992: 11).

In addition, it would seem reasonable to assume that local colleges and universities have various kinds of professional and technical expertise that, while likely to be different and perhaps of variable quality, could be effectively coordinated and diffused to local firms. This would be an especially desirable outcome for those SMEs that lack the internal capabilities of upgrading their own product and process technologies. Research shows that a relatively large number of small manufacturers in the United States are slow to invest in new technologies and adopt best practices (Rosenfeld 1992: vi). Obstacles to such investment and subsequent adoption include a relatively small scale of operations that cannot support specialists and support staff for R&D activities, insufficient intelligence about market trends and new innovations, and frequently a lack (or perceived lack) of access to knowledge-generating sources at the local or regional level.

At the same time, however, it appears equally plausible that a variety of barriers exists to the formation of a consortium of

local universities and to the subsequent diffusion of technical and professional assistance to SMEs located within that region. For example, local universities and colleges are frequently in competition with each other at a number of levels, and cooperative ventures among them could be perceived as either self-defeating or creating a conflict of interest. It is also conceivable that some of these educational institutions may have a wealth of technical and professional skills, but lack the experience and/or public service mandate or mission to diffuse that expertise externally to local manufacturing establishments. In addition, many of the educational institutions, particularly some of the smaller ones, may have very limited academic specializations and lack the specific kinds of expertise and technological know-how that are needed to upgrade the competitive posture of local firms.

From a different perspective, interchanges between universities and companies may be hindered because of what some refer to as a deep-seated suspicion of such collaboration within the academic community out of concern for independence and academic freedom (Porter 1990: 726). On the other hand, in his assessment of the university as a regional booster of economic development, Florax argues that skepticism about university-industry linkages has gradually been overthrown by the notion that such close cooperation can actually yield mutual benefits. As illustrative of this harmony of interaction, he refers specifically to success stories in the Silicon Valley, Route 128, and the Cambridge Phenomenon (Florax 1992: 8-9; see also Saxenian 1985, Saxenian,

1994).

It is also the case that various alliances among companies for strategic planning, marketing, and/or shared R & D activities are frequently prone to failure because of structural or organizational difficulties. Most frequently cited categories of problems include conflicts arising from different interests and objectives of the partners, the expense of carrying out the agreement, restrictive laws, lack of experience in such cooperative ventures, and difficulty in reaching a formal agreement and following through with the accord (McConnell 1992: 2-6, Investment Canada 1990: 2). In a recent study of international strategic alliances, the authors report a failure rate of from 50-70 percent among corporate partners (Schuler *et al*. 1991: 51-60). Hence, one might anticipate similar difficulties and outcomes when universities attempt to develop strategic partnerships.

3. The GRIT program

It is within the context of these potentially positive and negative expectations of cooperative ventures among universities that the Greater Regional Industry Technology Program (GRIT) was established. In particular, the GRIT program grew out of the realization that the international, cross-border area of western New York State and the southeastern portion of the Province of Ontario in Canada, which is generally referred to as the "Niagara

Region," has a very similar industrial base,[1] and the belief that various governmental agencies and private-sector groups within the region should be joining forces to foster greater intraregional linkages, market the area as an integrated region, and address the technological needs of local manufacturers.

Cooperative efforts within the cross-border region to further economic growth and industrial development have already begun. For example, the economic development agencies of 16 counties located in western New York State and 8 regional municipalities and metropolitan areas within southeastern Ontario (i.e., the region that extends from Syracuse, New York westward to Toronto, Canada) are combining resources and working together to market the Niagara Region for the purpose of attracting new industry and tourists to the area. In addition, a consortium of 8 Canadian and 16 American colleges and universities within the Niagara Region (i.e., from the University of Toronto eastward to Syracuse University) have formed the Golden Horseshoe Educational Alliance. The mission of this binational, educational network is to broaden faculty and student exchanges, promote collaborative research and teaching ventures across a broad spectrum of academic disciplines, and direct some of the research activities of the Alliance toward addressing key economic and industrial issues of the region.

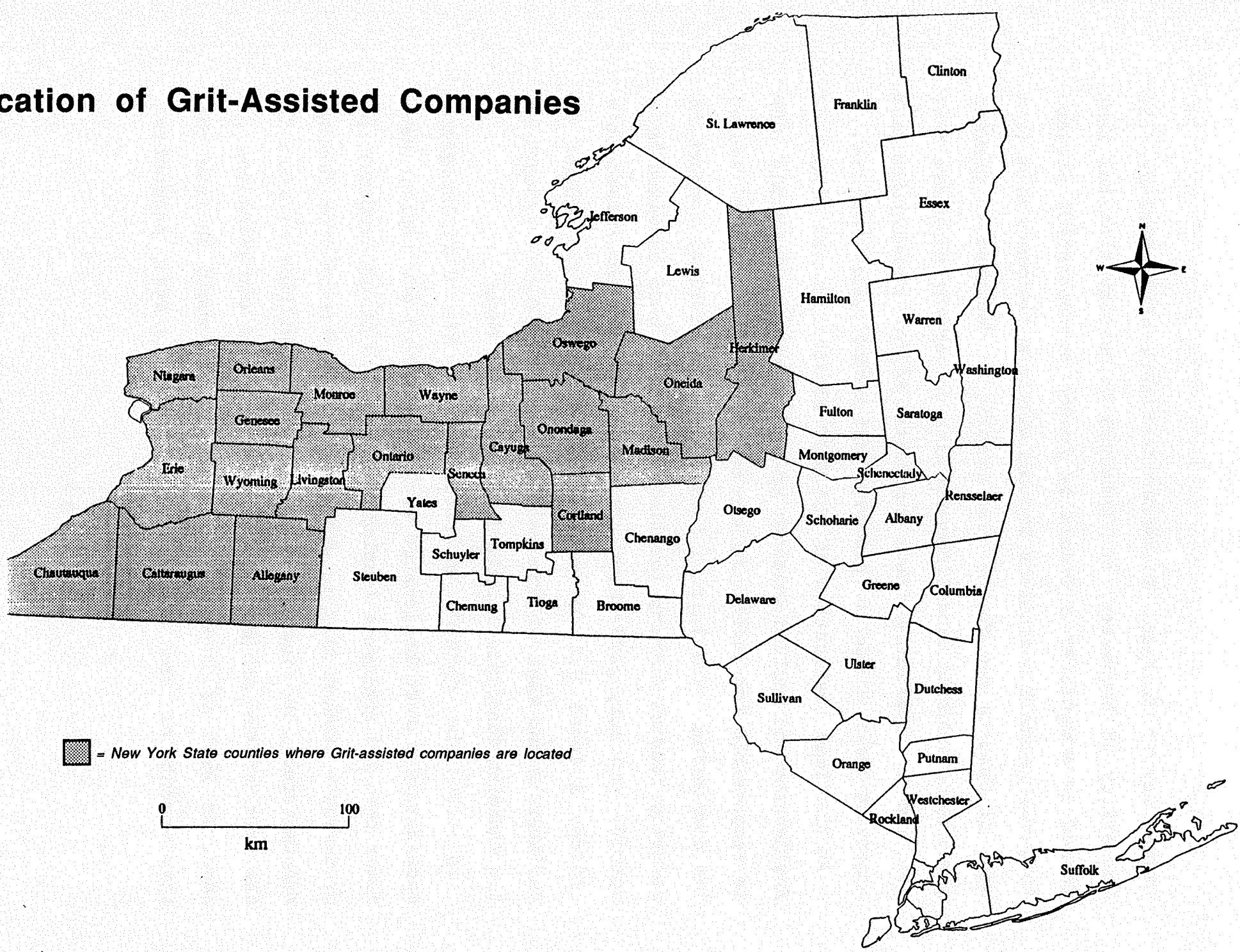
It is within this atmosphere of cross-border cooperation that the GRIT program began operations in the early months of 1995. The program consists of a consortium of engineering schools at the

University at Buffalo, Rochester Institute of Technology, the University of Rochester, and Syracuse University that has been formed to administer a federally funded demonstration project targeted to small businesses located within a 20-county area (see map) of Upstate New York.[2] The Program is designed to provide small manufacturing establishments with university expertise that can aid in upgrading their products and/or redesigning and improving their production processes and technological know-how.

As the lead institution of the GRIT consortium, the School of Engineering and Applied Sciences at the University at Buffalo (UB) is responsible for initiating the two-year project and overseeing its completion. The initial leadership and political support in securing federal funding for the project has been provided by a special industry-government consultant to the UB President's office, a local U.S. Congressman, the Dean of the School of Engineering and Applied Sciences at UB, and the Consul General of the Canadian Consulate located in Buffalo, New York.

In order to receive assistance from the GRIT Program, manufacturers must be located within the 20-county region, have fewer than 500 employees (including the firm's parent company), be producing a product that is experiencing competition from foreign manufacturers, be financially stable, and be willing to share in the cost of the project (where cost includes contributions of cash, as well as in-kind provisions, which would include the involvement of the company's technical staff, production

Location of Grit-Assisted Companies



facilities, and/or equipment). Moreover, the projects that are proposed by the SMEs for upgrading must be ones that require professional expertise and technological know-how that are possessed by one or more of the engineering schools in the consortium; that can be completed within one calendar year, or less; and that are likely to result in the creation of new jobs and/or the retention of existing employment within the region.

4. Preliminary assessment of the GRIT program[3]

4.1 Nature of activities to date

The GRIT program consists of two rounds of funding, each of which lasts for approximately one year. Following informational sessions held throughout the region to alert firms to the program, 40 companies submitted 44 applications for technical support in the first round, and 32 firms requested assistance on 37 projects in the second round. The Technical Activities Committee (TAC), which coordinates the project activities of the GRIT program, and which consists of 2 professional engineers from each of the four campuses, evaluated the applications and selected 11 projects for funding in the first round and another 10 projects for the second phase. For each of the projects, one of the four universities agreed to be the "lead" institution, and in several instances two universities are cooperating on the same project. Two- and three-

person teams of engineers (made up of faculty and graduate students) from across the four campuses have been formed to address the technological needs of the companies selected.

Several tasks are involved in reaching an agreement between the consortium and a particular manufacturing establishment. At the outset, the TAC must identify faculty members at one or more of the four institutions that are capable and willing to assume responsibility for transferring needed technology and engineering know-how to the firms. Once these faculty members have been identified, a series of meetings takes place between the faculty member(s) and the technical people at the targeted company to prepare a task plan. Eventually, a contract is worked out between the lead institution and the company that identifies the tasks that will be carried out within the specified time frame, defines the cost-sharing arrangement, and describes the nature of the deliverables required at the conclusion of the project.

Examples of some of the GRIT projects are those requesting assistance in refining a recently fabricated sensor chip for an electromagnetic environment simulator; developing simulation models and productivity studies of production cells for a firm producing precision-machined steering and suspension components for the auto industry; developing specifications using ergonomics for an adjustable bed frame for a firm that makes adjustable therapeutic beds and tables; and developing a PC-based controller for a company that makes optical, microgrinding machines. In each instance, the average level of funding provided by the GRIT

program averages $50,000-$60,000, with matching funds and/or in-kind services provided, when possible, by the assisted firms.

4.2 Potential payoffs to members of the consortium

The four universities involved in the GRIT Program benefit in several important ways from the successful conclusion of the projects. For example, the GRIT program:

- Provides financial incentives for faculty and students, which is especially useful in times when the availability of internal and external funding is limited.
- Provides a means for universities to recover some of the indirect costs associated with their ongoing research activities.
- Enables universities within a consortium to combine research capabilities and to capitalize upon their comparative advantages, which is very important in times of limited faculty and financial resources.
- Contributes to community service and builds good relationships with the local communities.
- Provides on-the-job training and work experience in applied research for engineering students.
- Provides faculty with real world examples that can be incorporated into classroom instruction.
- Creates opportunities for additional cooperative

activities (both of an academic and community-outreach nature) among the participating universities.

4.3 Problems associated with "growing" the consortium

Based upon the experiences of the GRIT program over the past two years, several problems associated with "growing" such a consortium can be identified. First, each of the four universities has its own internal "culture" and experience in developing linkages to the external community. For example, these differences include how to handle patents that may be developed as a result of the research, how to pay faculty for external service, and what priority should be given to the responsibilities associated with the consortium vis-a-vis competing activities. For a couple of the universities, this was the first time they had been involved in a joint research project with another educational institution, so it took some time for their administrative "machinery" to work out the details of the partnership.

Another problem involved the identification of individual faculty members with the specific expertise needed to provide the technical assistance required by the corporate applicants. In some instances, the faculty members who were most qualified to provide the requested technical assistance could not be matched to the project because they already had a full research agenda, they were unable to secure what they perceived to be sufficient financial or other incentives, or they were unwilling to become

involved in such research. For example, non-tenured faculty might be reluctant to become involved in projects where the emphasis is upon applying existing technical knowledge rather than upon conducting original research that can result in publications. Moreover, timing was an important consideration because certain faculty with the needed expertise were unavailable to adjust their academic work schedules to correspond to that of the GRIT program. In several cases, the technical requirements of the project called for faculty expertise from more than one of the members of the consortium. In fact, several of the projects were selected primarily because they required the cooperation of faculty from several of the campuses.

Another difficulty arises in identifying the specific product-related deficiencies the SME has, and in determining the extent to which factors other than the need for new product development or process innovations may underlie the problems of the company. For example, it is quite possible that the enterprise is experiencing strong international competition because it has an improperly conceived international marketing strategy. In the GRIT program, the engineering schools pretty much assume that the problem is a technical one associated with the firm's product or process technology, which may not be the case. Ideally, a team of professionals (including engineers, marketing and corporate finance experts, and human resource advisors) would undertake a more in-depth analysis of the company's perceived difficulties and come up with a more comprehensive plan of action. An example of

this more thorough diagnostic approach is found in procedures followed by the Trade Adjustment Assistance Centers (TAACs), which are funded by the U.S. Economic Development Administration (Conway 1996). The TACCs conduct a comprehensive examination of the client's marketing and manufacturing processes that enables them to compare the overall characteristics of the company to industry standards.

Furthermore, the time lapse between the completion of the assistance for an individual SME and the end of the evaluation process may not be sufficient to demonstrate measurable impacts; hence, the assessment of the success of the program for a particular firm may be understated. It is also likely that the relatively small number of firms involved in the GRIT program and the relatively brief time frame of the assistance program will lead to an inconclusive assessment of the overall impact of the program upon the economic growth and development of the region. Ideally, the program should have the capability of tracking the performances of companies after the projects have been completed to determine longer-term impacts.

In a more theoretical context, the GRIT program may be subject to the false-reasoning syndrome, which occurs when one is unable to determine if the perceived outcome of the assistance provided to a particular SME would have occurred anyway without the involvement of the consortium. This becomes problematic when attempting to measure what Florax refers to as the "knowledge effects" of universities (Florax 1992: 182-3). While the

universities in the GRIT alliance may be utilizing their applied research to improve a firm's utilization of labor, capital, or technological assets, it becomes difficult to quantify beneficial outcomes from such assistance, and to argue convincingly that these benefits would not have occurred without the assistance. As part of the evaluation process, the chief executives of these companies are asked if the project would have been completed without GRIT assistance. Thus far, the responses to this question suggest, with little surprise, that the projects would not have been undertaken or completed without the expertise and financial assistance provided by the consortium.

Another perceived difficulty of the GRIT program is that, with some notable exceptions, the universities in the consortium and the manufacturing establishments within the region are already in place, they have developed rather separately over time, and, therefore, they lack a strong interdependence and compatibility that may be more evident among regional universities elsewhere across the nation. For example, when North Carolina's triangular research park was established in the mid to late 1950s, the strategy was to find companies that wanted to expand their research into fields in which the three universities within the region (i.e., the University of North Carolina at Chapel Hill, Duke University in Durham, and North Carolina State University in Raleigh) had special strengths. At that time, these specialties included chemistry, electronics, and pharmaceuticals. This strategy, if successful, guarantees some level of compatibility

between the expertise the universities can offer to manufacturers within the surrounding region and the kinds of assistance these companies need and want. For the most part, the members of the GRIT consortium have not had these strong historical connections with the evolving industrial base of the cross-border region; hence, they face the challenge of integrating the needs of the local manufacturing community with the expertise of their faculty members. This challenge has important (and perhaps as yet unrecognized) implications for regionally based universities with regard to formulating priorities for hiring faculty and developing curricula for engineering students.

Finally, and as noted previously, the consortium faces the difficulty of maintaining its viability over the longer term. As with any alliance, various organizational and human resource difficulties must be addressed in a satisfactory manner, and all of the members of the alliance must be willing to work toward the resolution of problems arising from differences in their internal "cultures."

4.4 Potential benefits to the local region

As a further assessment of the GRIT program, it is useful to speculate about the potential benefits the efforts of the consortium may have for the western New York area. In questioning whether or not a university is a booster to a region's economic growth and development prospects, Florax notes that the

current conception of regional dynamics is thought to be primarily dependent upon the intraregional potentials and the self-organizing capacity of regions (Florax 1992: 9). Moreover, he indicates that: "The presence of a university is often taken to be an important regional potential,... and consequently its establishment or ongoing activities could serve as an important policy instrument within an endogenous-oriented regional policy" (Florax 1992: 9). What would be the nature of such policy?

Porter (1990: 656-7) argues, for example, that the most effective development policy, particularly for depressed regions, follows the principle of building upon industry clusters. He notes that magnets for clusters, in the form of universities, research laboratories, specialized infrastructure, and/or trained labor pools, are much more effective than subsidies.[4] In fact, the best regional policy, he says, identifies cores of industrial strength and builds upon them to encourage geographically concentrated clusters.

At one level, it can be argued that the GRIT program does not explicitly focus upon the region's strongest industry clusters. Given the nature of the GRIT selection process, the companies that actually receive assistance are those that meet the eligibility criteria, submit what is perceived to be the "best" proposals, and require specific faculty expertise that can be provided by the members of the consortium. Hence, companies in the region's most competitive industry clusters may or may not be among those

receiving assistance from the consortium. On the other hand, one might argue that the companies that are most likely to be facing strong international competition, possessing stable financial conditions, and willing to prepare project proposals and leverage their own financial resources to obtain R & D support from the consortium are those within the region that are in the strongest and most competitive industry sectors.

In the final analysis, however, the members of the GRIT consortium may or may not be focusing their assistance upon the region's most important and potentially most competitive industry sectors. What is lacking within the region is an endogenously oriented policy focused explicitly upon enhancing the competitive strengths of key industry clusters. Until these industry sectors are well defined and a policy instrument has been formulated and put in place to address the technological needs of the companies in these clusters, the kind of "innovative milieu" envisioned by Camagni for various **lagging** industrial districts in the European Union is unlikely to materialize within the western New York region.

The concept of innovative milieu involves a "...set of relationships that occur within a given geographical area that bring unity to a production system, economic actors, and an industrial culture, that generate a localized dynamic process of collective learning and that act as an uncertainty-reducing mechanism in the innovation process" (Camagni 1995: 20). Such innovative-intensive areas are characterized by "...strong

elements of local entrepreneurship, close interaction and cooperation among firms, and relevant externalities associated with specialized labor markets" (Camagni 1995: 318). These attributes enhance the competitiveness of the local production fabric, which is often made up of flexible small and medium-sized firms. Camagni also argues that "...without the true involvement of the local socioeconomic fabric, externally driven growth seldom generates a sustained development process in the long term" (1995: 318). An expanded and cluster-oriented GRIT program **could** become an important agent in fostering the kind of local "fabric" and technological infrastructure that creates an innovative milieu for the western region of New York State.

It is also instructive to consider the possible impacts a GRIT program that broadens the membership of the consortium to include several Canadian universities might have on the economic vitality of the **international**, cross-border region of southern Ontario and Western New York. As noted earlier, the initial conceptions of the GRIT program included extending membership across the Canadian-American border. Hansen notes, for example, that: "Border regions may be fragile...because national frontiers artificially fragment complementary regions (Hansen 1981: 22). Moreover, border regions by their very nature frequently provide opportunities to attract trans-frontier capital investments, transportation and warehousing activities, and export-oriented manufacturing and service enterprises. Given these natural advantages of the Niagara region, the similarity of the industry sectors on both sides of

the border, and the fact that in many ways this cross-border area is already operating as a functional economic region, a modified and integrated GRIT program operating on both sides of the border has the potential to contribute to the further development of an innovative milieu for the entire Niagara Region.

5. Conclusions

One of the objectives of the GRIT program is to determine whether or not such a university-based outreach to small firms could be adapted to a broader geographical context and serve as a useful model for university-industry cooperation at local and state-wide levels in other parts of the United States. With that objective in mind, it seems useful to assess the purpose and design of the GRIT demonstration program by comparing them to the criteria Rosenfeld utilizes to define the "best" or "most promising" programs to assist SMEs (Rosenfeld 1992: 22-52). In his assessment for the Aspen Institute[5] of state-level economic development programs designed to address the informational and technological needs of SMEs and to advance the economic health of regions, Rosenfeld argues that the best[6] and most effective programs have the following characteristics:

- They have a scale of operation that is sufficient to make a difference in a region's economy, and they are funded at an

appropriate level over the long-term. In contrast, the GRIT program is a demonstration project and is focused upon a relatively small number of firms in the region; therefore, the overall impact of the program upon the long-term health of the Niagara region is likely to be minimal.

- Good programs provide comprehensive, one-stop strategic planning for the targeted firms. The GRIT program, in contrast, was set up solely to address a company's need for technological expertise in product design and/or process innovations. It does not take into account other potentially troublesome difficulties of the company, such as an improper marketing strategy, or the ineffective utilization of human resources.

- Good programs are accessible to firms in communities of all sizes and in all places. The GRIT program is accessible only to those companies that meet certain size and other financial specifications; however, it is potentially available to any of the firms that are located within the twenty-county area surrounding the four universities that meet the other criteria.

- Good programs must be sustainable. The GRIT program is a two-year demonstration project, with no guarantees of subsequent funding. From the beginning, however, the intent has been to carry out the GRIT projects, assess the outcome of the program, and, if it is successful, to make a case to the Federal Government (as well as to various state and local governments) that the program should be duplicated elsewhere in the nation. It must also be noted that the time commitment of the GRIT program to a

particular firm's technological problems is typically one year; in contrast, Rosenfeld reports that most state-level programs limit the number of days per firm and average only two to three days per client (Rosenfeld 1992: 44).

- Good programs respond to and stimulate demand. Rosenfeld argues that occasionally technical specialists are inclined to promote new practices before the need is evident. He suggests that the demand for specific technical expertise should come from the company, which is in direct contact with the marketplace. On the one hand, the GRIT program is demand-oriented in the sense that the projects proposed by the manufacturers dictate the search for faculty expertise to match the company's technical needs. One could also argue, however, that ultimately it is the supply of specific faculty expertise within the consortium that determines which firms and their projects will be selected to receive assistance.
- Good programs complement and expand private services, not duplicate them. No services provided by private-sector agencies within the Niagara region are duplicated by the GRIT program.
- Good programs involve SME owners/managers and labor in their design and planning. The GRIT program created an external advisory committee made up of industrialists, government experts, and individuals from various research laboratories around the country with experience in providing technical services to the corporate world.
- Good programs improve a region's level of skills and wages

and quality of work life. As a result of the GRIT program, some transmission of technical skills may take place in the process of upgrading a company's product and/or process technology. And, to the extent that the project is successful in restoring the international competitiveness of the companies receiving assistance, the GRIT program has the potential to make a small contribution to improving the wages and quality of work life for at least those who are directly associated with the assisted companies. However, because the program is for a limited duration and focused upon a very small number of companies, the overall impact upon the region is likely to be minimal.

- Finally, good programs feature a return-on-investment mentality. The GRIT program requires that the participating firms share in the cost of the program by providing both real dollars and in-kind contributions. With respect to the impacts of the GRIT program, after the knowledge transfer has taken place, upon the company's annual sales, profits, competitive posture, contributions to the local tax base, and employment record, it is too soon to make such an assessment. On the other hand, during the evaluation process several of the chief executives have indicated that the major impact of the GRIT assistance has been simply to stabilize the operations of their company, and thus to enable their organizations to survive as more healthy enterprises. For example, one of the GRIT projects, which involved the development of a computer-based simulation model, enabled a company to make trial and error changes to its processes in a more

timely manner and without incurring extreme cost of laboratory experimentation. The longer term effects of these changes may, in fact, significantly and positively impact the company's financial and competitive posture.

Overall, and with some notable exceptions, it would appear that the purpose and much of the operational design of the GRIT program correspond to what Rosenfeld would classify as "best" or "most promising" programs at the state level. Nevertheless, more fine tuning, additional experimentation in other geographical and university settings, and a long-term monitoring of the impacts upon the assisted firms seem prudent if the GRIT program is to serve as a viable model for effective transmission of new knowledge and technologies between universities and small and medium-sized manufacturing enterprises in the United States.

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An earlier and preliminary version of this paper was presented at the annual meeting of the Association of American Geographers at Charlotte, North Carolina in April 1996. At that time, the GRIT program was in the early stages of implementation, and no definitive assessment of the program and its associated projects had begun.

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Notes

1. The similarity of the industrial base of the cross-border, Niagara region is revealed in a recent study conducted by the Canada-United States Trade Center at the University at Buffalo (McConnell 1994). The investigation focused upon the 8253 manufacturing establishments located within the Niagara Region whose products are classified as belonging to one of 8 technology-intensive manufacturing sectors (i.e., chemicals and allied products, petroleum refining, rubber & miscellaneous plastics, fabricated metal products, non-electrical machinery, electrical and electronic machinery, transportation equipment, and scientific instruments). Two important findings emerged from this analysis. First, almost 60 percent of these 8253 establishments are specializing in two key industry sectors: non-electrical machinery and fabricated metal products. The second, and perhaps more remarkable, observation is that the percentage distribution of firms among the different industry categories (at both the two- and four-digit levels, as defined by the Standard Industrial Classification indices) is virtually the same on both sides of the Niagara River. These findings suggest that certain economies of scale may be forthcoming by joining private-sector and university forces across the entire region to address common intraregional issues related to industrial competitiveness.

2. Initially several engineering schools in southern Ontario were asked to become involved in the GRIT program. The intent was to forge a cross-border network of schools that could combine faculty expertise to address problems common to a large number of the firms within the entire international, cross-border region. However, because of restrictions placed upon the use of U.S. federal funds by the sponsoring agency, and because of financial constraints at the time within the Province of Ontario at the time, the linking of engineering schools across the border for this particular project has been temporarily postponed.

3. The author has served as the official "internal" evaluator of the GRIT program and has been associated with all of the various phases of the program, except for the actual delivery of the engineering technology to the corporations. The assessment of the program is based upon two detailed survey instruments that have been created and administered by the author to the CEOs of the individual firms, as well as to the faculty members who head up the project teams that actually work with the individual companies. The program is also evaluated by a panel of external people selected from across the country as experts in government, industry, and engineering education, and who have experience in working closely with small companies.

4. By subsidies, Porter is referring to generalized payments to induce or "bribe" firms to locate plants or other facilities

in a region (Porter 1990: 656).

5. The Aspen Institute is an international nonprofit organization whose broad purpose is to seek consideration of human values in areas of leadership development and public policy. One of the special interests of the Institute is to build knowledge about how states can address economic problems, contribute to the policymaking process, and enhance the competitiveness of small companies. The address of the Institute is 1333 New Hampshire Ave., NW, Suite 1070, Washington, D.C. 20036 USA.

6. Rosenfeld identifies several state-based programs for SME as having operated long enough and with a sufficient record of achievement to declare them as "best" practices in the United States. These include Pennsylvania's Industrial Resource Centers, Georgia Tech's Economic Development Laboratory, Maine's Center for Technology Transfer, and Michigan's Northern Economic Initiatives Center (Rosenfeld 1992: 20-21).

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