Can the more advanced developing countries foster the production of software based on comparative advantage resting on the availability of low-wage, skilled professional workers? This is what one strand of literature, closely conforming with conventional trade theory claims, but another view, that of the neo-Schumpeterians, is that the accumulation of technology capacity is a cumulative, evolutionary and time-consuming process, one that is particularly challenging for developing countries. In this regard, this article examines the software industry in the border city of Juarez, Mexico, where presumably, the proximity to the United States would ease any supply bottlenecks involving material or informational inputs. The case study, it is concluded, lends some support to the traditional comparative advantage view as far as Juarez software production is concerned, but strongly bolsters the neo-Schumpeterian position when considering software development by Juarez technicians for the local market.

Prologue

The field work for this study was conducted during 1990 with some updating until an earlier version was completed in March, 1993. All producers of computer software in Juarez were interviewed, mostly in person with a few telephone interviews. For companies, the Heads of Management and Information Systems Departments were targeted; individual software producers were interviewed directly. Information on Juarez users of software was collected, through interviews with the software developers, direct contact with major users, and the personal experience of one of the authors who is heavily involved in the software industry in Juarez. Department Chairs of Management and Information Systems Departments of all universities mentioned in the study were interviewed and relevant university catalogues were analyzed for course offerings and degree requirements.

We are not in a position to replicate the survey, but we believe that the findings offer useful insights into the process of establishing a software industry in the more advanced developing countries. We have left the information and discourse in its 1993 form. An epilogue gives some of our impressions about the current situation.

Introduction

As top-tier developing countries aspire to develop endogenous capacity to design and produce computer software on a competitive basis, a fledgling literature on the topic has begun to appear. With this paper we hope to add, in a constructive manner, to this growing body of studies. As far as we are aware, it is the first regional investigation of software in the Third World.

For at least the past decade, concern with the role of technology in promoting economic development has been shifting from a preoccupation with technology transfer per se to the process of endogenous technological capacity-building. Potentially, a software industry can contribute to endogenous accumulation of technical capabilities. The design of computer software is a “learning nexus” involving cognitive reasoning; insights into managerial techniques; intimate connections with the informatics sector, itself a locus for technical learning; and technical linkages with software users. Typical observations that an endogenous software industry is important to Third World nations are: “Today software production is an industry essential for the growth of the economies of
developing countries: launching programmes to promote strong endogenous software industries is a priority task.” (UNIDO, 1993: iii) and “The establishment of a dynamic software industry has been identified by many [developing countries] as essential to meet the needs of a growing number of domestic users of informatics systems” (Correa, 1990). We hope to contribute to this discussion, i.e., how developing countries can foster the accumulation of technological capacities.³

Our primary goal is to shed light on a dispute in the literature involving Third World software production. One view of software opportunities, one which fits comfortably with orthodox international trade theory, holds that the labor-intensive nature of software design, coupled with the availability of low-wage, skilled workers, provide a comparative advantage for the more technologically advanced developing countries.⁴ In addition to export opportunities, it is contended that a more intimate knowledge of local niche markets, also opens the way for a healthy domestic software industry.

This position is disputed in a new strand of literature, loosely identified as neo-Schumpeterian, which suggests a different outcome.⁵ While not entirely pessimistic about the more advanced developing countries finding competitive niches domestically and in the global market, the task, they believe, is considerably more complicated than the traditional comparative advantage thesis implies. The acquisition of technology is only the start of an extended, evolutionary period necessary for the absorption and cumulative mastery of the technology. Much technical knowledge is “tacit” or firm-specific, and can only be acquired through experience. Thus the neo-Schumpeterian view is that establishing a viable software industry in a Third World country will be a much more difficult and lengthy task than envisioned by those basing their argument strictly on relative factor costs and local, niche advantages.

With regard to these contending views, one would think that the software industry in Cd. Juarez, Mexico should serve as an acid test. If the comparative advantage-cum-local niche thesis has validity, surely it would be in a metropolitan area such as Juarez that has had almost three decades of dynamic industrial expansion, and one juxtaposed to a large, technologically developed country where necessary hardware, information, and technical know-how are readily available.

The following section reviews software programming and services in Juarez after which sections are devoted to (1) the development of human resources for supporting a software industry and (2) software users and user-producer relations. Reasons for cautious optimism are then presented and policy recommendations are proffered. A short conclusion follows and, as indicated above, the article concludes with an epilogue.

**Software Programming and Services in Cd. Juarez**

Often termed the “maquila” capital, Juarez, over the past 30 years, has evolved from a sleepy border town to a vibrant city with a diversified economy.⁶ In 1992 there were 2,010 maquiladoras throughout Mexico employing almost one half a million workers (Vargas 1992). With 321 plants and 135,000 workers, Juarez is by far the largest maquila employer in Mexico (Twin Plant News 1992). The expansion of the maquila industry has stimulated many segments of the service sector. The majority of factories hire independent contractors to prepare food for the workers and there are several thousand American professionals working in Juarez that patronize local restaurants, shop at retail stores, pay Mexican auto insurance and consume similar services.

The construction industry has boomed over the last decade with building of factories, administrative offices, government buildings, schools, roads, houses, apartment complexes, restaurants and stores. Enrollment of regional universities has grown leading to expansion of campus facilities. Since annual audits and tax returns are mandatory for maquiladoras, accounting services are in demand. The legal profession is booming in the areas of corporate, environmental and immigration law. Transportation companies in Juarez are responsible for the fifteen hundred border truck crossings per day. This list of examples is by no means complete; the biggest impact comes from wages and taxes paid by maquila workers.⁷

One might expect that a robust software industry would be stimulated to meet the information needs for all of this economic activity. Positive expectations would be supported by the proximity of Juarez to the United States which should provide easy access to requisite hardware, relevant printed matter, market information, and software experts. Yet, the results of our findings are somewhat disappointing; there is very little development of indigenous software capability in the city that is geared toward the local market. Most software is imported from the United States or bought from Mexico City. Many important firm-level software decisions are controlled outside of Juarez which means that the selection, analysis, design, and development activities occur somewhere else. By and large, this leaves the local developers to handle minor modifications and maintenance activities. Having said this, however, software development and exports by one software maquiladora is thriving. Each major component of the Juarez software industry will now be examined.

**Package Software for the Local Market**

Package software is a computer program written to satisfy the needs of a particular market niche rather than the specialized requirements of a single user. It is widely considered more difficult to create packaged software compared to a customized product. In addition it is more difficult to market because the seller has to make a convincing case that the software will fit the buyer’s individual situation. This is especially difficult in developing countries where general computer literacy remains low. It puts pressure on engineers to design user-friendly software, yet built-in conflicts between packaged software and inexperienced users persist. Many of the powerful, general American programs overwhelm the users in Juarez. Illustratively, many users of the Lotus 123