# AN EDUCATION IN MICROPILES: THE EXPANSION OF THE MARKET IN NORTH AMERICA AND HOW YOU CAN DO IT TOO

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## Abstract

Although micropiles have been used in North America for decades, it is only in the last 10 years or so that a rapid expansion in the market has been observed. This paper provides a personal analysis of the respective contributions of the various industry groups, namely contractors/suppliers, Federal and local governments, universities, professional engineering societies, ISM and trade organizations. A list of "essential influences" or market control factors is proposed, being the essential goals of a business plan aimed at the creation of a vibrant, regional/national market. Such influences are, of course, in addition to the background factors such as geological and economic, which fundamentally drive demand. Practitioners in other countries are challenged to create their own model of market evolution and the requisite strategies for expansion.

## 1. Introduction

One common observation which can be made of the various national micropile markets is that they are each very different. The size and dynamics of each market reflect a multitude of specific factors, such as the prevailing geotechnical and geological conditions and challenges, the technical demands of the construction industry, the intensity and the functional capabilities and restraints of the various parties in the professional engineering circles. There are, therefore, major contrasts between micropiling to underpin structures originally founded on timber piles around the Baltic Sea, micropiling as seismic retrofit for transportation facilities in Japan and the Western U.S., and micropiling for the restoration of war-damaged churches and museums in Western Europe. Each of these applications has been well described in this, and previous, IWM meetings.

One commonality, however, is that, for a "new" specialty geotechnical technique like micropiling to become widely accepted in any country, the engineering community must become educated as to both the engineering aspects, but also with respect to how such works are best procured, i.e., how to establish and implement the most appropriate method of contract award and administration.

This paper describes the expansion of the micropile market in North America through an analysis of the contributions made by the various groups of participants which, for simplicity, are listed as follows:

- Specialty Contractors and Suppliers

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- Federal Government
- State Government
- Universities
- Professional Engineering Societies
- IWM/ISM
- Trade Organizations

The analysis pertains only to North America, but it is hoped that it will be of value and interest to specialists in other countries, both as a template for their own similar retrospectives, and a guidance to possible future business development activities. In this regard, it should be noted that an ISM-sponsored series of short courses was held in 9 venues in the U.K. and Ireland in November 2006 — a concept born during the ISM meeting. Attendees were presented with the following "U.S. Model" and challenged to recreate their own model.

## 2. Specialty Contractors and Suppliers

As is the case throughout the specialty geotechnical construction industry in North America, innovation is introduced primarily by specialty contractors, usually in alliance with companies who manufacture and supply the specialized equipment and materials which that particular construction technique requires. Micropiles were introduced into North America in the 1960s and 1970s by specialty contractors and materials suppliers from Italy and Germany. Given the great potential for such work in New England and California in particular, it is somewhat surprising that the market was very slow to develop in the U.S., although it is reasonable to speculate that potential clients found it difficult to commit to a new technology which was largely described in foreign languages and for which there was, in effect, extremely limited competition: experience with other techniques being introduced into the U.S. confirms that one key for real market growth is to have a minimum of 3 strong and viable competitors. Only by the late 1970s and early 1980s was there a significant growth in the market, coincident with the entry of previously established U.S. contractors proficient in other drilling and grouting-based technologies, such as ground anchors. Such companies, particularly strong in the Northeast, won these projects, mainly by offering pre- or post-bid alternative design-build packages. They followed up by publishing technical papers and other news releases, as well as conducting regular "brown bag" seminars to consultants and owners in key market areas such as Boston, New York and Washington, DC. Also, off their own "bottom lines," these specialty contractors conducted or otherwise sponsored practical research projects, for example by installing and testing "sacrificial" test piles, or by investigating individual elements (e.g., steel casing) or interfaces (e.g., grout/cap connection) in laboratory environments.

The human and financial resources actually available to contractors and suppliers are, of course, limited and North America is extremely large. The expansion of the market was, therefore, relatively slow and occurred in well recognized "leaps" as, for example, when northeast contractors opened a new regional satellite office — the key examples being in Seattle, WA and Los Angeles in the late 1980s. These particular ventures were especially prescient given the business opportunities which arose on the West Coast following the Loma Prieta and Northridge earthquakes of that time.

In all these ventures, the contractors were closely supported by suppliers of specialty equipment (e.g., powerful, low headroom drilling rigs) and special materials (e.g., high yield reinforcing bars, specially threaded drill casings, and injection-bore bars). Again, it may be observed that the competition between these various suppliers is particularly keen: this is a great spur to both innovation and cost effectiveness, but need not be the death of profit.

The contractors and suppliers, however, have not always been totally helpful to the growth of the industry. In their zeal to create company recognition for their own respective "type" of micropiles, a number of terms were coined, some service marked, and ultimately potential clients were puzzled at the real difference (none!) between, for example, pinpiles, minipiles, root piles and micropiles. As noted below, this has now largely been corrected as a direct result of the classification and nomenclature introduced by FHWA and promoted by the trade associations and professional societies.

Today, admirable efforts of this segment of the industry continue, although it is noticeable that the trend has been for such companies to aggressively support trade association and professional society initiatives, with the reasonable expectation that, if the whole market increases in size, then the volume which can be generated by each good competitor will also increase substantially. Although advertising and promotion by individual companies continues, of course, via websites, seminars, technical papers, and so on, it is clear that this group has gravitated, almost as if unawares, towards a common educational strategy for the industry at large: "the best friend of a specialty contractor is an educated client."

## 3. Federal Government

The first, truly important contribution by the Federal Government in the form of the FHWA and, in particular, the Geotechnical Research Manager, Al DiMillio, was the sponsorship of the State of Practice Review in 1993. Although the four-volume outcome was, as a deliverable, of great benefit to industry (because it provided perspective, classifications and uniformity), the most enduring gift was that the project brought together, for the first time, an international Peer Review Group. The group principally comprised Schlosser and Frank (from France), Herbst (Germany), Turner (U.K.) as well as the "Godfather of Micropiles," Fernando Lizzi himself. The "core," together with key U.S. researchers such as Kulhawy and Mason (from Cornell University) and the Finnish engineer, Lehtonen, were the heart of the IWM concept which began in 1997, the year that the State of Practice study was published by the Co-Principal Investigators, Bruce and Juran (Polytechnic University of Brooklyn).

FHWA continued its direct sponsorship of IWM over the next 6 or 7 years, until ADSC provided the prime external financial support. Through IWM, exchange of technical knowledge was implemented amongst the various segments of the North American market, and between the North Americans and their IWM colleagues overseas, especially in W. Europe, Finland and, of course, Japan. (The first IWM in Seattle in 1997 had the strategic goal of knowledge transfer to Japanese engineers, especially those who were closely involved with bridge retrofit following the catastrophic Hanshin earthquake in 1995.)

The second great Federal initiative was the commissioning of the so-called "Implementation Manual" which was published in 2000. In essence, this distilled the

information from the State of Practice and created a “how to” guide aimed principally at users in the DOTs. It should not be overlooked that this Manual was principally authored by two specialty contractors — very strong IWM supporters — Armour and Groneck.

The third enduring action by the FHWA was to commission in 2005 the development of a two-day short course to be taught to State DOTs. Supported strongly by ADSC, this course was progressively developed by a number of micropile specialists and is now taught regularly by the same specialists to DOTs under the flag of the National Highway Institute (NHI). It is this course that became the basis for the ISM courses taught in the U.K. and Ireland, as mentioned above.

As a final point, it must be noted that the FHWA also participated in specific field demonstrations (e.g., Mendocino, 1978) and tests (San Francisco, 1992) prior to the major investments of the mid-1990s. Each was valuable in its own right — none was as enduring in impact as their successors.

## 4. State Government

Micropiles have been used in certain states since the early days, almost universally as contractor-proposed alternates on projects where traditional piling methodologies were simply not feasible. Many of these projects proved less than satisfactory for either party due to technical “teething” problems, and/or contractual/procurement difficulties. There is, therefore, a long but sporadic history of usage in the heavily urbanized states of New England and in states with bridges on karstic limestone bedrocks. The California DOT (Caltrans) were arguably the first to conduct systematic research and evaluation, in direct response to the damage caused by Loma Prieta. However, the bulk of the work was, in fact, conducted unpaid by the contractors who were trying to receive DOT approval for their respective “micropile systems” as a precursor to bidding the huge volume of work which came out from the mid-1990s.

The major initiative in recent years was the “Pooled Fund” study, initiated by Al DiMillio in 2001 and representing the joint research funds of 8 states. Under the administrative leadership of Caltrans, by far the largest contributor, the resultant research has focused largely on seismic issues and pile/cap details. Disappointingly, little information has so far been released, and there seems to have been no major positive impact on the micropile market as a result.

It may be concluded that the systematic “education” of the State DOTs, via the NHI short course, may well prove to be the most important State contribution: this powerful group of users is now becoming progressively more comfortable with, and receptive to, micropile technology to the extent that it is no longer regarded in some states as either innovative or particularly “risky.”

## 5. Universities

The Polytechnic University of Brooklyn has, since 1993, been a center of excellence in micropiling. Its involvement runs from the State of Practice (Design Volume), through active collaboration with the French National Research Project,

FOREVER, to current joint research with CERMES in Paris. Some desk research has been conducted at Cornell University and laboratory work at both University of Washington and at Missouri-Columbia. There have been some sporadic laboratory and field studies undertaken at other universities (e.g., Carnegie Mellon, Auburn, Wyoming) typically in close collaboration with a certain sponsoring contractor.

However, in general, it is accurate to say that academia has not proved to be a leader in the expansion of the micropile market in the U.S. This is not altogether surprising when one considers the intensely practical, field-driven nature of the subject and, accordingly, the very high cost of conducting truly original and/or meaningful original research. Furthermore, very little teaching of micropile technology at undergraduate or even graduate level is conducted, in part due to lack of knowledgeable teachers, in part due to lack of teaching materials. (As noted below, however, ADSC, via its "Faculty Workshop," is attempting to redress this situation.) For the updating of practicing engineers, micropiles are described during the annual Grouting Short Course at the Colorado School of Mines, in Golden, Colorado.

## 6. Professional Engineering Societies

The GeoInstitute of the American Society of Civil Engineers sponsors no micropile committee, neither do any of the other professional organizations relating to consulting engineers or engineering geologists. Occasionally, however, a specialty national conference in a micropile "hotbed" (e.g., Boston) will feature a paper or a session on micropiles, while case histories are frequent presentations at regional conferences where PDHs or CEUs are awarded for attendance. In general, however, the absence of a standing committee or other focal point has resulted in the impact of such societies on market development and evolution as having been relatively minor and sporadic. This group has also not been able to issue national "guideline" documents.

## 7. International Society of Micropiles (ISM)

The impact of the forerunner of ISM, namely the International Workshop on Micropiles, was described in Section 3, above, under the influence of the Federal Government. ISM has created a very strong national (and international) focus on micropiling and has noticeably raised the technical and commercial profile. It has encouraged sharing of knowledge from all segments of the industry and has acted as a gateway for the introduction of international expertise and experience of direct relevance to the U.S. market. It has provided valuable work products in the form of the Proceedings of the successive IWMs and the databases prepared to cover micropile bibliography and load test data. It has helped to provide clear "research needs" guidance to various bodies contemplating such works. The ISM has also been directly responsible for the growth in certain regional markets (e.g., Toronto, Canada) by means of inspiring specific individuals or companies. In similar vein, the series of one-day short courses taught by ISM members in the U.K. and Ireland in November 2006 was specifically designed to stimulate growth in these mature markets. If successful, a similar project in S. Africa will be another example of intense technology transfer, but to

an entirely new market. Regarding such ISM-sponsored events, it was frequently recounted by attendees in the U.K. and Ireland that they were permitted or recommended to attend by their supervisors simply because it was an ISM event and not perceived to be a commercially overt seminar such as a contractor "brown bag." This experience should be a very encouraging sign for the contractors themselves, most of whom are already aware through their activities with ADSC and DFI that a "united front" during technology transfer is an extremely efficient and cost-effective strategy. The rise of ISM has thus allowed the individual contractors to "throttle back" somewhat in the intensity and scope of their own respective promotional efforts. Already almost 20 countries are represented.

## 8. Trade Organizations

In the U.S., the relevant organizations are the ADSC (The International Association of Foundation Drilling) and DFI (Deep Foundations Institute). DFI first convened a micropile committee in 1994, the first goal of which was to produce a Guide Specification primarily for work in the private sector. It also collaborated with the FHWA to facilitate the first IWM in Seattle in 1997. DFI has often had micropile sessions at its bi-annual international conferences and frequently publishes papers in its quarterly magazine. After much prompting by micropile activists in the late 1990s, the ADSC also formed a Micropile Committee in 2000, which has met on a quarterly basis since then. Very pragmatically — because many of the members were common — the ADSC and DFI agreed to a Joint Micropile Committee in 2002. This Committee organizes 1- or 2-day regional seminars or workshops, on average twice per year. The ADSC, via its Industry Advancement Fund, directly funds research and, for a crucial period in the early 2000s, directly funded the IWM/ISM activities following the collapse of FHWA funding. The ADSC also funds training sessions for field personnel, and produces the Faculty Workshop, intended basically to "train the trainers." The Committee exerts a review influence over micropile codes and guidelines prepared by FHWA, NHI, AASHTO and the International Building Code. In its annual conferences, sessions are devoted to micropiles and, indeed, one-third of its "GeoCubed" Conference in 2005 dealt with micropiles. Micropile articles are common in its magazine (6 per year), and a library of publications is available for downloading. Not least of the considerable benefits of these trade organizations is the opportunity they provide for practitioners — frequently direct competitors — to meet regularly and air issues facing the industry as a whole. All segments of the industry (academia, consultants, contractors, owners and suppliers) are fully and vociferously represented.

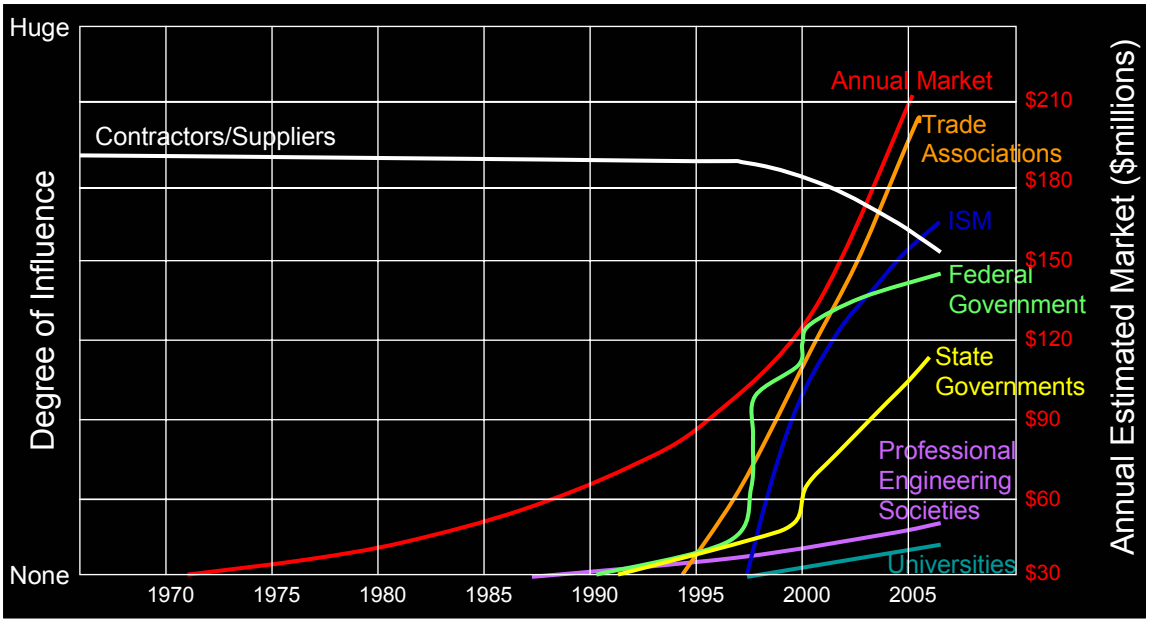
## 9. Summary of Influences on Market Evolution

The following is a tabular summary of the influences as presented in this paper.

| GROUP | INFLUENCES | |
|---|---|---|
| | POSITIVE | NEGATIVE |
| 1. Specialty Contractors and Suppliers | • Hungry and active.<br>• Traditionally they have "led the charge."<br>• Created market growth by geographic expansion and evolution of strong competitors.<br>• Exploited "new" markets, e.g., seismic rehabilitation, karstic foundations by technical and constructional skills.<br>• Publications/seminars. | • Over-commercial.<br>• Confusion due to plethora of names. |
| 2. Federal Government | • Research funding source mainly in 1990s and early 2000s.<br>• Products provided industry uniformity.<br>• Initial sponsor of IWM/ISM.<br>• Continuing sponsoring of DOT level courses. | • First major intervention only in early 1990s.<br>• Research funding now gone. |
| 3. State Government | • DOTs becoming "educated" in micropiles.<br>• States Pooled Funding initiative. | • Results from Pooled Fund study not readily forthcoming. |
| 4. Universities | • Certain centers of national and international repute and collaboration.<br>• Some development of strong "contractor friendly" initiatives.<br>• Some promotion via short courses. | • Little teaching.<br>• Little research.<br>• Individuals, not Departments, are prominent. |
| 5. Professional Engineering Societies | • Exposure via national conference papers.<br>• Strong regional exposure. | • No committees.<br>• No national "guideline" documents. |
| 6. ISM | • Access to, promotion of, national/international knowledge and experience.<br>• Excellent publications/workshops.<br>• Promotes "technology communism."<br>• Non-partisan/non-commercial.<br>• Industry useful databases.<br>• Simulates regional markets. | • In infancy — needs secure funding. |

| GROUP | INFLUENCES | |
|---|---|---|
| | POSITIVE | NEGATIVE |
| 7. Trade Organizations | • Strong, active, well led and well funded.<br>• Contractor led, all inclusive.<br>• Strong institutional leadership.<br>• Platform for knowledge distribution and education via seminars, publications, conferences.<br>• Source of research funding.<br>• Generate industry guidelines.<br>• Funds "teacher training."<br>• Can influence regional, national construction codes. | • Danger of over-commercialism/ protectionism.<br>• Can be expensive for individual participants. |

The following graph is a very subjective attempt to illustrate the respective influences of these 7 different groups with time. Practitioners in other countries are challenged to produce a similar model.




## 10. Observations

It would seem that a number of factors or influences must be in place, or put in place, in order for a national or regional micropile market to be created and to flourish. In the business planning vernacular, these are, in effect, the project goals. How these goals are implemented, i.e., the strategies, will not necessarily be the same in all markets and, indeed, may be fully expected to be different. It is this group of responsive strategies that the reader will have to develop and implement in order to win the game

in his own particular market. The author would propose the following list of goals, not prioritized.

- The clients/potential users must be educated.
- There must be at least three viable competitor contractors.
- There must be a technical committee or other specific focus forum where representatives from all the business segments can meet and interface regularly.
- There must be some type of national/regional “guideline” document containing draft specification models.
- The subject must be taught at university level.
- There must be some source of funding to conduct research and technology development/promotion.
- Federal and local government must become fully engaged.

It must be noted, of course, that these specific issues must build on the fundamental drivers for the creation and growth of a micropile market. Such drivers include geology, seismicity, national economics, and industry requirements.