

ASFE White Paper

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2000–2010: As We See It

This *ASFE White Paper* was prepared for the exclusive use of ASFE members by ASFE's Practice Issues and Trends Committee. The Committee initiated its activities in 1996, under the direction of Chairman Daniel L. Harpstead, P.E. (Powell-Harpstead, Inc.), with the assistance of other organizations and a recognized futurist. The Committee completed its work under the direction of Chairman Dr. Gary W. Raba, P.E. (Raba-Kistner-Brytest Consultants, Inc.). ASFE's Council of Fellows also conducted a study of future trends and their likely impact on geoprofessional practice, identifying many of the same developments forecasted by the Practice Issues and Trends Committee. This paper incorporates the vision of the Council of Fellows.

Overview

The future is determined by the confluence of interrelated developments. This *ASFE White Paper* identifies major trends now affecting geoprofessional consulting practices, the developments that have impelled those trends, and the scenarios likely to unfold over the next five to ten years.

Commoditization of professional services is one of the most significant existing trends likely to intensify. Commoditization represents a 180-degree reversal of what "used to be," when technical substance made business style almost immaterial, excusing poor interpersonal skills and a penchant for disregarding budgets and, more particularly, schedules. Today, many, if not most clients assume candidate firms

have the technical abilities required to perform routine services, in part because so many services have been or are being process-mapped as voluntary standards and/or mandatory regulations. Style is in the ascendancy. What seemingly matters most to clients is a firm's ability to understand client needs, the firm's reputation for meeting budgets and schedules, and the personalities of those making the sale. Offering a reasonable fee is important; offering the lowest fee is not always necessary.

That salesmanship, customer service, and price have become the three dominant selection criteria should not be surprising. They apply to virtually all American businesses, underscoring the fact that distinctions between professional

service firms and other business entities are rapidly blurring. The large size of many firms tends to accelerate this trend, and growth is predicted to continue, as firms seek to create the discipline mix needed to offer clients the convenience of "one-stop shopping," to gain the financial wherewithal to invest in new technology, to establish the capital base needed for equity investments in client projects, and just to survive in what is and will remain an "eat-or-be-eaten" marketplace.

Large size also helps firms reduce the per-capita cost of the overhead necessary to deal with a growing array of regulations affecting human resources, business management, accounting methods, and technical output. This

“regulatory overload” also accelerates commoditization, forcing more firms to conduct more activities in the same regulatory-compliant manner, eroding significant differences in corporate cultures.

Continually more of those individuals who are disenchanted with the traits of large or growing firms will leave to form their own small (micro) firms, and they, too, are in a position to thrive. They are exempt from or otherwise not particularly affected by any number of regulatory impacts, can avail themselves of new technology quickly and inexpensively, and can obtain assignments from any number of sources.

Growth and standardization of themselves tend to encourage the depersonalization of services and, to a very real extent, the depersonalization of staff; i.e., people, too, are becoming commodities, and the loyalty of firms to personnel, and personnel to firms, is rapidly becoming a vestige of the past. Those most likely to advance within a firm are individuals willing to sacrifice family time. For many, this will be unacceptable. Where they live and how they live will become key issues. Continually more technical personnel will work on a project-by-project basis, to derive more of the advantages enjoyed by “solo” practitioners. The inability to attract and

retain highly motivated professionals will become a severe problem in the years immediately ahead. It will be eased somewhat by information technology that permits firms to operate on a 24-hour basis, simply by “switching” projects to technical and professional personnel located in developing nations. Such techniques will have the added advantage of meeting clients’ desire for rapid, “just-in-time” delivery, while also lowering costs.

Relying on drone-like production skills will de-emphasize innovation in favor of “off-the-shelf” solutions. Such a development could easily put innovation at risk, because, in engineering and construction, innovation has come far more from the field than from the laboratory. To some extent, this has occurred by default, simply because engineering, environmental, and construction industry research has been largely ignored for decades. Those who stand to gain the most from innovation are the larger firms that rely on design/build, build/own/operate/transfer, and other “client-outsourced” project delivery systems. Those firms may establish their own R&D departments, on an individual and/or shared basis, to develop unique new, possibly patentable methods. These new methods will put such firms in a better position to

obtain the performance-based financial rewards often associated with client-outsourced projects. “Outsourcing” also encourages clients to select firms on a noncommoditized basis, due to the nature of the services required, the long duration of many projects (decades, in some cases), the close client/consultant relationships needed for mutual success, and the overall amounts of money involved.

The ability to innovate and meet clients’ outsourcing needs may become particularly important in emerging new markets that are ideally suited for geoprofessional involvement. One of the most important of these new markets is infrastructure rehabilitation and replacement. Because many such projects will be initiated only after a failure occurs, the clients involved will often select firms that can provide rapid resumption of service and long-term repair or replacement with minimum disruption.

Utilization of water resources will become a key issue, especially in areas with marginal agricultural capabilities. In areas with no agricultural capability, aquaculture will become important. While these opportunities will likely spawn situations where substance will predominate over style, those

without style will be at a severe disadvantage.

Will the confluence of these trends result in the demise of professionalism, if not our professions themselves? The Committee is of the opinion that only professionals can determine the outcome, by re-defining what it is professionals do and how they do it. "Outsourced services"—which cannot be considered commodities—may comprise the vehicle ASFE's member professionals use to achieve redefinition. To a very real extent, "outsourcing" requires design and environmental professionals to function as "master builders," operating within trust-based relationships and strategic partnerships. Somewhat ironically, that's exactly how it used to be, which is why some ASFE members regard their outsourcing activities as a means to move "ahead to the past."

The issues presented for your consideration include the following, in no particular order of importance:

- Regulatory Overload,
- Stratification of Firms,
- Information Technology,
- Demand for Faster Service,
- Character of the Workforce,

- Public and Tax-Favored Competition,
- Procurement, and
- Discipline-Specific Opportunities.

Regulatory Overload

Businesses are required to contend with a growing universe of regulations that affect almost every aspect of their activity: accounting methods; wages and salaries; benefits; occupational safety and health; accessibility; workplace attitudes; etc. Design, environmental, and related professionals must also deal with myriad public sector procurement regulations, especially those relating to overhead calculation, treatment of reimbursable expenses, labor rate caps, site-specific safety and health, project-specific accessibility, and so on. A wide array of regulations and "standards" also must be followed, and obtaining exceptions when they do not serve the client's or public's best interest is a complex, time-consuming ordeal.

As regulations have become more intrusive, firms have begun to resemble one another more, because they use the same prescribed or strongly suggested methods to comply. Sameness reinforces commoditization.

Regulatory proliferation also heightens the risk of noncompli-

ance. Large firms are in the best position to manage this risk, because they can afford the on-staff expertise and information technology (IT) required to stay "on top" of regulatory requirements, disseminate guidance, and monitor compliance.

Small firms are also in a good position to deal effectively with regulatory overload, in part because their small size in many cases exempts them from compliance, and/or makes certain other issues (e.g., employment practices liability) far simpler to deal with. They can also become specialists in certain narrowly defined issues, permitting them to be fully informed of regulations in that area.

Those with the most to contend with are mid-sized firms, because they must deal with all the issues that confront large firms, but have far fewer resources at their disposal.

Outlook

Regulatory overload will continue. Large and small firms' ability to stay on top of the technical regulations will be a marketing asset. Mid-sized firms will either have to grow, or somehow nurture the development of shared services to give them the ability to deal with regulated activities cost-effectively. If they do not obtain this ability, then existing trends that threaten mid-sized firms will continue.

For all firms, relying on certain “standard” approaches jeopardizes their ability to differentiate themselves in the marketplace through technical quality and innovation. Firms that adopt customer-oriented marketing and service capabilities will treat this as a business opportunity. Those who believe a regulatory surcease is needed will be required to work through their associations to give their opinions political strength. Associations may not have the volunteers or income needed to make this happen, however, especially if the largest firms come to believe that associations exist principally to serve the needs of smaller firms that cannot get things done on their own.

Stratification of Firms

The “merger mania” that has characterized the design and environmental marketplace over the past five years has resulted in “large firms” becoming larger and “small firms” becoming smaller.

Large firms have been purchasing other large firms, mid-sized firms, and even some smaller firms for reasons such as:

- expanding their service mix to meet almost all the technical needs of large clients, continually more of which outsource to meet those needs, and prefer to rely on just a few providers,
- creating the financial capacity for design/build and equity participation (e.g., build/own/operate/transfer), leading to strategic partnerships and barriers to competition,
- gaining reputation and experience,
- gaining national and/or international locations and “presence,”
- increasing revenue and profit to increase the value of publicly traded stock, to make a firm a more attractive and valuable acquisition target, or to position it for an initial public offering, and/or
- improving efficiency by reducing per-capita overhead.

Mid-sized firms have also joined the merger-mania “club,” to gain the additional office locations and/or discipline mix they need to compete with large firms.

Outlook

As firms continue to grow, more individuals will leave them to start their own one- or two-person practices. Most such practices will thrive, because they can easily take advantage of information technology (IT) to offer a level of service that belies their smallness. By focusing on a narrowly defined niche, or spe-

cialty, they will be able to meet the discipline- or discipline/location-specific needs of large firms, and the similar needs of mid-size firms seeking to compete with large firms. They also will be able to link with similar operations to create project-specific virtual firms whose discipline/experience mix closely matches project requirements.

Large firms will also encounter new opportunities, encouraging them to adopt even more “big business” attitudes. They not only will seek equity-based solicitations; they also will encourage “outsourcing” by clients and prospects for traditional services, to the detriment of their less well-funded competition. Some large firms will also take advantage of their financial position to “buy” market share, by offering fees many of their competitors cannot afford to match, by accepting risks too significant for others, and/or by purchasing firms (often at prices that will be lower than otherwise, because of the targeted firms’ competitive deficits).

These trends cannot help but jeopardize professions and professionals. To achieve targeted profits, large firms will be encouraged to emphasize quick production—even when high-risk projects are involved—and deemphasize quality and innovation. Bringing in business will become a major concern,

focused far more on client-oriented organizations and activities than on peer- or profession-oriented organizations and activities, weakening the "professional infrastructure." As a consequence, the largest organizations, which typically have been the source of professional leadership over the years (large companies can afford to give principals time off to lead), may become far less involved in the future, and thus may also be creating a chasm between their operations and what could be termed (in a commercial sense) the "mom and pops."

Mid-sized firms will continually need to scramble to survive. Many will adopt the attitudes and procedures used by their large brethren, and thus will become larger themselves, or more sensitive to the bottom line and the need to categorize professional activities as "questionable overhead."

Small firms may feasibly become the "last bastion" of professionalism. Unfortunately, their small size severely limits their principals' ability to become association/society leaders.

Information Technology (IT)

Recent advances in information technology (IT) have enabled design and environmental professionals to gather, assemble, and analyze more information

more quickly, and to provide what appear to be better quality instruments of service faster, and for less cost.

As substantial as IT advances have been within the past five years, they will be even more substantial in the next five, and will occur at a faster pace. Those that are the first to adopt and master new IT developments will enjoy short-term competitive advantages.

Most firms have already adopted basic IT, and many have become "flatter" as a result, requiring fewer "overhead staff." Word processing and voice mail allow firms to produce their proposals, reports, and correspondence faster, with fewer administrative staff. Cellular phones and pagers permit field personnel to cover more site activities. Electronic transfer of documents accelerates technical review and editing while reducing the need for copies and overnight delivery, along with the attendant administrative involvements.

Many firms have gone so far beyond "basic IT" that even sophisticated IT procedures are becoming somewhat commonplace; e.g., CD ROM delivery of reports, drawings, and specifications; client access to consultants' data via Internet home pages; and use of electronic transfer to obtain draft-

ing services performed on a 24-hour basis in other nations, often by personnel who are paid but a fraction of their U.S. counterparts' compensation.

The smallest organizations—one- and two-person firms—arguably have gained the most from IT to date. CD ROM databases, scanners, electronic file transfer, e-mail, Internet access, and other IT tools have given them the ability to perform functions that previously required a much larger workforce. IT and ever-more powerful laptop computers have also given them the ability to perform complex engineering functions while in the field.

Outlook

All firms will be affected by the coming generation of IT developments foreseen by the Committee, including:

- improved data/information storage,
- improved document transfer,
- remote data entry (e.g., field data to the office or virtual office),
- direct links to field activity, and
- transfer of engineering design tasks to practitioners in other nations.

These developments are likely to be complemented and accelerated by innovations in the areas of low-cost video conferencing (including holographic video conferencing), voice e-mail, and video e-mail, among others.

Gaining a competitive advantage by being the first to adopt new IT does not occur without risk, and the size of that risk is magnified by the dollars involved, for capital, training, and maintenance. Cost also is associated with the trial-and-error potholes that mark the road to the leading edge. But cost (in the form of lost opportunity) can also arise from waiting for the perfect system.

Quality control comprises another significant risk. Because fewer people are involved in the evolution of deliverables, fewer opportunities for error detection exist. This problem is exacerbated by the pervasive—yet erroneous—assumption that close review and double-checking are less important, because computers perform work more accurately than people. (“Garbage in, garbage out” still holds true, witness the alarming number of proposals and reports that contain extraneous paragraphs from misapplied “boilerplate,” fail to include important new wording, or present wildly inaccurate data that achieves unmerited credibility because of the

intricacy of the color plot, or because each number comprises at least five digits to the right of the decimal point.)

Smaller firms, especially the one-person “shops,” will continue to be the first to adopt new IT technology, because it often is introduced in the simpler formats they use, rather than the more complex “networked” versions larger organizations rely on. This also means less costly acquisition, faster training, and fewer maintenance requirements. Quality control is also less of a problem, because many of the “one-man bands” were previously seasoned project managers at larger firms. (The younger professional staff many large firms rely on often are more adept at IT than the technologies which their employers hired them to apply.)

Large firms do not generally compete with tiny ones, of course. They compete with other large firms or those in the mid-size category. For the most part, large firms will fare well. They have the financial wherewithal to acquire new technology, and most employ full-time IT professionals, making debugging, trouble-shooting, in-house training, technical assistance, and maintenance less problematical. The most significant IT impediment some large firms will face will stem

from bureaucracies and their inherent desire to cleave to the “old ways” instead of adapting core philosophies to the “new ways.” Internal resistance will probably diminish quickly, however, given the significant benefits that large firms can derive by using information transfer to obtain the services of low-cost foreign labor, and to achieve 24-hour progress by exploiting time zone differences.

Mid-sized firms may be in the most precarious positions, because they will likely face increased competition from large firms and from one- and two-person operations that join forces to create high-tech virtual organizations comprising individuals whose skills, in aggregate, are near-ideal matches for the nature of the project involved and the services required.

Demand for Faster Service

The notion that “time is money” has never fallen out of favor. Information technology (IT) tools have permitted firms to produce fast, but this has only served to whet clients’ demand, not keep up with it. Firms that can meet clients’ ostensibly unrealistic schedule requirements have a distinct competitive advantage, especially when they can project an image of high-quality service despite near-frantic turn-around requirements (e.g., by complying with ISO organizational

standards, by relying on IT solutions (“garbage in, garbage out” notwithstanding), by meeting ASTM and other technical standards, etc.).

Outlook

As firms take on more commissions that incorporate faster turn-around times, we can expect some of the following negative outcomes:

- *More liability exposure and stress.* Working fast invariably heightens the risk of errors and omissions by those who perform the services. Demands for faster performance and heightened risk will increase stress.
- *More errors.* The reduction of administrative staff permitted by greater reliance on IT reduces the opportunity of error detection from “below.” The pace at which managers and senior staff will be working will dampen their ability to check deliverables, increasing the likelihood of errors and omissions.
- *More training.* To offset the foregoing problems, firms will dedicate more time, money, and effort to the training of project managers, to help ensure that the flatter organizational structure they need does not lead to unacceptable liability problems. Training requirements will be more de-

manding than in the past, because project managers will have to know more and do more. The stressful environment in which they work will weaken their ability to learn, however, requiring even more training time, thus creating even more conflict with production schedules, and inducing even more stress.

- *Less client contact.* Because of time pressures, and given IT “aids” such as e-mail and video-conferencing, person-to-person contact with clients will decrease. This will increase the risk of misunderstanding client needs, and reduce project managers’ ability to create and nurture the client-consultant relationships that can enhance understanding and establish the lines of communication essential to rapid and low-cost defusing of potential claims.
- *Lower quality of life.* The time pressures associated with worklife will conflict directly with professionals’ and others’ desire to spend more time with family and friends. The stress involved will encourage continually more individuals to seek other types of work or to become “solo” practitioners.

While some of the frantic pace now being encountered stems from the nation’s surging eco-

nomics vitality (“make hay while the sun shines”), much of it also is due to clients’ and others’ reliance on IT, which portends no let-up of the pace. IT enhances management capability and shortens performance times, permitting more comprehensive planning and earlier onset of revenue flow. It can also facilitate more involvement in international projects, helping to ensure a steady flow of projects to firms with international presence, and the ability to disperse (and manage) work to offices or subcontractors worldwide. As IT improves (at four times the pace that existed just five years ago), the pressure for faster delivery will increase.

Small firms that specialize in just a few disciplines will fare well, assuming their staffs will be small and highly skilled, with the experience required to detect problems quickly. Their ability to respond quickly and well will also be enhanced because their staffs will function as true teams, with genuine trust in one another’s capabilities.

Large firms will face the most significant challenges, because of profit demands, acceptance of projects with short deadlines and/or high levels of risk, reliance on more individuals new to the firm and/or the practice in general, and utilization of hierarchical structures to help ensure quality control.

Hierarchical structures will become detriments to large firms' other goals, of course, which will create an immediate need for more and more effective project management training, designed to consider and compensate for the stressful atmosphere in which project managers will work. Somewhat ironically, the most effective method of training is likely to be based on mentoring, the fundamental method used by the professions for centuries, but which in recent years has been significantly downplayed in favor of skills training and making more time available for "production." Unless mentoring is performed by people whose principal task is to mentor, however, mentoring will not likely be performed, because of its time demands.

Character of the Workforce

A recurrent theme in various "Workplace 2000" scenarios is "new" employees' desire to spend more time with their families and friends, and to otherwise "smell the roses." Their attitudes toward work differ significantly from their firms' senior members'. Being part of a dual-income or single-parent household accentuates the importance of "quality of life" issues, and continually more of the "new" employees are part of such households. For them, the stress associated with work can make leisure sacrosanct.

At one time, firm loyalty would have had a significant counter-effect. That no longer is the case. Employers are far less loyal than in the past, as are employees. Even higher rates of employee turnover are likely, therefore, as:

- a spouse is transferred to or is offered a new position in an area of the nation or world that is more appealing,
- a less stressful position becomes available in another firm or industry, or
- the opportunity to enter a "be your own boss" individual consultancy beckons.

Turnover will also be created because of the growing "lean and mean" outlook, which involves staffing up or down to meet project size and expertise requirements.

Turnover brings with it lessened levels of efficiency, because existing managers must spend more time orienting, training, supervising, and double-checking. They must work longer hours to take care of the firm's work, and thus become more susceptible to making mistakes, more stress on the job, and more family stress because of the time spent at the office or at home on office work.

Outlook

Turnover or the threat of turnover will place a premium on high-performance employees, who are devoted if not to their firms, then to the work ethic. They will be aware of their value, however, and thus will command commensurate salaries, and will likely be resistant to any undesirable change, such as relocation.

Some will welcome relocation, when it is to the "right" area. But once in that area, they will not want to move again. Because some areas of the nation will generally be perceived as "wrong," reassigning people there will create problems, creating a local labor pool that may lack certain important skills.

Especially in those areas that are perceived as somewhat unattractive, and/or where the labor pool is somewhat marginal, the need for contract labor will grow, thus creating opportunities for contract labor companies. While contract employees can provide real benefits in terms of the accounting ledger, working with them can create some practical problems. They are far more difficult to motivate, and they require more oversight because they lack experience with a firm's technical and procedural preferences. This situation will accelerate reliance on information technology (IT) to have continu-

ally more tasks performed by individuals located in other nations. More opportunities will also exist for small firms or individual practitioners, some of whom will take on the role of itinerant project managers.

The most significant concern for many firms of all sizes will be identifying core staff to whom they can entrust their future. The competition for these individuals will grow fierce, exaggerating the problems associated with “employee piracy” and creating hard feelings between formerly collegial organizations. (Interestingly, the desire to curtail employee piracy was a principal factor leading to the creation of the guild system from which the professions grew.) Salary escalation will be one likely result of the situation, along with efforts to make the work environment less stressful. That type of development will encourage more people to enter the profession, easing the problem, but not until at least another decade has passed.

Public and Tax-favored Competition

Public-sector outsourcing to private-sector firms has contributed to the expansion of the nation’s economy, reversing long-term trends toward bureaucratic expansionism. Unions that represent govern-

ment engineers have been particularly opposed to outsourcing. In Massachusetts and, more recently, in California, a union was successful in establishing a ballot initiative that would have mandated far more work—not less—being performed by government-employed engineers. Although the stated purpose was to lower taxpayer costs, the actual result would have been far different, because private-sector vs. public-sector cost comparisons would have permitted the public-sector to exclude from accounting costs a wide array of real costs both they and the private sector must bear, but which only they could ignore.

Tax-favored competition can be a more complex issue, especially when the competition comprises educator-led teams composed principally of graduate students and even some undergraduates. Relying on such groups to perform services ordinarily performed by consultants seems to be “win-win” from everyone’s point of view. Educators can supplement their college salaries. Students can gain valuable “real world” experience. The public-sector clients usually involved, and taxpayers, pay far less than they otherwise would for the services involved. Even consultants might be deemed to benefit, because the quality

of the labor pool will be augmented by virtue of entry-level personnel’s “real-world” experience.

Outlook

Unions that represent professionals have a great deal to lose as a consequence of outsourcing, so they will continue to fight, but will choose a different arena: the private sector, where huge firms will employ a growing number of dissatisfied employees who are less attuned to “professional heritage,” and where continually more former government employees and former (or current) union members work. Unions will also recognize that engineering firms will be unprepared to deal with union organizing activities.

Tax-favored competition will become more pervasive, but will ultimately abate as a consequence of solutions that involve academia, the public sector, and private consultants.

Procurement

At one time, engineers were known as the “master builders,” individuals or firms that were able to take care of virtually all project elements. Over time, and for various reasons (including liability issues), single-source responsibility became fragmented. The project owner would select a prime

professional organization that put together the overall design team, and a contractor to put together the building team.

Those responsible for construction were in a position to set a fixed price for their work, because they had plans and specifications to review. And, because they did, bidding became a logical contractor selection method.

A far different situation existed with respect to the professionals required to develop the plans and specifications, and owners generally relied on qualifications-based selection (QBS). Through QBS, a client looks principally at firms' understanding of the client's needs, and their qualifications to perform the services required, among other objective and subjective factors. Subsequent to selection, the client and professional discuss project specifics, with the professional outlining alternative approaches, the initial and long-term fees and costs associated with each, and the risks associated with performing or not performing them. This latter aspect of procurement—known as mutual scope (of service) development—helped ensure a shared vision of the project and its requirements, thus to establish clear and realistic mutual expectations.

Because fee typically represents one percent or less of the overall project cost, and because the services provided for that fee significantly influence what all other costs will be, those procuring services have long been advised to avoid being "penny-wise and pound-foolish." Long-term thinking does not seem to be as popular today as it once was, however, with continually more client (and consultant) organizations focusing on monthly or quarterly results. ASFE members, among others, are therefore more frequently required to forgo mutual scope development and simply submit bids in response to client-developed scopes of service, some of which are based upon standards issued by organizations such as ASTM. Client-developed scopes leave many questions unanswered, however, forcing responding firms to make a variety of assumptions about client requirements. Those that assume the client wants less service rather than more are more likely to obtain the assignment. Bidding also encourages contractor-type gamesmanship and precludes development of shared expectations at the outset of a project. This situation can aggravate known problems, leading to more lawsuits and claims as a consequence of client-consultant relationships that are devoid of trust, and the inability of

either clients or consultants to fulfill unrealistic expectations. As a consequence of these developments, any number of professional services have been or are becoming commoditized, at least in the eyes of clients. The long-term implications of this trend could be profound. Professionals' key concern entering a project could become self-protection. Many will be discouraged from providing excellence, because the scope—in order to support a low fee—will not permit expenditure of the time which excellence requires. Without excellence as a goal, professionals will have far fewer opportunities to obtain the "psychic income" traditionally derived from doing a "great job."

Associations such as ASFE generally cannot take an aggressive stance on procurement issues, because doing so could be considered an effort to restrain trade. This leaves action up to individual firms. In the past, however, encouraging firms to train their project managers and other employees about the importance of QBS and mutual scope development has achieved less-than-successful results. Some firms don't seem to care. Others believe, with some justification, that efforts made to "educate" the clients lead to large expenditures of time that are counterproductive.

Outlook

Firms that emphasize client satisfaction will help preserve QBS concepts in a commoditized marketplace. By stressing on-time, within-budget delivery of routine (commoditized) services these firms will establish client trust. When the needed services are not routine, clients will trust the firms to charge a reasonable fee to implement a mutually developed scope.

To a very real extent, "outsourced services" comprise a growing element of nonroutine services, for all sectors of the economy. Outsourced services include design/build, design/build/operate, build/own/operate/transfer, operation and maintenance, and environmental management services, among others. Because these services are not commoditized, most clients will select based on a variety of factors, including (in many cases) firms' ability to finance the project. Many firms will institute important changes in order to offer outsourced project delivery options, expanding their service mixes to include a number of services now considered nontraditional. In a return to "how things used to be," outsourced projects will be so all-encompassing, the firms able to take them on will become the classic "master builders" of their age. The performance-based remuneration aspects of many outsourced

projects will put a premium on the "master builders'" ability to deliver high-quality results on time and within (or below) budget, abilities that commonly are associated with "classic" professionalism. And also, ironically, a growing number of the smaller firms will look to large and mid-sized firms for business, encouraging networking through professional organizations, the classic professional marketing method of the late 19th and early- to mid-20th centuries.

Discipline-Specific Opportunities

The future will create new demands for certain specialties that will be available to those who plan for the opportunities now. Some of the key opportunities envisioned, in no particular order:

- *Infrastructure Rehabilitation:* While the demand for new infrastructure will exist in a number of second- and third-world nations, infrastructure rehabilitation, modernization, and replacement opportunities will escalate rapidly in the United States, particularly in the areas of energy, water, wastewater, and transportation. Because much of this work will be initiated subsequent to failure, subspecialties will be needed to quickly restore service (if only on a make-shift basis) and to

effect repairs and/or rehabilitation on a rapid schedule, with minimal disruption to service.

Aging environmental containments will also comprise a market, and innumerable landfills may have to be mined to rectify containment problems. New technology will also permit the extraction of important resources now buried in landfills.

- *Water Resources:* Water, once taken for granted, will rapidly assume a position of extraordinary importance in virtually all nations. Storage and reuse expertise will be in particular demand. New and modernized surface and subsurface structures (dams, tanks, towers) will be needed; new aquifer recharge and storage techniques will have to be developed. As the cost and/or comparative scarcity of water increases, reutilization of marginal wastewater and surface run-off will become more cost-effective. Technical expertise will also be required to help regulators and politicians develop equitable means for sharing water resources.
- *Agriculture and Aquaculture:* Engineering expertise will be particularly important in developing nations where agriculture is feasible, but water is in

short supply. New types of irrigation systems will be needed. Soil improvements will be required, too, both to combat erosion and to better support the growth of crops. In those areas of the world where agriculture is not feasible, aquaculture will take on more importance.

- *Mining:* The restoration of surface and subsurface mines, particularly coal mines, will become more important, to overcome environmental threats and to undo the

damage mining has caused. New techniques for extracting minerals while doing less damage will be in demand, along with techniques for extracting minerals from previously discarded wastes.

Outlook

Some firms already are involved in these specialty areas, and any number of firms, no matter what their current discipline mixes, can access them. As the market begins to develop rapidly, those with existing expertise will gain the largest

foothold. Growing demand will quickly attract other firms, however. Small firms will capture business from both large and mid-sized firms that need either high-level and/or local support. Mid-sized firms will need to focus themselves as regional experts, while large firms will position themselves principally for major domestic projects and other projects worldwide. Larger firms' ability to provide equity participation should put them into a strong position as the price of water and minerals rises.