INPUT IT Intelligence Services

August 1993

MARKET ANALYSIS PROGRAM

Dear Colleague:

Enclosed is your copy of INPUT's 1993 report on the *Process Manufacturing* industry. This edition, covering the 1993-1998 period, continues our new approach to major vertical markets in that it combines the traditional INPUT interview-based survey and forecast activity with the vision of an industry expert. INPUT believes that this combined approach strengthens our assessment of the trends, issues, technologies, and market developments that currently drive this market.

For this report, INPUT interviewed a broad range of users and managers of information systems, plus a number of leading vendors in information services to the industry. This survey base, coupled with the knowledge of an experienced industry specialist, has resulted in what we feel is a highly informative and insightful report.

I would be pleased to receive your opinions and suggestions on this or any other of our reports in this new format.
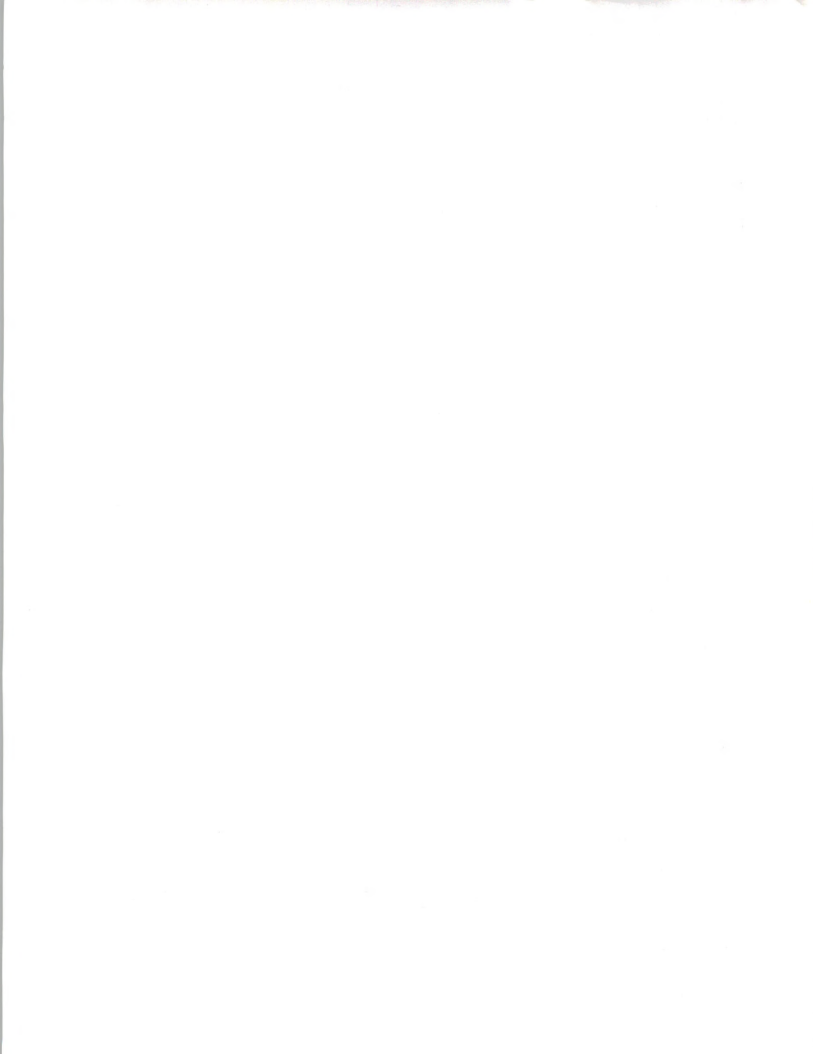
Sincerely,

Bob Goodwin

Robert Goodwin
Manager
Information Services Market Analysis Program

Enc.

Please insert this binder behind the Process Manufacturing tab in your MAPS binder.

report

program

August 1993

Dear Colleague:

Enclosed is your copy of INPUT's Information Services Market Analysis Program report on the *Process Manufacturing* industry. This edition, covering the 1993-1998 period, continues our new approach to major vertical markets in that it combines the traditional INPUT interview-based survey and forecast activity with the vision of an industry expert. INPUT believes that this combined approach strengthens our assessment of the trends, issues, technologies, and market developments that currently drive this market.

For this report, INPUT interviewed a broad range of users and managers of information systems, plus a number of leading vendors in information services to the industry. This survey base, coupled with the knowledge of an experienced industry specialist, has resulted in what we feel is a highly informative and insightful report.

Please insert this report behind the *Process Manufacturing* tab in your Market Analysis Program binder.

I would be pleased to receive your opinions and suggestions on this or any other of our reports in this new format.

Sincerely,

Bob Goodwin

Robert Goodwin
Manager
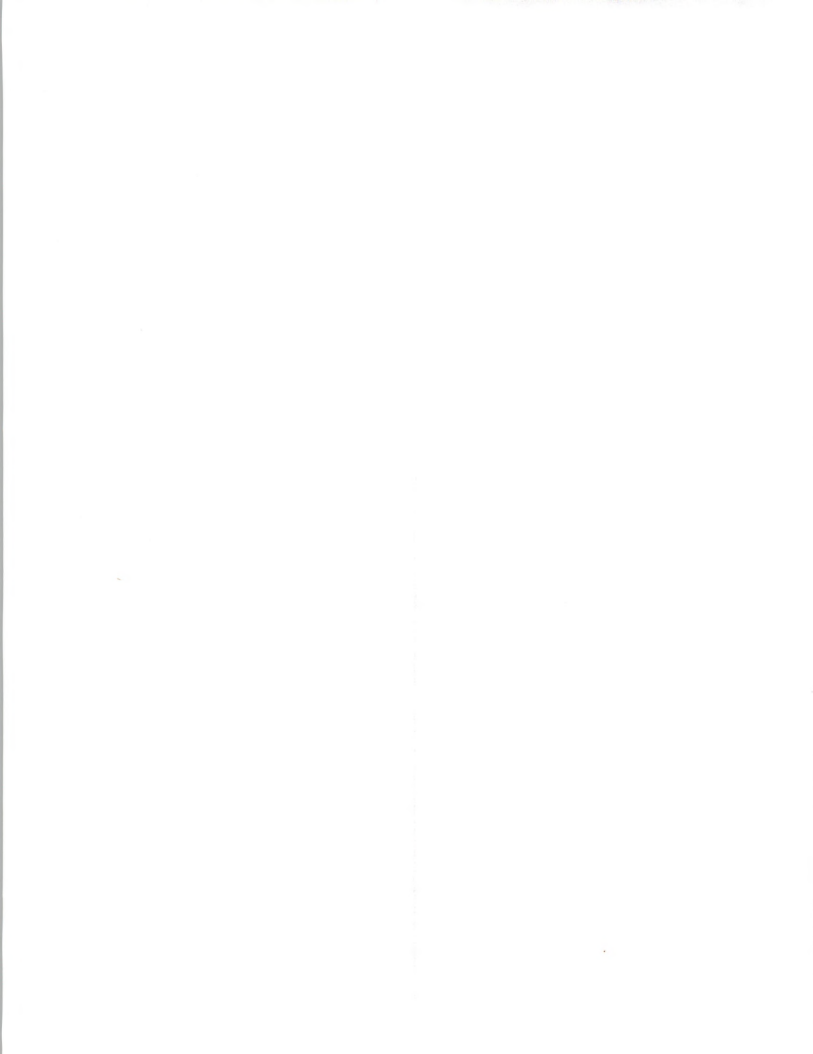Information Services Market Analysis Program

Enc.

VERTICAL MARKET ANALYSIS

PROCESS
MANUFACTURING
1993-1998

U.S. Information Services
Market Analysis Program

PROCESS MANUFACTURING

INFORMATION SERVICES
OPPORTUNITIES & TRENDS

1993-1998

INPUT ®
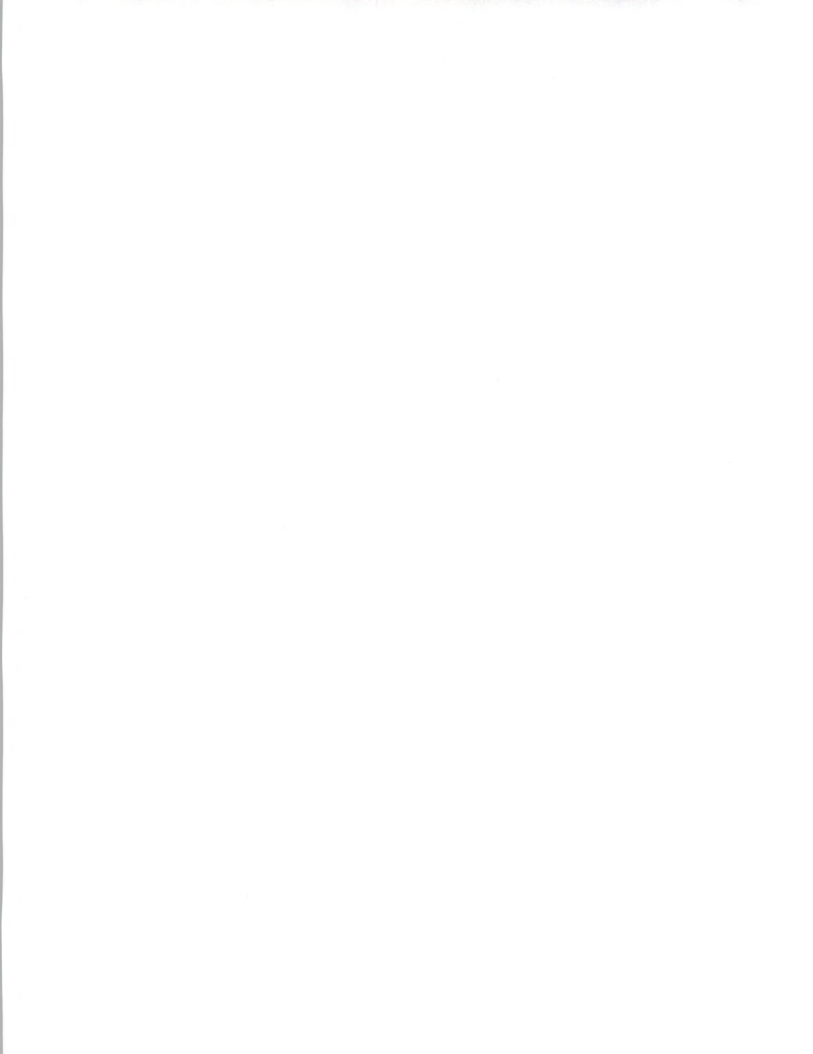
Published by
INPUT
1280 Villa Street
Mountain View, CA 94041-1194
U.S.A.

Information Services Market Analysis Program
(MAP)

Process Manufacturing

*Information Services Opportunities & Trends
1993-1998*

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Exhibits

Exhibits (Continued)

I

Introduction

A

Purpose, Organization, and Methodology

This section identifies the purpose and scope of this report, identifies key issues affecting information services expenditures in the *process manufacturing* market sector, notes how the document is organized and explains INPUT's research methodology and the techniques used in the preparation of forecast data.

1. Purpose

The purpose of this forecast report is to identify key opportunities and challenges for the users and providers of information services in the process sector of the manufacturing industry. The 1993 INPUT forecast for this sector is included.

Sector Definition - The *process manufacturing* sector, as defined by INPUT, includes:

- The traditional inclusion of all companies that fall within the Standard Industrial Classification (SIC) Codes of 20xx, 24xx, 28xx, 29xx, 30xx, 32xx and 33xx, as shown in Exhibit I-1, is used to identify the process manufacturing sector. Some discussion is devoted to hybrid companies, i.e., those companies that incorporate both discrete and process operations to produce their products.

- A process operation is most easily defined by identifying the form of the material used at the beginning of the operation and its form after use. If the material changes form during production and cannot be uniquely identified in the end product, then a process operation has probably occurred. Additionally, if the input material cannot be brought back to its original form, then a process has occurred to change it.

EXHIBIT I-1   **Process Manufacturing Sector**

SIC Code	Description
10xx	Metal mining
12xx	Coal mining
13xx	Oil and gas extraction
14xx	Mining/quarrying nonmetallic minerals
20xx	Food and kindred products
21xx	Tobacco products
22xx	Textile mill products
24xx	Lumber and wood products, except furniture
26xx	Paper and allied products
28xx	Chemicals and allied products
29xx	Petroleum refining and related industries
30xx	Rubber and miscellaneous plastic products
32xx	Stone, clay, glass and concrete products
33xx	Primary metal industries

- Current successful business practices incorporating Total Quality Management (TQM) principles are causing the lines between discrete and process definitions to blur. The desire to utilize the concepts of continuous flow, flexible manufacturing, process control, 100% quality, 100% service, reduced cycle times, and increased customer responsiveness forecasts a blending of the best of process and discrete practices. The implementation of the concepts indicates an increased use of automation and information services in the market; it also predicts a redirection of the marketing, development, and delivery practices for the vendors of such services. It is appropriate to note here that TQM measures ALL activities in a company in terms of a "process" environment.

Companies in the process sector do exhibit some unique requirements that are typically fulfilled by their management information systems:

- Recipes are used instead of plain bills of material.

- Process operations, or work instructions, must be used constantly and consistently.

- There are often intermediate steps in the production of goods.

- Many process companies generate "byproducts" and "company products" during the production process.

- Lot traceability is a necessity.

- Unit-of-measure conversions can be complicated.

- Regulatory compliance reporting is mandatory.

- Distribution logistics and traffic management can be major concerns.

Key Issues - Market issues discussed in the report influence the potential for the use of information services, which include:

- The implementation of TQM principles and computer-integrated-manufacturing (CIM) elements is bringing about a new company structure, often referred to as business re-engineering. The portions of that change referred to in this report are:

  - Cellular organizational structure and the team approach to continuous improvement

  - Separation of the planning, execution, and control functions as those activities apply to achieving TQM objectives

  - Outsourcing and building vendor relationships, both in information services delivery and partnering for manufacturing operations and the purchase of services and materials

  - The use of computers and information services to promote the completion of company goals and the relevance of new technologies as they apply to achieving the sought-after results

  - For users the questions, "How do I go about improving?" and "When I begin, what do I look for?", in terms of the use of information services, will be answered. For the information services vendor the dilemmas of what, when, where, and how to continue and grow are addressed. Special emphasis is placed on the aspects of client/server approaches to new systems. Each mode of delivery for systems and services is explored.

- Manufacturing markets are being influenced by conflicting forces:

  - Foreign competition and new markets
  - Global needs and concerns with easier communication
  - Spillover from the 1980s' merger and acquisition activity
  - The dramatic decrease in product life cycles
  - The need to run lean yet be more customer-responsive
  - Growth and its attendant investment versus profitability

- All but the oil and petroleum industries are predicted to grow at a comfortable rate through the forecast period, and personnel growth is projected to grow at a slower rate than revenues.
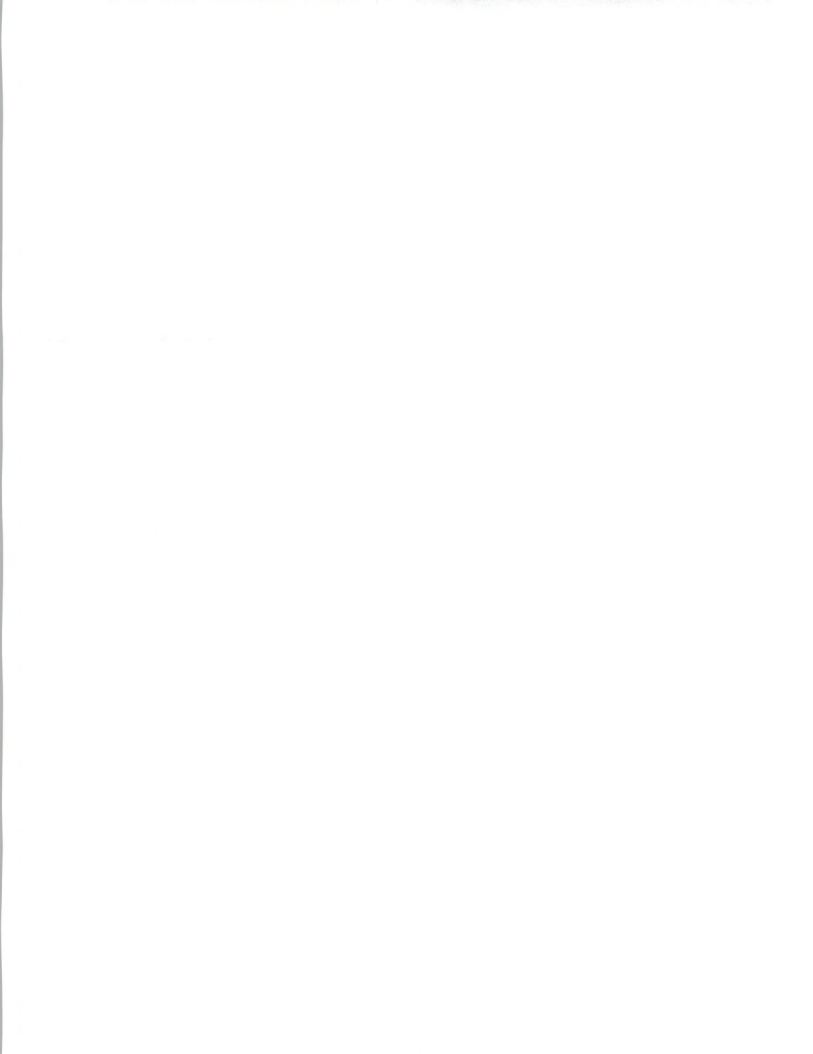
- Profitability has returned for most, but there is still some uncertainty due to large company problems and restructuring costs.

- Inflation has definitely slowed and interest rates remain low, but taxes are being increased.

- The regulatory environment will remain as a major concern in most process industries. Self-regulation is running rampant in the mode of ISO 9000 requirements in the European Community and Baldrige Award competition in the U.S.

- The proven new business practices in TQM and CIM offer some of the greatest challenges to the companies in the marketplace. The two elements necessary to achieve continuous improvement, tools and training, are available, but are they understood and will businesses invest fast enough to reap the benefits?

- The recognized need is for immediate, accurate, integrated information availability. Networks, distributed computing, open systems, and relational data bases offer those qualities on a reasonable return-on-investment basis. Knowledge must be acquired and applied to take advantage of new technologies.

- Can and will the vendors use the best technology to achieve an "open systems" status?

- The concept of downsizing makes sense. The payback is significant and/or fast enough to justify doing it.

2. Organization

In addition to this introductory chapter, the report contains analyses of the information services market and competitive environment as described below:

- Chapter II, *Trends, Events, and Issues*, discusses changes, market issues and activities, and competitive factors in the process manufacturing sector that can have an impact on the current and future use of information services.

- Chapter III, *Information Systems Environment*, examines the changes brought about by new technology and business practices.

- Chapter IV, *Information Services Market*, presents an analysis of the expenditures for information services, by delivery mode and submode, for the U.S. process manufacturing market.

- Chapter V, *Vendor Competition*, discusses key industry issues and considers the competitive positioning of major vendors. It also identifies

significant vendors by size and application area and offers profiles of a selection of leading vendors.

• Chapter VI, *Conclusions and Recommendations*, offers suggestions and recommendations for participants in the process manufacturing market.

• Appendix A, which contains the forecast data base, presents a detailed forecast, by information services delivery mode and submode, for the process manufacturing vertical market. A reconciliation to the previous forecast is also provided, together with a list of related reports of possible interest to the reader.

3. Methodology

Much of the data on which this report is based have been gathered during 1992 and early 1993 as part of INPUT's ongoing market analysis program. Trends, market sizes, and growth rates are based upon INPUT research and in-depth interviews with users in the process manufacturing industry and the IS vendors serving the industry. INPUT maintains ongoing relationships with, and a data base of, all users and vendors that it interviews. Interviewees for the research portion of this report were selected from this data base of contacts.

INPUT Library - In addition, extensive use was made of INPUT's corporate library located in Mountain View, California. The resources in this library include on-line periodical data bases, subscriptions to a broad range of computer and general business periodicals, continually updated files on over 3,000 information services vendors, and the most up-to-date U.S. Department of Commerce publications on industry statistics.

Financial Data - It must be noted that vendors may be unwilling to provide detailed revenue breakouts by delivery mode or industry. Also, vendors often use different categories of industries and industry segments or view their services as falling into different delivery modes from those used by INPUT. Thus, INPUT must estimate revenues for these categories on a best-effort basis. For this reason, the delivery mode and individual segment forecasts should be viewed as indicators of general patterns and trends rather than specific, detailed estimates for individual years.

B

General Business Trends

As noted in the Economic Assumptions section of the Department of Commerce's 1993 U.S. Industrial Outlook, U.S. economic growth in 1992 was somewhat less than was forecast in the prior year. The very slow recovery seen at the end of 1991 continued into 1992, with unemployment remaining at undesirable high levels—a condition fueled primarily by

corporate restructuring and defense industry cutbacks. Even though process manufacturing sales were encouragingly high during the latter part of 1992, business expenditures continued to remain low, due to both an ongoing desire to reduce costs and improve profits and uncertainty as to the precise nature of any economic (primarily tax) reforms that would be proposed by the new Clinton administration to support its various programs.

In 1992, the major burden for implementing economic policy fell on the Federal Reserve, a strategy which caused the Fed to steadily reduce the federal funds rate from 8% in June 1990 to 3% in September 1992, forcing a general reduction in all interest rates to the lowest levels in years.

The outlook for 1993 is cautiously optimistic, with many of the uncertainties tied to the new administration's attempts to both reduce the budget deficit and, at the same time, stimulate a still-sluggish economy. At this time, messages remain mixed, with proposed corporate taxes favoring small businesses and those who make capital investments and penalizing larger corporations, especially services firms, through a 2% increase in the top corporate tax rate, from 34% in 1992 to 36% in 1993. Personal income will be reduced by a proposed average increase in income taxes of 3% for middle-income families and 5% for those in the highest income categories. All taxpayers, both business and individual, will also experience higher energy costs due to proposed new energy taxes. Many critics of the administration's proposals fear that the new taxes risk slowing the economy just when it has started to show some healthy growth and there is a general wait-and-see attitude to determine how successfully the proposals survive the conflicting agendas of the congressional process.

INPUT uses the Blue Chip Consensus (economic) report, and various other sources (Federal Reserve, IMF), to identify anticipated economic growth trends and incorporate GDP assumptions in both industry and delivery mode financial forecasts. Economic growth in 1992 had a very slight upward movement, but the 3% growth in GDP anticipated for that year is now forecast for 1993. This modest 3% growth is the logical result of the pressures placed upon the defense industry, tax uncertainties, a weak commercial real estate market, high federal debt, slow growth in the labor force, cautious financial institution lending policies, and the growing economic interdependence of the industrialized nations, causing one country's economic problems to affect all. Balancing these growth inhibitors are the healthy gains in corporate profits noted in 1992 and a pattern of increased consumer spending.

In summary, U.S. economic fundamentals strengthened in 1992, establishing a foundation for the modest but steady 3% growth predicted for 1993.

II

Trends, Events, and Issues

This chapter presents the significant trends, events, and issues affecting process manufacturers in the U.S. The conditions explored include the economy, the competitive picture in the market, and the current business practices of restructuring/re-engineering and implementation of total quality management (TQM) principles.

As companies in the market restructure, they are making greater use of available technology from information services (IS) vendors. Additionally, TQM implementation requires increases in automation, improved workflow, and immediate information movement and availability. The latter part of the chapter discusses recent trends and improvements in information technology offerings. Particular attention is given to the use of advanced technology by process manufacturers as they re-engineer and implement TQM.

A

The Economy

As mentioned in the introduction, available information indicates a modest and prolonged recovery from the recent recession. The markets for process manufacturers are generally very mature and rarely exhibit explosive growth. The products are usually considered commodity-like, where the key to success is to be the low-cost producer. The picture for the future is mixed, but with the exception of the petroleum and related industries subsector, the process manufacturing sector is predicted to return to revenue growth and profitability in 1993. The prospects through the following five years are for growth which will roughly match increases in the global economy. The expected growth in revenues is accompanied by even more modest increases in employment, especially in larger companies. The difference between revenue and employment growth rates forecasts productivity increases that are abnormally high, even for a recovery period.

Many of the leaders in each segment are presently "restructuring". Restructuring, when completed in process manufacturing companies, has typically meant labor force downsizing, increased productivity and realignment of core businesses. Companies like Sara Lee, RJR/Nabisco and Phillip Morris have both bought and sold businesses in realignment activities. Many entities which were purchased in the 1980's buying sprees are now being sold.

Exhibit II-1 shows the 1993 estimates for selected top segments of the process manufacturing sector. The segments are chosen by logical grouping rather than by strict SIC code. For instance, only petroleum refining is displayed in one grouping rather than the entire 29xx code. The intent is to show the size and growth in those areas where there has been significant change and where opportunities lie for the increased use of Information Services.

EXHIBIT II-1

1993 Market Forecast Data—Process Manufacturing Selected Logical Groupings

SIC Code	Description	1993 Shipments ($ Billions)	1992-1993 Growth (Percent)
201x-206x	Food products	204.2	2.1
2911	Petroleum refining	122.9	.4
3011-3089	Rubber/plastic products	85.9	3.6
3312-17	Steel mill products	54.9	2.4
282x	Industrial chemicals, plastics	53.4	3.1
24xx	Lumber and wood products	46.7	2.6
208x	Beverages	44.5	1.2
284x	Soaps, toilet preparations	43.2	2.5

Source: Department of Commerce

The numbers shown substantiate the general feeling among our survey respondents. The economy is on its way to a very modest recovery for the process manufacturing sector.

As domestic companies continue to attempt penetration of foreign markets, they face a mixed global economy. Conditions in Western Europe and former Eastern Bloc countries are bleak for now. Uncertainty reigns for Japan both in terms of its economy and the question of open markets.

The passage of the North American Free Trade Agreement (NAFTA) could be a mixed blessing; new markets will open but lower labor-cost competition will appear. The opening of the European Community could be a real boon to the makers of consumer nondurables.

The effects of the new administration in Washington cannot be determined as yet. INPUT anticipates the following:

- Tremendous defense budget cuts will be made, possibly affecting over 1,000,000 civilian jobs that surround military bases. Although those order reductions by themselves will have little effect on the process manufacturing sector, the effect on the economy has yet to be determined.

- Some type of national health insurance program will be initiated; the thrust is toward businesses paying the bill.

- Taxes will be increased substantially for businesses, particularly large companies.

- Indications are that environmental issues and regulation will receive increased attention.

- Some effort will be made to quicken the pace of economic recovery, which will be healthy if inflation can be held under control.

- Research and development will be rewarded, especially in small companies.

- An investment tax credit for plant and equipment purchases will be implemented, with the exact size and nature presently undetermined.

No actions have occurred yet to give more definition to the changes that might be faced.

B

Competition

Domestic companies appear to be poised to capitalize on emerging competitive opportunities. Forced by the recession and aggressive foreign encroachments into the marketplace, businesses are employing new practices to survive and prosper. The new concepts are referred to by many euphemisms, such as "restructuring," "business re-engineering," "downsizing," "total quality management," and "continuous improvement." Regardless of the terminology and the customized methods used, the principles constitute an approach to doing good business, i.e., delivering excellent products and/or services on a timely basis and at a competi-

tive price, and assuring customer satisfaction. The approach mandates total responsiveness to individual customers and to entire market needs; thus, a truly market-driven business will prosper.

The overriding trend in process manufacturing companies is toward implementing the "new" concepts mentioned above. Although the use of the principles has been proven to be highly beneficial, the actual implementations have been slow. As mentioned previously, many "restructuring" costs are just now being absorbed, indicating a period of time before benefits will be fully recognized. Those companies and/or industries that began the implementation of the new concepts early are now reaping the rewards.

As companies in the process sector began fighting foreign competition with new practices, they found themselves moving into "market leader" positions. Now other companies are joining the march toward "excellence". The process industries have a unique characteristic in regards to size. In other industries new ideas often come from small businesses. Because of the critical mass required for financial success in process manufacturing, environments, most innovation must come from the larger companies, where innovation and change have traditionally been slow.

The new principles of TQM are proven; they are being used and they are being implemented further. For the buyers and sellers of information services this is an extremely important trend. TQM has at its heart the use of automation and totally integrated information which is available immediately. Because of the new concepts, computer-integrated-manufacturing (CIM) has become a reality in many companies. As workers become empowered they are not only allowed to make decisions, they must make decisions. Immediate, complete, and accurate information is required at all levels for decision-making to be effective.

The process industry is well-poised to take advantage of new capabilities in information technology. The needs to measure performance, test for quality, offer quick- response shipments and utililize advanced logistical concepts for product movement have been fulfilled with automated solutions. The special concerns for being the low-cost producer, honoring shelf-life restrictions, and meeting the demands of large marketers like Wal-Mart have forced companies in the market to automate. When the market concerns are added to the absolute requirements for regulatory compliance, then the drive to automation becomes mandatory.

The process industries have built islands of automation and information through necessity. The regulatory agencies (EPA, FDA, OSHA, etc.) have made intricate reporting a requirement for most process companies. That reporting must typically be performed by computerized methods. In addition, the new requirements for doing business in the European Community call for meeting the ISO 9000 guidelines, which will also involve more automation. Baldrige award competition in the US will bring more reporting requirements.

C
Re-Engineering

An Andersen Consulting publication states:

"The need to link people, strategies, technology, and operations—while important in any change initiative—has become particularly evident through the 'business re-engineering' phenomenon that has captured the attention of clients, analysts, and the media.

"Through business re-engineering, organizations do more than improve a function or a technology—they fundamentally rethink the way they do business. Because of its nature, re-engineering can have far-reaching impacts on an entire organization. No company should reinvent its operations or revise its strategies without taking into account how its people are affected or the role technology plays.

"More and more, companies are looking to re-engineer themselves as a dramatic move to strengthen themselves competitively."

Restructuring is occurring on a large scale throughout process manufacturing companies. Although it has many facets, the major elements are listed in Exhibit II-2.

EXHIBIT II-2

Process Manufacturing

Elements of Re-Engineering

- Team assignments to perform complete operations, typically called "focused cells".

- Worker empowerment, moving decisions to the lowest possible level

- Continuous improvement in terms of:

  - Shortening all cycles in the business operations

  - Work towards achieving 100% acceptable quality in all processes and products

  - 100% customer satisfaction

- Responsiveness to total market and individual customer needs.

- Streamlining to perform only in a company's area of expertise.

The use of cellular concepts in manufacturing has brought positive change to the work environment. The old hierarchical structure shown in Exhibit II-3 has given way to the cellular structure shown in Exhibit II-4.

EXHIBIT II-3

Process Manufacturing

Hierarchical Organizational Structure

```
                    ┌──────────────┐    CEO
                    │  Corporate   │    CFO
                    │  Management  │    COO
                    └──────────────┘    VP Engineering, Sales,
                                        Marketing, Human Resources

┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│ Corporate    │    │  Corporate   │    │  Corporate   │
│ sales        │────│  control     │────│  engineering │
│ staff        │    │              │    │  staff       │
└──────────────┘    └──────────────┘    └──────────────┘

┌─────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────┐ ┌────────┐
│Customer │ │ Product sales│ │  Plant staff │ │  Plant   │ │ Plant  │
│service  │─│ staff        │─│  management  │─│engineering│ │control │
└─────────┘ └──────────────┘ └──────────────┘ └──────────┘ └────────┘

                    ┌──────────────┐
                    │     Line     │
                    │  management, │
                    │  all products│
                    └──────────────┘

┌─────────┐ ┌─────────┐ ┌──────────────┐ ┌──────┐ ┌────────┐
│Receive, │ │ Produce │ │Store, inventory│ │ Ship │ │ Report │
│test     │─│         │─│ control      │─│      │ │        │
└─────────┘ └─────────┘ └──────────────┘ └──────┘ └────────┘
```
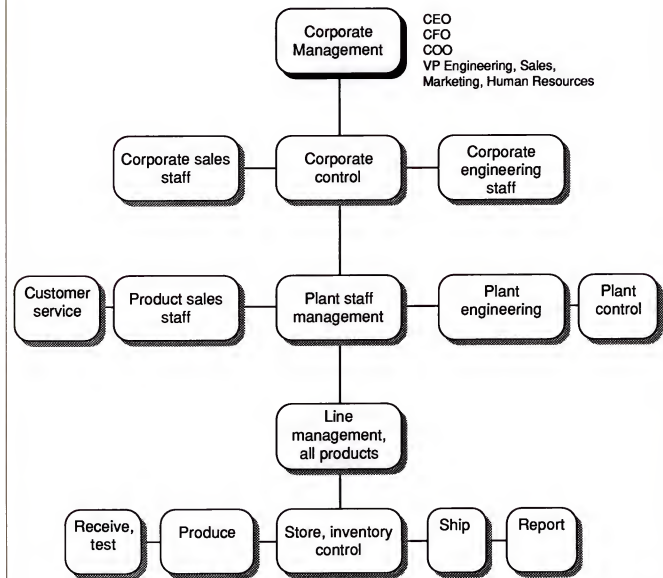
EXHIBIT II-4

Process Manufacturing

Re-Engineered Organizational Structure

All functions are responsible individually and collectively for "customer service" levels of 100%. A customer can be either internal or external.

*CWIC is "cells within a cell", where workload and diversity of assignments may call for further quality control and responsibility.

Each focused cell has total responsibility for the completion of its operation.
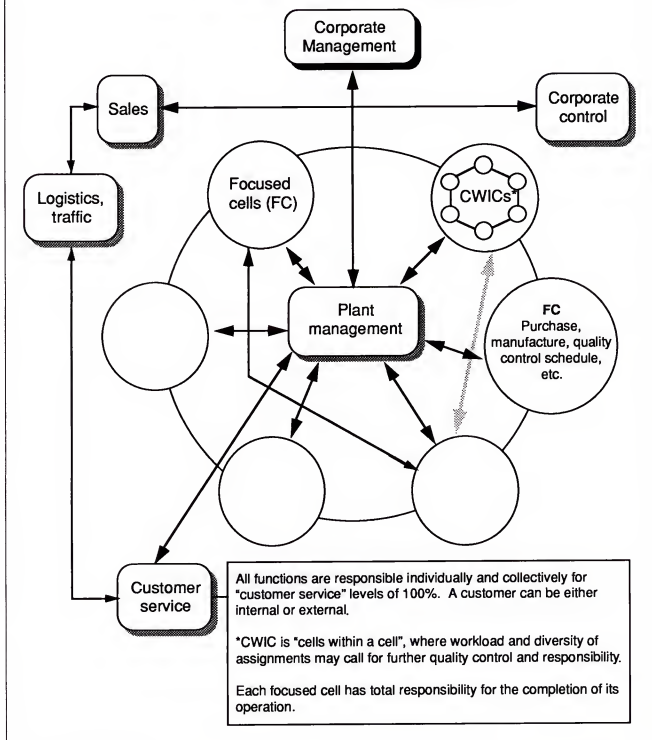
The cellular structure leads to worker empowerment and accountability. With quality and service the key watchwords, the ability to react must lie at the point of opportunity or problem. The cellular approach often has significant results in the process industries. Many products have several intermediate steps prior to completion, and the products from one intermediate step can be used in more than one end product. By moving decision-making power downward, process companies can gain many more control points than in older, hierachical structures.

As worker involvement and the team approach succeed, real benefits to companies are becoming evident in terms of continuous improvement:

• Product life cycles are shortening dramatically, and "time to market" for new products is keeping pace with the change. Most process companies are including plant engineering in the product development cycles to assure earlier delivery of new products.

• Order-receipt-to-shipping cycles have contracted rapidly. Large buyers and marketers are demanding the use of Electronic Data Interchange (EDI) for ordering, acknowledgements and delivery schedules. Line-fill rates and hard delivery dates are commonly a contingent part of purchase orders, particularly in consumer nondurables. Aside from better customer service, these improvements also offer financial benefits in terms of lower inventories and fewer returns.

• Quality improvement reports are often dramatic. Scrap reductions typically are improving from the 3-5% range to less than 0.5%. This is particularly important in the process industries, as raw materials usually cannot be recovered for reuse.

• The cycle reductions and improved quality lead to higher customer satisfaction. Adding the ability to use computers and automation to track production lots gives the manufacturer methods to continue satisfaction through better and quicker service after the sale. Also, many of the process industries are *required* by statute to track and maintain production lots, i.e., foods, beverages, pharmeuticals and chemicals.

The above improvements lead automatically toward satisfying total market and individual customer needs. Automation is aiding in this pursuit through the electronic interchange of data and through advanced network services, giving businesses a quick reaction capability.

As the restructuring has begun, a new phenomenon has occurred. Businesses have been able to streamline (or downsize) and generate a positive effect on overall performance. Operations that don't fit a company's normal practice are often outsourced. Product lines are being sold. Many professional services are being contracted out in lieu of adding in-house personnel. Middle management jobs are being eliminated. There are numerous reasons for all this:

- In the past, heavy taxes (50%) and higher profitability levels made an employee's cost appear to be 50% of actual costs. With lower profits, extremely high benefits costs, and lower tax rates, the picture has changed.

- The acquisition activities of the 1980s left many companies with too diverse a businesses mix, too much duplicated overhead, and heavy debt burdens (often causing losses simply due to interest charges). Streamlining and downsizing became necessary for survival.

- The commodity nature and low margins of most process products now mandate an ability to operate within the lowest possible cost structure. Most process businesses require heavy capital investment to enter a particular market; the key is to protect that investment and deter further market entrants.

A recent study by Deloitte & Touche reveals the importance of re-engineering as a trend in manufacturing. The average number of re-engineering projects being conducted in 1992 was 5.5 per manufacturer. This high concentration is leading to a re-emergence of the importance of computer-integrated-manufacturing (CIM). The original concept of CIM was restricted to making computers talk to one another. Today's information needs to support the re-engineered business call for true "Information-Integrated" Manufacturing and Service. Current technology in networking (local area networks and client/server approaches), operating systems standards, and relational data bases are bringing CIM to reality. Process companies have long used statistical process controls (SPC) to assure consistent quality, and this gives them a head start towards increased automation.

D
Regulatory Issues/Events

Regulatory Issues—Almost all of the segments in process manufacturing are heavily impacted by regulatory requirements. A variety of regulatory issues are involved, as shown in Exhibit II-5.

EXHIBIT II-5

**Process Manufacturing
Regulatory Constraints**

Industry	Regulation
Chemical/Petroleum/Paper	EPA/Green Movement
Food/Beverage	FDA/NLEA 1990
Pharmaceutical	FDA/Electronic Filing
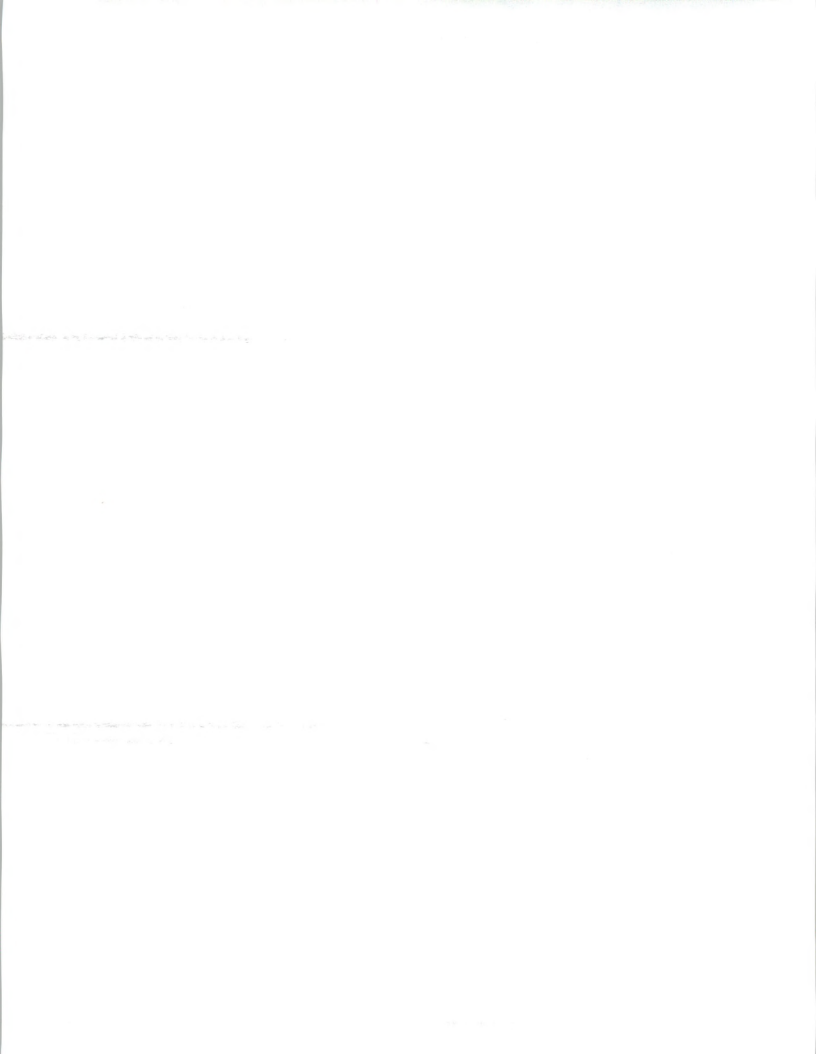
These industries are particularly affected by environmental regulations and the green movement. New regulatory requirements are constantly being introduced and modified. In the chemical industry, regulations support "right to know" requirements that provide information to the public. Material Safety Data Sheets (MSDSs) are required to provide information on every product for hazardous materials tracking. Companies face hefty fines if they are found to be out of compliance, so regulatory issues become a critical part of running these businesses. Much of the regulation relates to process safety measures that describe how to manufacture, how to train staff, and other safety-oriented concerns. Most process companies face constant EPA oversight due to emissions into air and/or water.

For the food industry, different regulatory requirements and agencies are involved. A recent requirement of significant impact to this industry is the Food Labeling Law, introduced by the FDA and referred to as the Nutrition Labeling and Education Act (NLEA). Compliance with this regulation is expected to cost the food industry $250 million to $350 million. There is concern that an overload on the FDA review process will result in a slowdown in getting products reviewed and a consequent delay in getting new products to market.

Many process manufacturers and IS vendors cited ISO 9000 as a key regulatory issue that will impact their ability to compete internationally. ISO 9000 will require companies that want to do business in Europe to obtain vendor certification. This will require detailed documentation of internal business processes. European customers will establish partnering arrangements and do business only with certified vendors.

Clearly, regulation can be a barrier to both global and domestic competition . This applies not only to the restrictions placed on companies by regulations, but also to the documentation required by government entities to provide proof of compliance. Advances in information technology at the PC/workstation level have allowed chemical companies to track waste and maintain Material Saftey Data (MSDS) documentation. Electronic filing to the federal government in the pharmaceutical industry will require companies to provide needed information on-line. The intent of this is to speed the approval process, allowing new drugs to be available for public consumption sooner. In the food industry, labeling software allows companies to rough out ingredients in new products and track changes, thereby reducing the need for chemical analysis. Streamlining the paperwork associated with regulation will allow companies to be more competitive and speed up the process of introducing new products.The levels of performance required to meet expectations will force more and more companies to re-engineer and incorporate more TQM principles, leading to greater use of automation and CIM techniques.

III
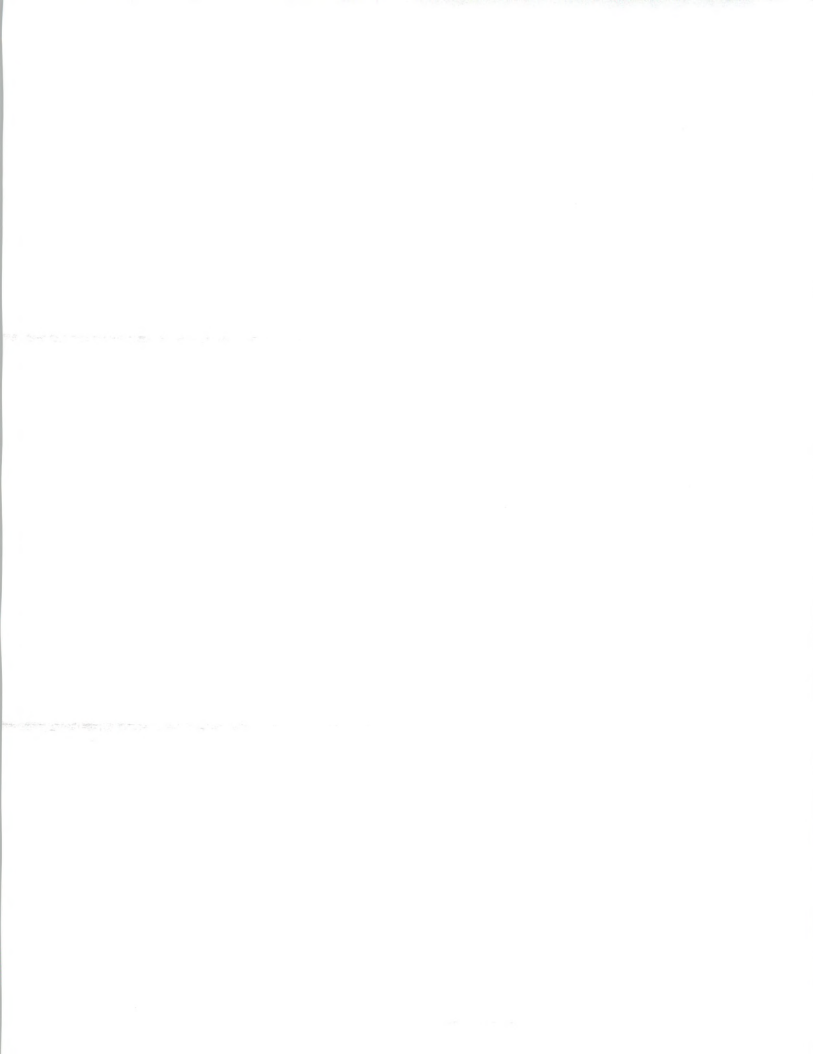
Information Systems Environment

With the emergence of a brighter domestic economic picture and a resurgence in leadership by U.S. manufacturers, immense change is taking place in the use of information systems. As business re-engineering occurs, the role of the information systems department becomes one of facilitation and/or education rather than operations. The "downsizing" or client/server approach to processing, storing, and moving information often causes a transfer of some or all of IS budgets to end-user departments. This trend toward client/server environments is being caused partly by cost reduction programs and partly by a need for information services to match the emerging new business structures. Underscoring this trend, a recent INPUT survey into manufacturing firms shows that more than 50% of all respondents are in the midst of downsizing and/or implementing client/server technology.

A

Client/Server and Downsizing

The move toward a client/server environment matches the business needs for decision-making at the point of problem or opportunity. A constant theme in INPUT survey responses is "downsizing," but over 80% over those who were downsizing were not actually reducing IS budgets. More often than not, the move to a client/server environment causes an *increase* in both computing power and total IS expenditures. This is particularly true in the process manufacturing sector. Process manufacturers have instituted many islands of automation in the last two decades. The need for things like automated process controls, automated conveyor systems and the uses of EDI forced computerization in specific areas of business. Most of the business and planning systems were customized and "home-grown"; application packages were not available. The situation has changed, and process manufacturers can now take advantage of their past automation, combined with new application packages, to implement a client/server environment. Exhibit III-1 offers an example of a downsized environment.

EXHIBIT III-1

Three-tiered Downsized Applications and Functions Model

Superservers

Magnetic & Optical

1. Transaction reservoirs
2. Archival data warehouses
3. Backup for distributed applications
4. Enterprise repository

Downsized Applications   Gateway to and from Outside Work

Magnetic & Optical

DDB Servers

DDB Servers

1. Distributed data base management
2. Network management
3. Integration of business systems
4. Object management
5. Connectivity

Any Topology   Downsized Functions

RISC IWS   Client

PS/2 IWS   Client

Diskless IWS   Client

1. Compute intensive
2. Knowledge-based
3. High-resolution I/O driver

1. Data capture/editing
2. Report preparation
3. Personal data bases
4. Personal productivity
5. Continuous Learning

1. Automated processes
2. Secure processes
3. Data entry and editing
4. Information retrieval

INPUT anticipates increased expenditures for IS to be included in the end-user (client) departmental budgets. Although client/server implementation looks like downsizing to the IS department, it results in a tremendous increase in power to the end user. As Exhibit III-2 shows, survey respondents concur with INPUT's analysis of end-user involvement. Divisional IS and End-User Staff are regarded by the majority of survey respondents as more important than Corporate IS. Packaged Software is now an important element in the plans for change.

EXHIBIT III-2

Process Manufacturing
Source of Development Resources

Source

Divisional IS	142
End-User Staff	112
Corporate IS	78
Packaged Software	64
Other Services	35
Systems Integrators	5

Number of Responses
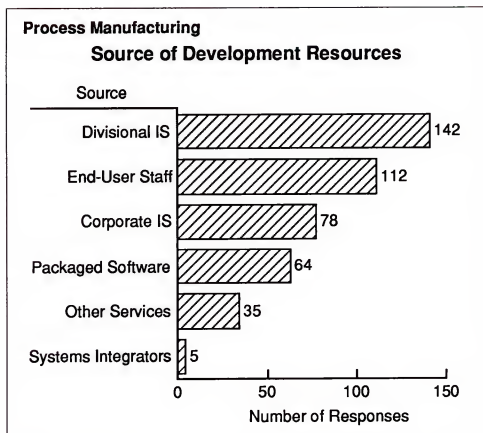
Exhibit III-3 shows the dramatic move towards workstations/PCs in new applications. This relates directly to the responses indicating plans for implementing client/server applications.

EXHIBIT III-3

Process Manufacturing
Planned Platforms for New Applications

Platform

Workstation/PC	103
Mainframe	94
Minicomputer	63

Number of Responses
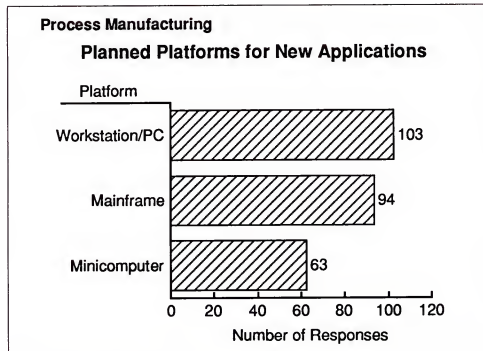
Several advances in technology have added to the ability to move information to the end-user in a manufacturing environment. These include:

- Reduction in computing costs

- Increased local-area network (LAN) power

- The advent of relational data base management systems (RDBMSs), and structured query languages (SQL)

- The adoption of some standard for "open systems;" UNIX is only the beginning

- The availability of sophisticated data collection methods and technologies; bar code technology, programmable logic controllers (PLCs) and electronic data interchange (EDI) are being used extensively in nearly all major companies

- The introduction of CASE tools and fourth-generation programming languages (4GLs)

- The development of standard integration tools for device interconnectivity (cell controllers)

B

Adapting to the Re-Engineered Structure

As Exhibit III-4 shows, the old hierarchical approach to CIM had two major drawbacks. First, each data base was its own island, and often wasn't accessible from other departments. Second, a significant amount of hardware and software integration was required. Adding to those complexities were the high cost of computers and the lack of the LAN power to move data quickly.
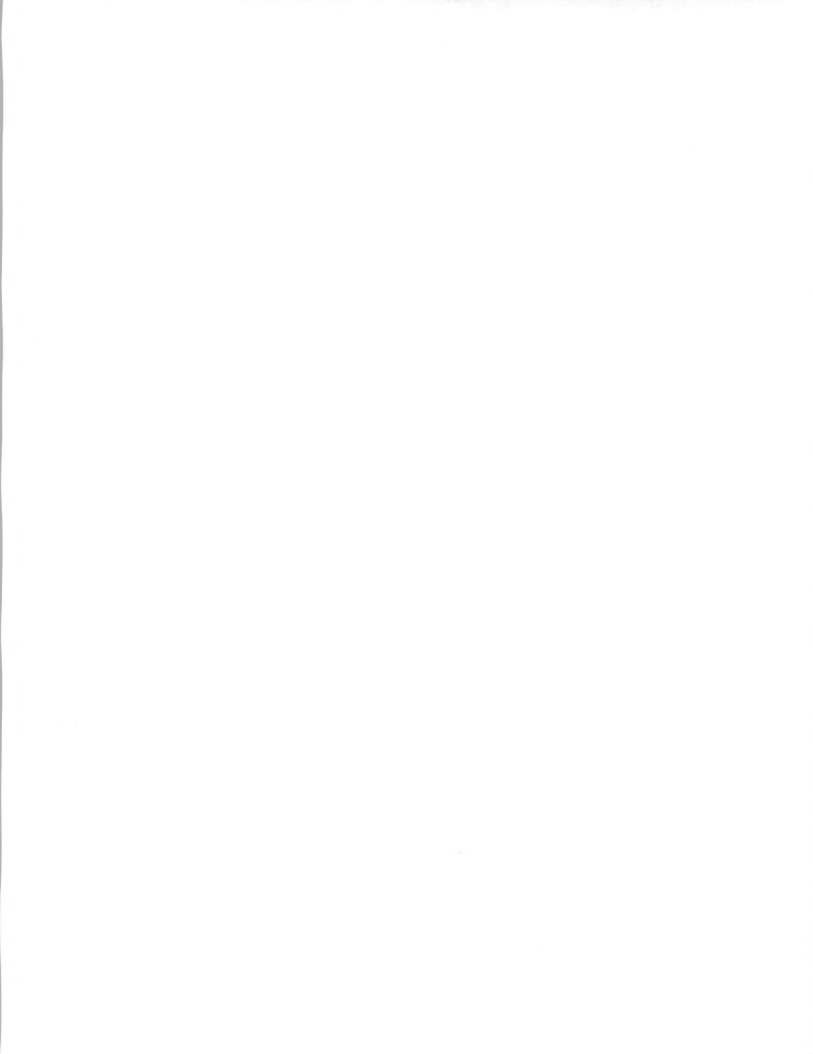
EXHIBIT III-4

Process Manufacturing

Old Manufacturing Control Hierarchy

1 = Software integration	DB = Data base
2 = Hardware integration	WAN = Wide-Area Network
3 = Plant scheduler	LAN = Local-Area Network
4 = Quality monitor	SFC = Shop Floor Control
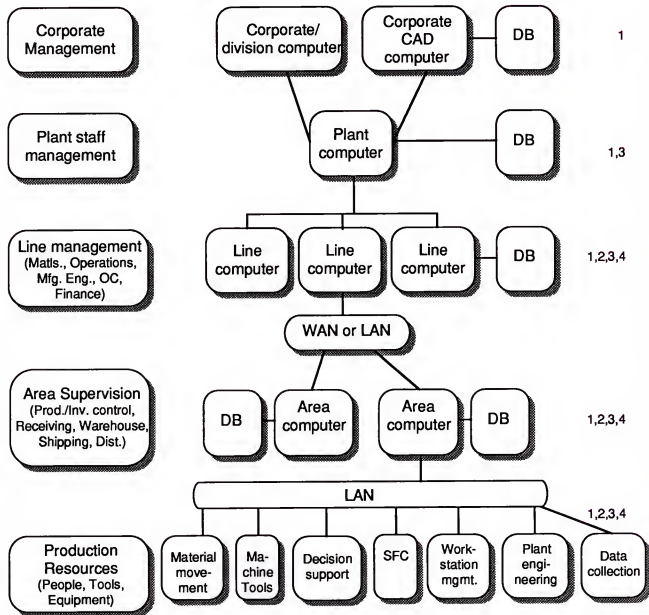
Current concepts being used, as business re-engineering takes place, are much simpler in structure, as shown in Exhibit III-5.

EXHIBIT III-5

Process Manufacturing

CIM in the Re-Engineered Business
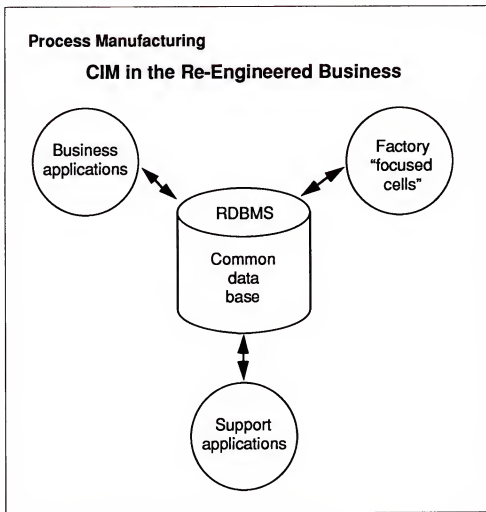
Each focused cell can now access the data it needs and information is shared by all. Exhibit III-6 shows the relationship of new IS structures to the re-engineered business.

EXHIBIT III-6

Focused Cell

FC
Purchase,
manufacture, quality
control schedule, etc
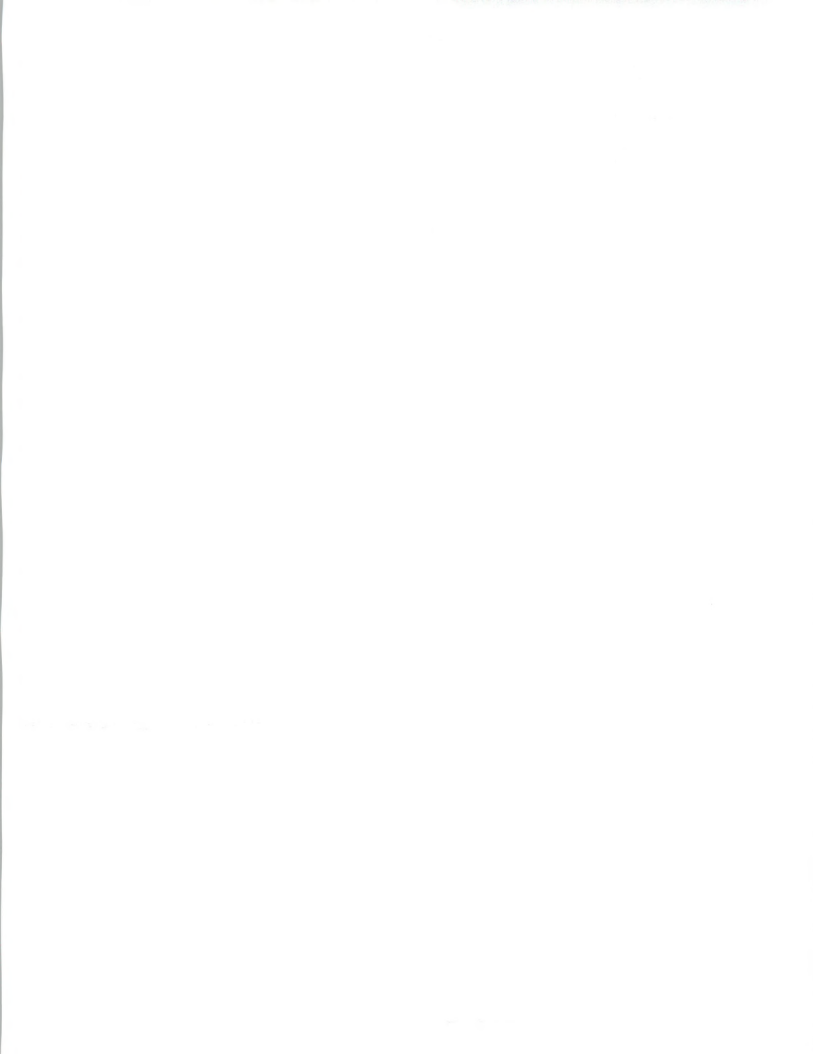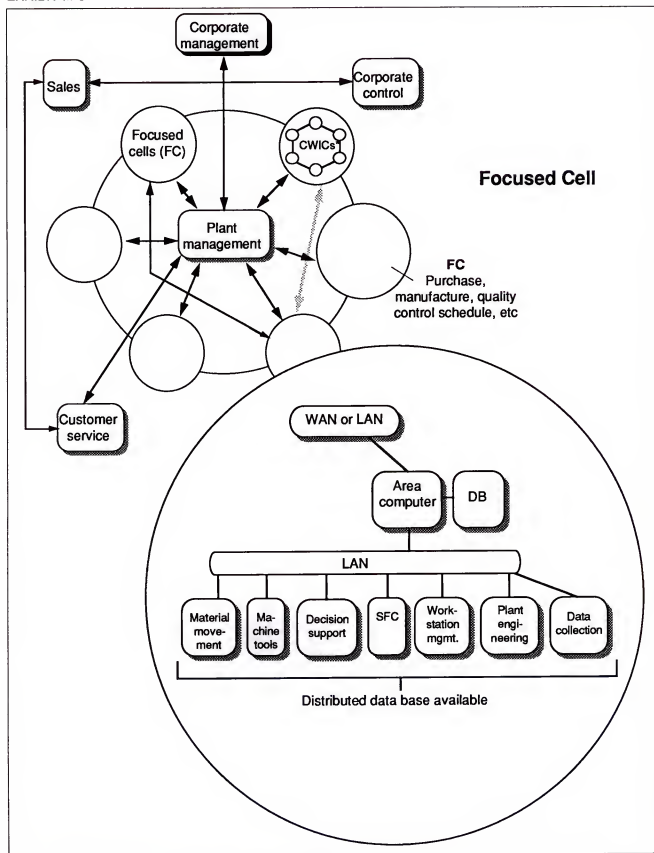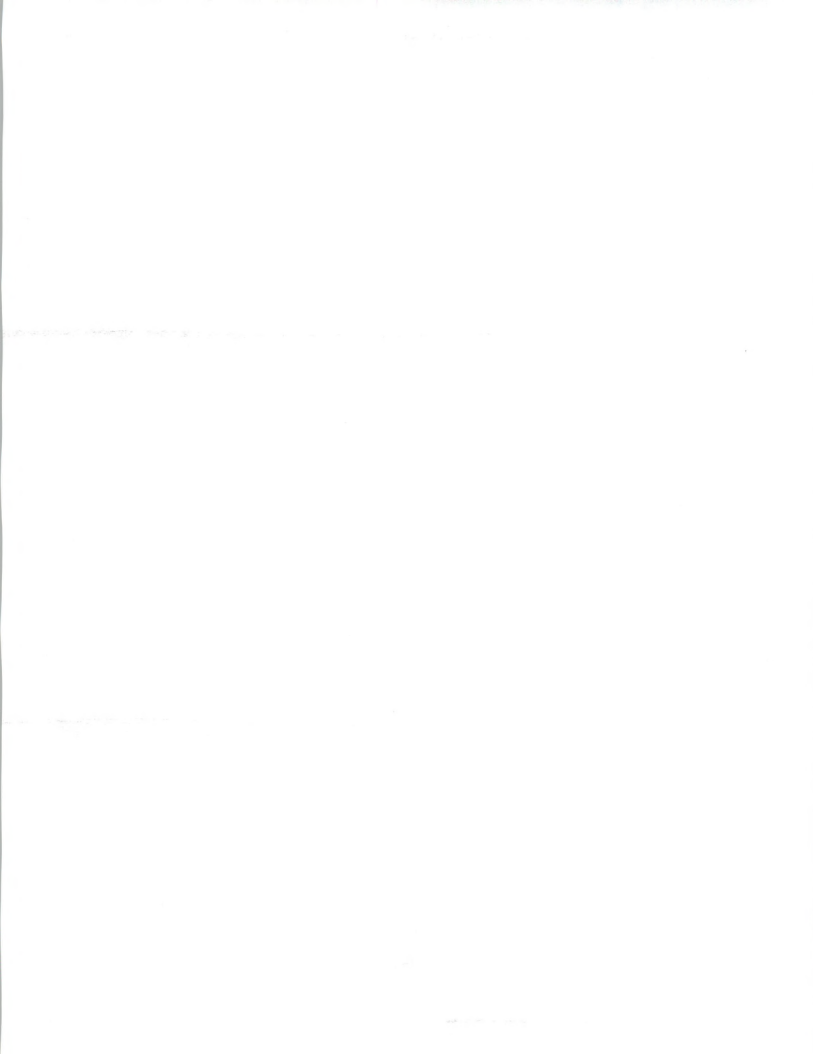
C

CIM and Open Systems

The preceding charts emphasize the critical value of "interconnectivity" and "interoperability" or, as the market now thinks of this conceptually, "open systems." INPUT sees the growing occurence of newly developed, UNIX-based application packages, increased end-user involvement and the moves to client/server environments as signs of the beginning of true open systems.

Little needs to be discussed concerning the lower costs of computers and the increases in their power and speed. The trend is expected to continue indefinitely as the semiconductor industry improves its products.

Local-area network products are improving rapidly. As knowledge is acquired through training and experience, and as new products are offered, INPUT expects WANs and LANs to become transparent to their users.

RDBMSs are aiding the advent of open systems by allowing users to share the same data. As a result, the need for customized integration of software should eventually decline. It will be necessary for the RDBMS vendors to create a "coexistence" environment, because users will implement multiple RDBMS application with software from multiple vendors.

Standards are now being adopted so that open systems can become a reality. The strongest move in that direction has been the acceptance of UNIX as an operating system in the manufacturing environment. The trend began in engineering departments, and as workstations improved and UNIX matured, entire plants have embraced the standard. UNIX, in its many different forms, does not constitute openness. The important point is that UNIX marks the beginning of the development of standards that will bring us to true open systems in the late 1990s.

During the late 1980s and early 1990s important strides were made in data collection and data movement activities:

- Bar code technology improved and has been adopted in nearly all manufacturing environments. A 1988 study of 1,500 manufacturers by Hitchcock Publishing showed the adoption of bar coding to be the number one IS activity at that time. Not one respondent (of over 400) in INPUT's 1993 survey mentioned bar-coding implementation as a new activity. In fact, Laser scanners and hand-held readers were being used in over 50 plants visited in 1992.

- Programmable logic controllers (PLCs) have improved and are being used in new ways. PLCs are now being delivered with embedded computers that contribute to total quality management performance. For instance, in addition to loading programs and controlling machinery, the

PLCs now transmit and receive information from shared RDBMS. They are also being used as data collection devices for immediate information availability and are the primary source for statistical process control (SPC) for quality.

• Electronic document interchange (EDI), begun in the early 1980s by the automotive industry, has become a necessary component of the manufacturing systems environment. This is especially true in process manufacturing, where orders and shipments can contain many items, many delivery dates and many delivery points. EDI capabilities are moving far beyond the initial stage of simple order transmission. IS departments are now working on complete information exchange, including orders, acknowledgments, shipment acknowledgment, invoicing, and even production schedules. Although most companies have some EDI in place, INPUT expects the steady pace of new developments to continue.

Fourth-generation languages are helpful in moving toward open systems, but they seem to be an interim step. All of the vendors of application software interviewed for this report agreed that object-oriented programming (OOP) is the wave of the future in working towards open systems. Surprisingly, only one company had attempted to redesign and develop its product in an OOP environment, and that product had not yet been delivered. *All* of the vendors are redesigning or developing for one or more products, and OOP principles are not being strongly embraced, so INPUT assumes that the general availability of OOP products in this market is at least five years away. None of the IS users surveyed reported current OOP activities. If the assumption holds true that OOP is required for truly open systems, then the late 1990s appears to be the time for change from current 4GLs to OOP-based systems.

An important development in manufacturing is the appearance of "cell controllers" and "application enablers." As TQM principles are implemented, statistical process control (SPC) becomes a necessity. The numerous devices and computers present (most machines are now delivered with embedded computers) must be connected in order to share data. Until the late 1980s, the integration of those devices was done on a customized basis. Several companies have now developed standard device "drivers" or "servers" that recognize disparate protocols and enable equipment and software to "interoperate." For example, bar code readers, CNC machines, PLCs, and computers can converse in what appears to be a common language, without custom integration efforts. A cell controller might appear as shown in Exhibit III-7.

EXHIBIT III-7

Cell Controllers

Data base

CASE Tools

Graphs

Statistical process control

Applications software server

Human interface server

Displays

MSG.

MSG.

Communi-cation network servers

Device servers

Future servers

CAD Views

Network

PLCs

Robots

Bar code reader

New Device

?
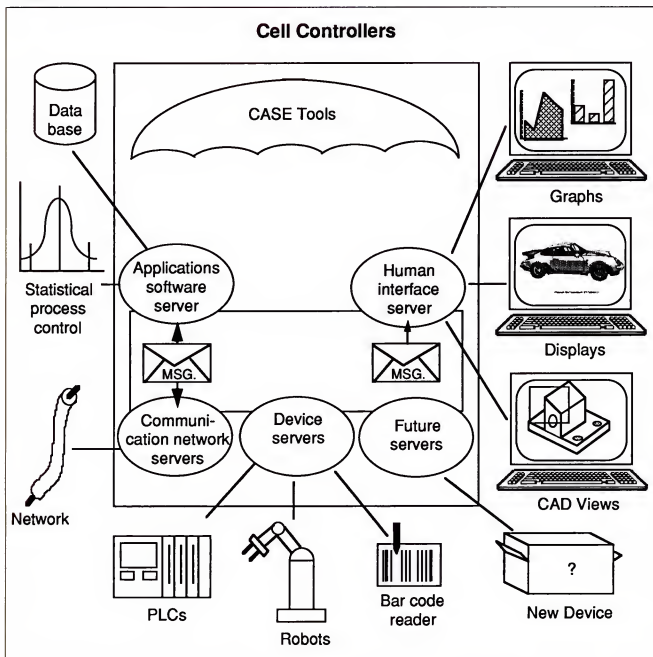
Exhibits III-8 through III-11 show where opportunities for specific exper-
tise should appear in the 1990s. The areas are divided into those func-
tional categories which are derived from re-engineered structures. The
process manufacturing companies, due to many past automation efforts,
should offer excellent opportunities to vendors of "niche" products,
particularly where openness and ease of integration are present. It seems
likely that many mainframe applications, like financials, will stay in place
while daily operational systems change. The new systems must easily
integrate with the old.

EXHIBIT III-8

Application Use by Process Manufacturers
Strategic and Planning

- Lead tracking
- Enterprise resource planning
  - Forecasting
  - Material requirements
  - Capacity requirements
  - Labor/machine requirements
  - Production

EXHIBIT III-9

Application Use by Process Manufacturers
Tactical and Execution

- Sales
- Order entry/configuration
- Scheduling/rescheduling
- Process and product quality assurance
- Purchasing
- Receiving and inspection
- Labor/machine tracking
- Maintenance prevention/emergency
- Shipping
- Inventory control
- Logistics/distribution
- Customer follow-up
- Reporting/communications

EXHIBIT III-10

Application Use by Process Manufacturers
Control and Accounting

- Accounts payable
- Accounts receivable
- Payroll
- General ledger
- Regulatory compliance
- Costing

EXHIBIT III-11

Application Use by Process Manufacturers
Support

- Customer service
  - Serial and lot control by site
  - Call handling
  - Follow-up
- Engineering
  - Flow design
  - Process quality
  - Manufacturing oversight
  - Quality assurance
- Human resources

The number one area for application development is improved customer service. Since this is the major issue for TQM, "customer support" and "customer responsiveness" systems are being developed quickly. There are six segments to these applications:

- Taking orders and commiting delivery dates (typically through EDI)

- Maintaining specific customer data in relation to business practices (not just name, address, price)

- Sharing data with production so that customer needs and requests are accurately communicated

- Tracking lot numbers throughout the production process, including all intermediate steps, and maintaining that data through the life of the product

- Call handling and follow-up

- Especially in process manufacturing, handling the logistics of distribution to multiple delivery points with a consideration for "shelf-life"

There are other elements to the concerns for responsiveness that are facing nearly all process manufacturers. With companies pushing to keep inventories at a minimum, a common desire is to wait until the last minute to configure a large order. The service levels required by large customers are causing process manufacturers to employ sophisticated forecasting packages, shorter-run production lots (production costs can go up), and logistics and traffic management systems in attempts to satisfy those customer requirements.

A surprising number of companies anticipate a complete change in their Manufacturing Resource Planning (MRP) II packages. Nearly all this change is related to the implementation of client/server architecture, and is often referred to as downsizing. The costs associated with old mainframe systems can be restrictive, especially in the areas of maintenance. Mainframe-based vendor software maintenance charges, for instance, can be as high as $100,000 annually, but newer MRP II systems are much less expensive. Maintenance is charged as a percent of sales price, so less expensive systems have lower recurring charges. The typical client/server MRP II system is sold by "seat" (number of concurrent users), and it can be relatively inexpensive to start up a new system and then add seats as the implementation matures.

Many process manufacturers are still in the home-grown, legacy systems mode. Because many of these companies are very large, with numerous plants, distribution centers and delivery points, those legacy systems will remain in place for some time. The systems are usually highly customized, so it will be difficult for packaged software vendors to meet all the perceived needs. Effective process software products are coming to the market which can cover most of the needs, but high levels of customization are still required. That picture should change rapidly with the advent of open systems.

Exhibit III-12 summarizes the reasons given for changing systems, as identifed in INPUT's 1993 report, *The Effect of Downsizing on Software Products Vendors.*

EXHIBIT III-12

Reasons for Change

Improved Data Access for Decision Support

More Flexible Application Implementation

Reduced Hardware Costs

Increased Overall Corporate Productivity

Improved Corporate Response Time & New Product Development

Reduced Software Maintenance Costs

Reduced Software Licensing Costs

0   20   40   60   80   100
Percent of Vendor Respondents

5 = High value, 1 = Low value   Key*: ▨ ▧ ▨ ☐ ☰
                                         5   4   3   2   1

*Shading indicates the rating assigned by respondents. The size of the shaded area shows the percentage of respondents who rated each benefit.

The process manufacturing market offers some distinct challenges to the vendors of information services. Companies will demand specific expertise in their particular area of business. Some of the areas which must be understood and can vary from company-to-company are discussed below:

- Intermediate steps in production - Sometimes the same raw material can be used in more than one product in subsequent steps. Sometimes a complete stoppage is required while an intermediate product "cures". The product may change unit of measure at the end of a particular step.

- Byproducts and coproducts - Many process companies create more than one end product at a time. In one step a product which is considered an end product may appear, while additional processes may turn it into another product.
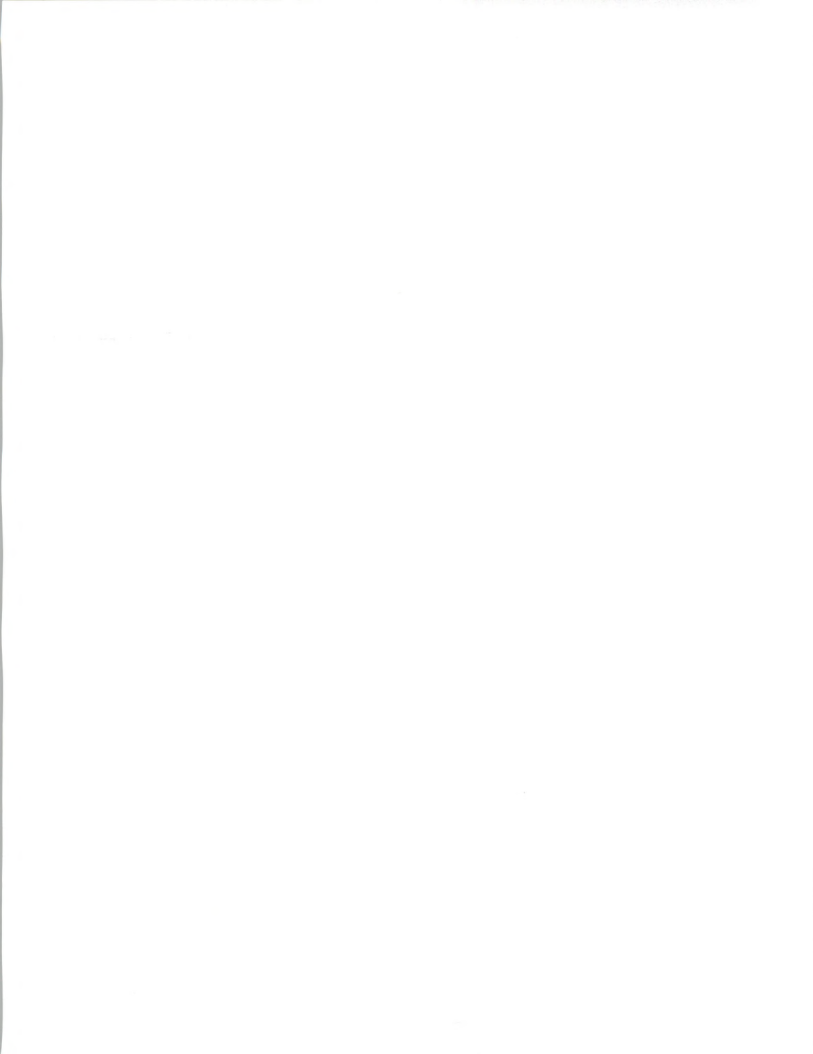
- Unit-of-measure conversions. It would not be uncommon to require conversions from gallons to pounds to ounces to eaches to dozens to cases for process products.

- A recipe is used for production instead of a bill of material. Although the two are similar, a recipe must carry special instructions for production.

- Lot traceability is an absolute must.

- Regulatory compliance reporting is mandatory.

- Logistics and traffic management are becoming crucial activities.

- Work instructions must be constantly available to assist in the new TQM efforts.

(Blank)

IV
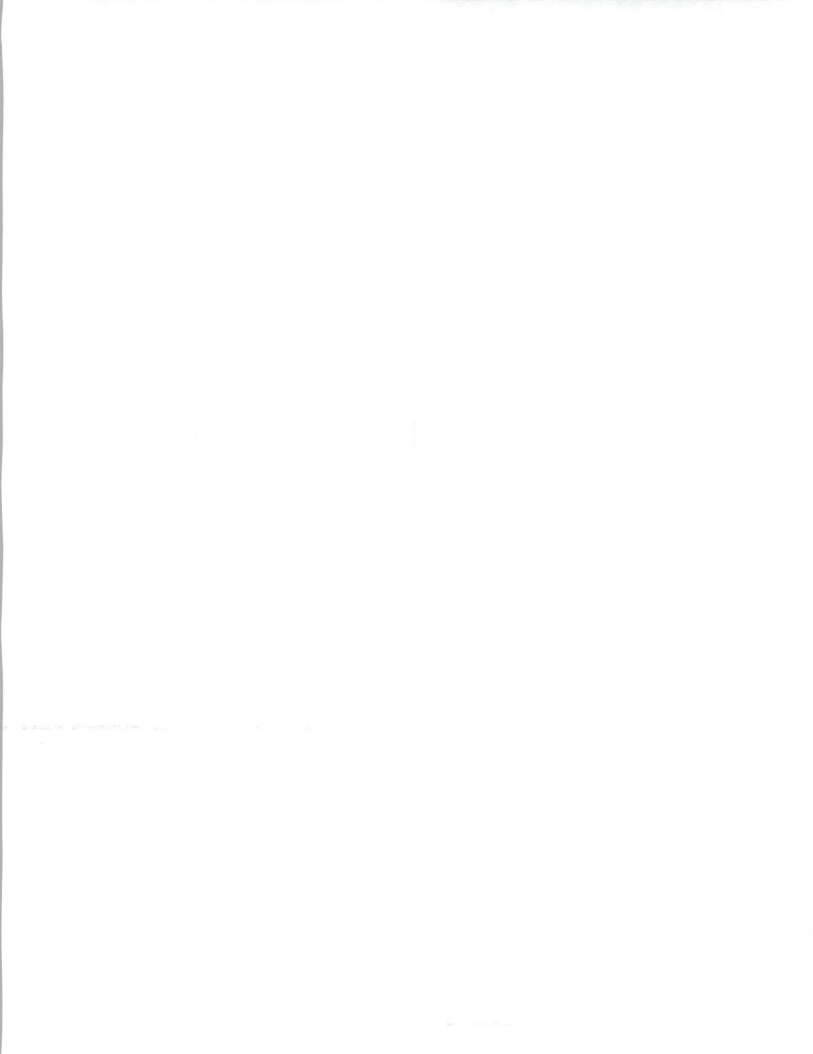
Information Services Market

A
Overview

The market for information services in the process manufacturing sector is expected to achieve healthy growth through 1998. The analysis in this chapter is presented in terms of services offerings by seven delivery modes. They are:

- Professional services
- Systems integration
- Systems operations
- Processing services
- Network/electronic information systems
- Application software products
- Turnkey systems

As shown in Exhibit IV-1, the total market for these services is forecast at $7 billion in 1993 (13% growth over 1992), expanding to $13.4 billion in 1998, at a compounded annual growth rate (CAGR) of 14%.

There are many reasons for the projected growth of expenditures in the process sector. INPUT's 1993 surveys show that 50% of users responding were in the mode of "downsizing and/or implementing client-server technology." While this indicates a bleak future for mainframe products and services, it does assure a form of new expenditures in the market. 70% of the respondents were actually migrating the mainframe applications, so downsizing describes a movement of budget dollars rather than elimination of those expenditures. Thirty-two percent of respondents who are expecting some change in systems in 1993 also expected the end-user staff to contribute development resource to the change. In some cases the mainframe will be used for cross-functional applications, such as financials, and perform double duty as a "super-server" in the client/server environment.

EXHIBIT IV-1

**Process Manufacturing Sector
Information Services Market, 1993-1998**
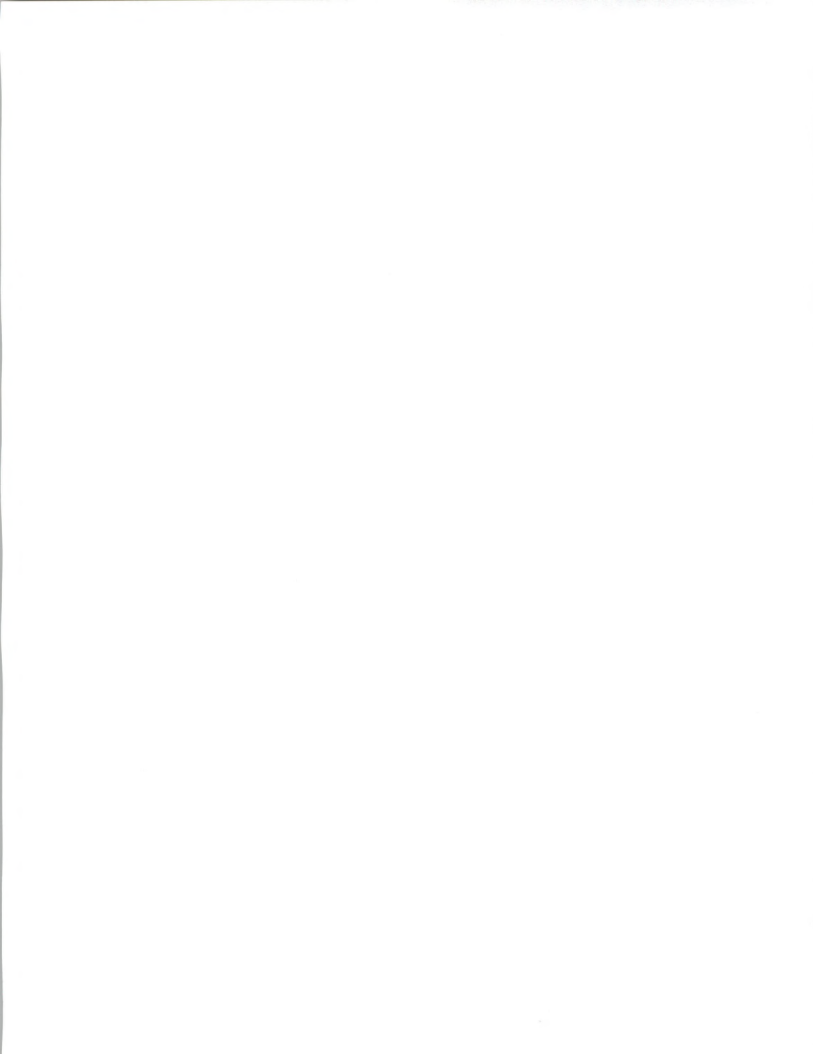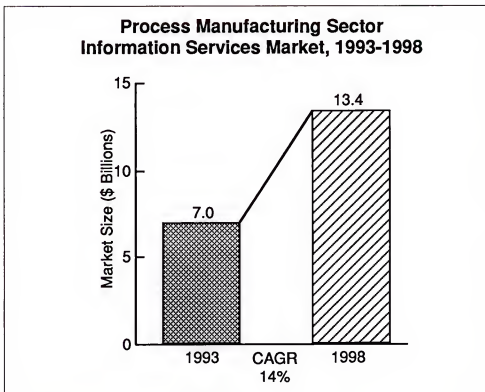
In the latter part of the forecast period INPUT expects expanded IS growth rates. As changes to company infrastructures occur (17% of respondents report current change), the IS function will be playing catch-up. In the next iteration of change, object-oriented programming (OOP) will become the standard environment. Knowledge and experience to use and implement OOP is slowly appearing, and should cause major redevelopment activities and systems changes within the next five years. The long-term advantages of OOP, primarily lower maintenance costs and easier systems changes for open/integrated environments, will far outweigh the costs of implementation.

1. Driving Forces

The re-engineering of business processes is the major force behind change and growth in the information services market. As restructuring occurs, it drives the IS function within a company to respond with new techniques for providing immediate and accurate decision-making information. As traditional hierarchies are flattened and the focused-cell teams become cross-functionally self-sufficient, many support functions are being dispersed into line roles. The move to client/server environments aligns with this new structure.

New competition among the vendors is aiding growth in information services market. All participants are developing systems or offering products/services in an embryonic open systems mode. In each category of delivery mode there are several vendors with strong capabilities and no
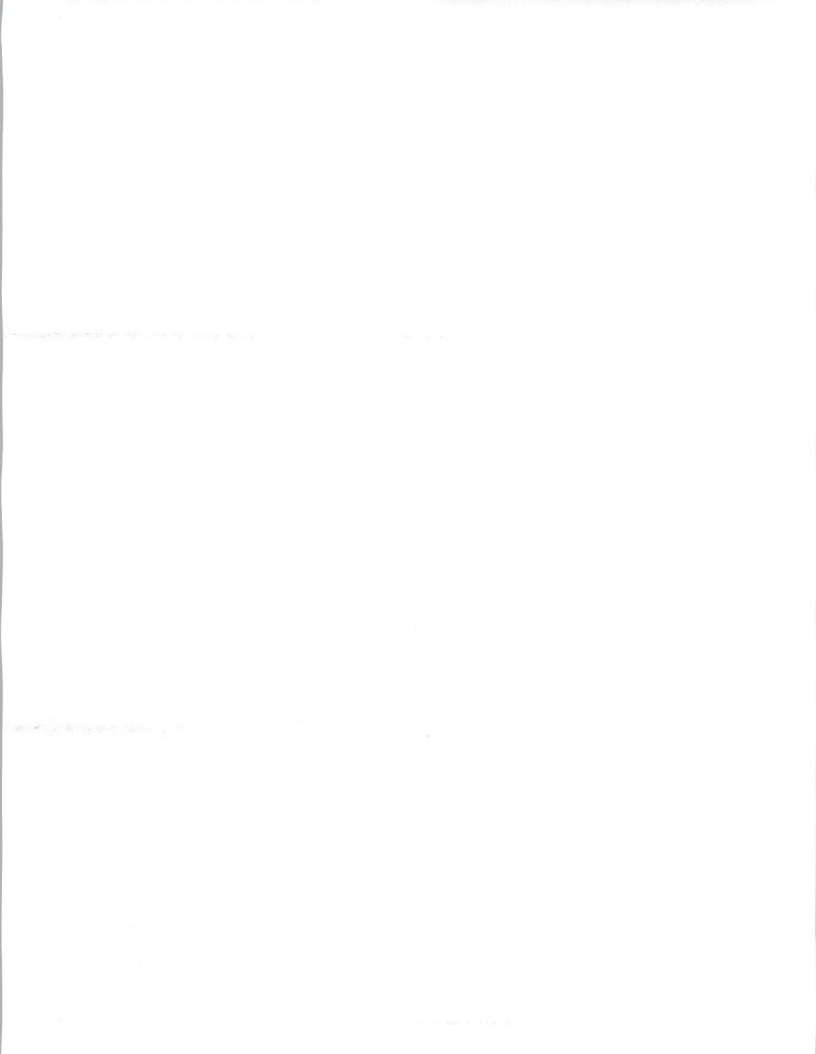
one vendor that has gained dominance. The process manufacturing market has traditionally been a home-grown, legacy system environment. The variances between custom requirements for each subsector, large company attitudes toward doing it better "in-house", and concerns for solving individual high pressure problems quickly (such as statistical process control and government reporting) have left process companies with designed islands of automation.

User knowledge is an important aspect of information services market growth. Computers and systems solutions are necessary components of the re-engineered business and total quality management programs. Participants are being trained continuously in new methods of using solutions and are looking to the vendors for specific expertise in market niches and methodologies.

The re-engineering activities taking place offer excellent opportunities to the vendors of information services. New systems will be needed. Training in new techniques will be necessary. Integration assistance will be mandatory to match some of the old customized systems. Redesign of legacy systems may be necessary in many instances to take advantage of current technology capabilities. The process industry has not taken advantage of packaged software to the same extent that other sectors have. In 1992 only 14% of the INPUT survey respondents reported using packaged software solutions. Vendors have recognized this phenomenon, and are developing specific solution software for the process sector. Marcam, Ross, Andersen, and Datalogix have all developed systems directed solely at this industry sector. ASK and SSA have developed "off-shoot" hybrid systems to meet many process requirements. It remains for the buyers of systems in the process industries to become proficient in the purchase of solutions before all those efforts will be rewarded.

2. Growth Inhibitors

Although healthy market growth is predicted in most delivery modes, there could be stronger growth if truly open systems were being deployed. The requirement for customization of products to achieve integration slows the implementation of systems solutions and the recognition of benefits. While the vendors of professional services and systems integration will benefit from the required customizations, total market expansion would occur more rapidly if expenditures were being placed for products rather than services. The allocation of dollars by category should change over the forecast period toward more product sales as open systems become available.

Training of personnel to use systems in the re-engineered business is taking longer than expected. Vendors of products, pressured by price competition, are not conducting in-depth training programs for their personnel. The expertise required to buy, sell, implement, and use systems solutions is often not present. Many decisions are required by users and they are usually committee decisions. With the combination of

untrained buyers, untrained sellers, and untrained implementors, decisions are usually delayed beyond reasonable time periods while committees perform evaluations. Third-party consultants are often hired to assist in the evaluations, adding another element to be satisfied in the decision process. As training advances and open systems appear, the decision process should compress, but for the next three years users and vendors will continue to face long decision cycles and difficult implementations. An added concern in the process sector is the difficulty in evaluating new products and vendors.

Exhibit IV-2 shows which applications large companies are expecting to change within the next two years. It also defines the plans for resource use among architectures, and platforms.

EXHIBIT IV-2

Process Manufacturing

Cross-tabulation of Characteristics
by Application Class

Application Class	Strategy		Platform		
	C/S - Downsizing	Downsizing	Client/Server	Minicomputer	Mainframe
	Number of Applications				
Financial	81	32	28	21	29	18
Mfg. Operations	76	34	29	26	15	29
Sales/Marketing	41	23	16	21	4	13
Infrastructure	28	16	5	15	4	7
Inventory	26	9	8	7	5	13
Purchasing	13	6	3	4	5	3
Engineering	9	2	1	2	0	4
Data base	8	2	1	2	1	5
Logistics	5	4	2	3	0	2
Personnel	2	2	2	2	0	0
Total	289	130	95	103	63	94
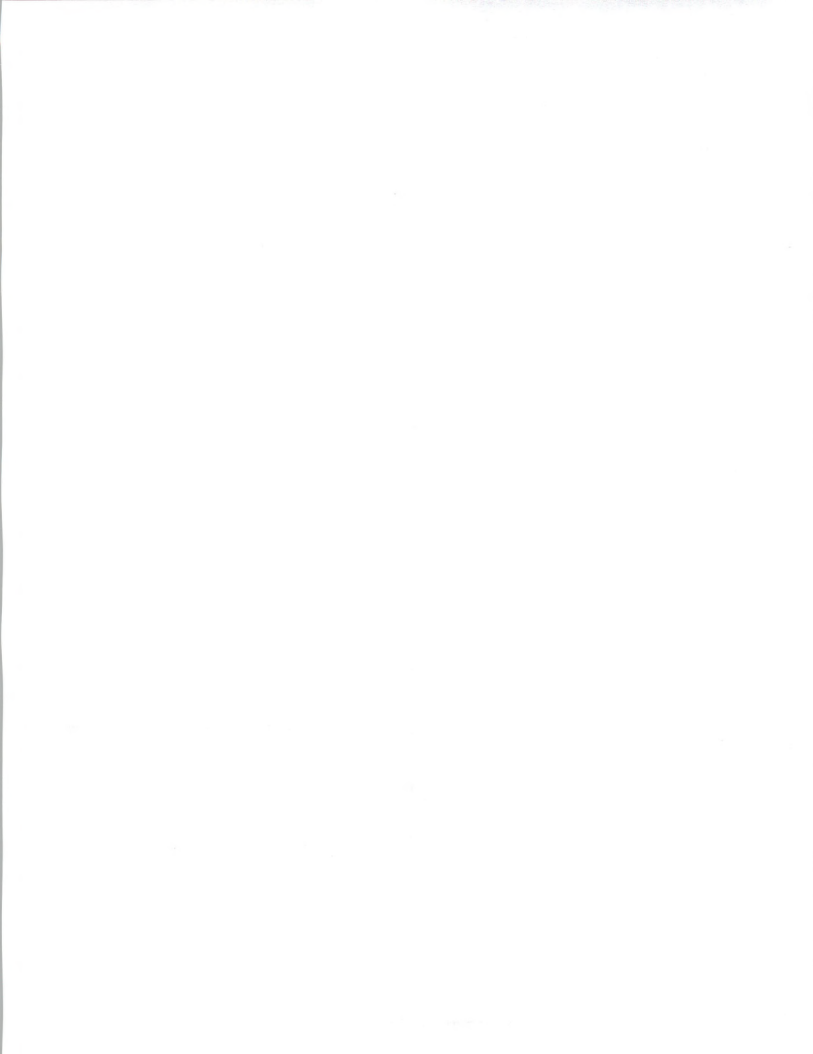
B
Delivery Mode Analysis

Exhibit IV-3 displays market size and growth rates by delivery mode.

EXHIBIT IV-3
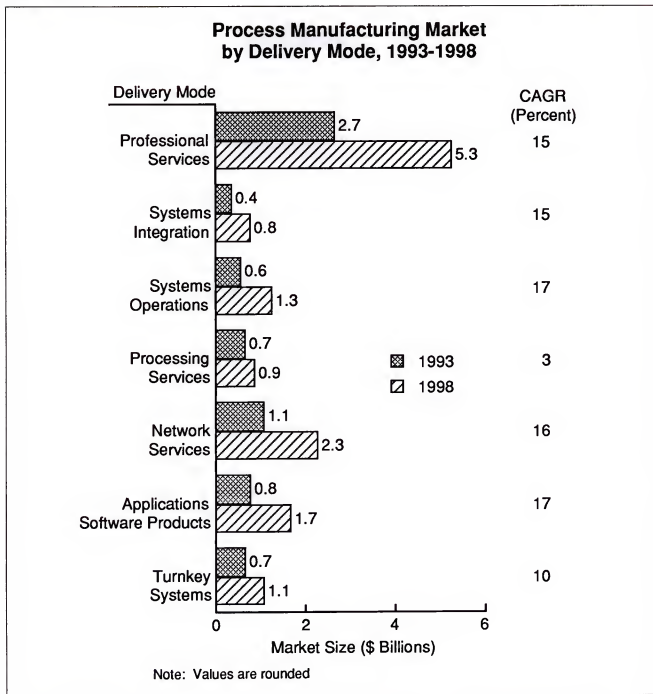
**Process Manufacturing Market
by Delivery Mode, 1993-1998**

Delivery Mode	1993	1998	CAGR (Percent)
Professional Services	2.7	5.3	15
Systems Integration	0.4	0.8	15
Systems Operations	0.6	1.3	17
Processing Services	0.7	0.9	3
Network Services	1.1	2.3	16
Applications Software Products	0.8	1.7	17
Turnkey Systems	0.7	1.1	10

Market Size ($ Billions)

Note: Values are rounded

1. Professional Services

The largest category of expenditures for information systems is professional services. At $2.3 billion, and growing at 15% throughout the forecast period to $5.3 billion, it represents a substantial market by itself. This service mode is comprised of three components.

a. Consulting

Consulting services are offered in numerous ways. There are large firms, like Andersen, IBM, and CSC, that offer complete services for business re-engineering. There are firms, like the "Big-Five," (excluding Andersen) that offer specific services for the purchase and implementation of solutions. There are many smaller companies and individuals offering expertise in niche areas and/or geographic locales. This is a growing sub-market with no clear leader. INPUT sees growth continuing at 15% through 1998. As specific expertise is required in particular areas, companies will contract for services rather than hire permanent personnel. The need for speed and the recognition that the benefits of early implementations far outweigh consulting costs is giving added growth to consulting services.

b. Education and Training

With the complexities of re-engineering, client/server implementations, and total integration comes the need for education and training. Those who consult, especially the larger firms, also conduct training. One service often begets the other. As we move toward open systems and object-oriented programming, INPUT forecasts continued 6% growth in education and training services, from $360 million in 1993 to $480 million in 1998.

c. Custom Software

The importance of custom software will remain an important factor in the process sector through the forecast period. Until truly open systems are introduced, there will be an attempt by many companies to protect their investments in legacy, customized systems; they will do this by creating more customized systems. With the advent of CASE tools, 4GLs, and refined functionality from vendor products, budget dollars should move toward purchases of products rather than custom development, but that is not the case yet. This largest of the professional services offerings was $1.4 billion in 1992, and will grow at a 16% CAGR through 1998, to $3.4 billlion.

2. Systems Integration

The systems integration market is another fast-growing delivery mode— 15% CAGR through 1998. The importance of systems integration at present can't be overstated. The buildup of islands of automation and information is a deterrent to the success of a re-engineered business.

Systems integrators are enjoying the growth of a market which requires specific knowledge in multiple disciplines, a knowledge which is seldom available in an in-house function. This is extremely important in the process sector as solution software becomes available.

There are large companies addressing the systems integration needs of users—Andersen, CSC, Computer Task Group, EDS, IBM, Coopers & Lybrand, Price Waterhouse, Ernst & Young, Arthur D. Little, etc. While all have the capital to attract personnel to answer cross-discipline needs of users, some vendors fail to train in the sales area. Cost overruns and missed schedules are common because of over commitment during the sales process. The problem is even worse when small, independent integrators are used; they don't have the cross-discipline expertise required to analyze and deliver complete integration.

As standards and tools are developed, the systems integration market should begin a slow decline in growth rate, around the end of the decade. There are already some vendors offering integration tools to address user needs. Fastech's Cellworks, US Data's Factory-Link, Savior's Flexis, and Lotus' @ Factory are examples of products designed primarily to tie equipment together. They use standard "drivers/servers" to bypass differences in protocols. The concept is expanding to application products with tools (called application enablers) from the same vendors. As open systems begin to appear, the length of integration projects will shorten and the requirement for cross-discipline expertise should diminish. When systems are designed with openness in mind and with object-orientation, each discipline can define its own integrated information needs.

This 1993 market of $380 million will reach $850 million by 1998.

3. Systems Operations

Systems operations is divided into platform operations, applications operations, desktop services, and network management. This mode is expected to grow at 17% CAGR through 1998, from $510 million in 1992 to $1.3 billion in 1998. INPUT's view is that client/server implementations and downsizing will create needs that can't be served in-house.

There will be some growth among large manufacturers using facilities management services for total operations. Several contracts in this market can represent annual expenditures of $100 million and up. The unit volume need not be high to create a large market, so competition for each contract will be fierce. This is an opportunity for large vendors, as users would typically not turn over complete operations to a smaller vendor. The lack of past experience among process companies in buying solution software might lead to some lucrative contracts for facilities management; the fear of failure in a difficult implementation could sway decisions.
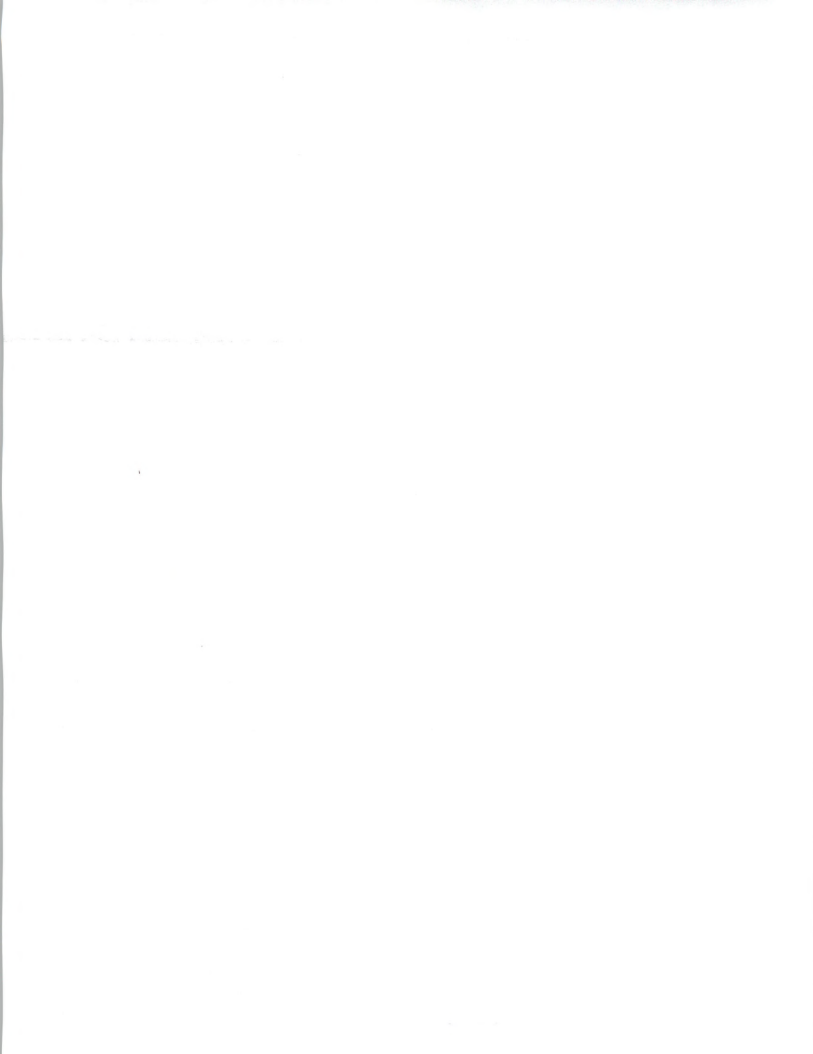
A push to the growth in systems operations will come from two very specialized pieces of the total puzzle, desktop services and network management. Desktop services now include document imaging and publishing.

Network management includes WANs and LANs and is complex, especially when considering the client/server, distributed data base concepts in use. Until products and knowledge are developed to maturity in these two areas, the market for services will continue rapid expansion.

4. Processing Services

Processing services is the slowest-growing delivery mode in the discrete IS market. Some growth should occur just as a byproduct of the momentum of those companies already using an "outsourced" approach. There will be some growth as a result of the move away from mainframes, as certain applications may need some very high-powered transaction and/or data base capacity. As equipment prices drop and parallel processor products mature (like the Carp systems product), pressures will come to bear on this market that vendors may not be able to withstand.

Companies that have offered these services in the past, like Xerox Computer Services and ASK, are no longer pushing for the sale of processing services, but offering turnkey systems instead.

5. Network Services

The second largest of the delivery modes, network services, is made up of electronic information services and network applications. This is a fast-growing category—expecting 16% CAGR through 1998—that will double from $1.1 billion to $2.3 billion by the end of the period. A large contribution will come from the expansion of EDI services/applications mentioned earlier. There will be intra-company needs for large, multi-plant companies that are creating focused plants relying on information from other focused plants. There will be increased vendor/customer communications to manage as users build partnerships and share more information.

6. Applications Software

Applications software will be the fastest-growing delivery mode, at a CAGR of 17% through 1998. Standing at $0.8 billion in 1993, this will be a $1.7 billion category by 1998, still far behind the current delivery mode leader (professional services - $5.3 billion). Applications software is divided into three segments:

a. Mainframes

The predictions of the total demise of the mainframe business are premature. INPUT sees this segment growing at 5% CAGR through 1998. Mainframes will still be used to perform many application functions in multi-plant environments. They will also be used as super servers in the client/server environments and as network directors. Many applications that are planned for removal from mainframes will be necessary until total
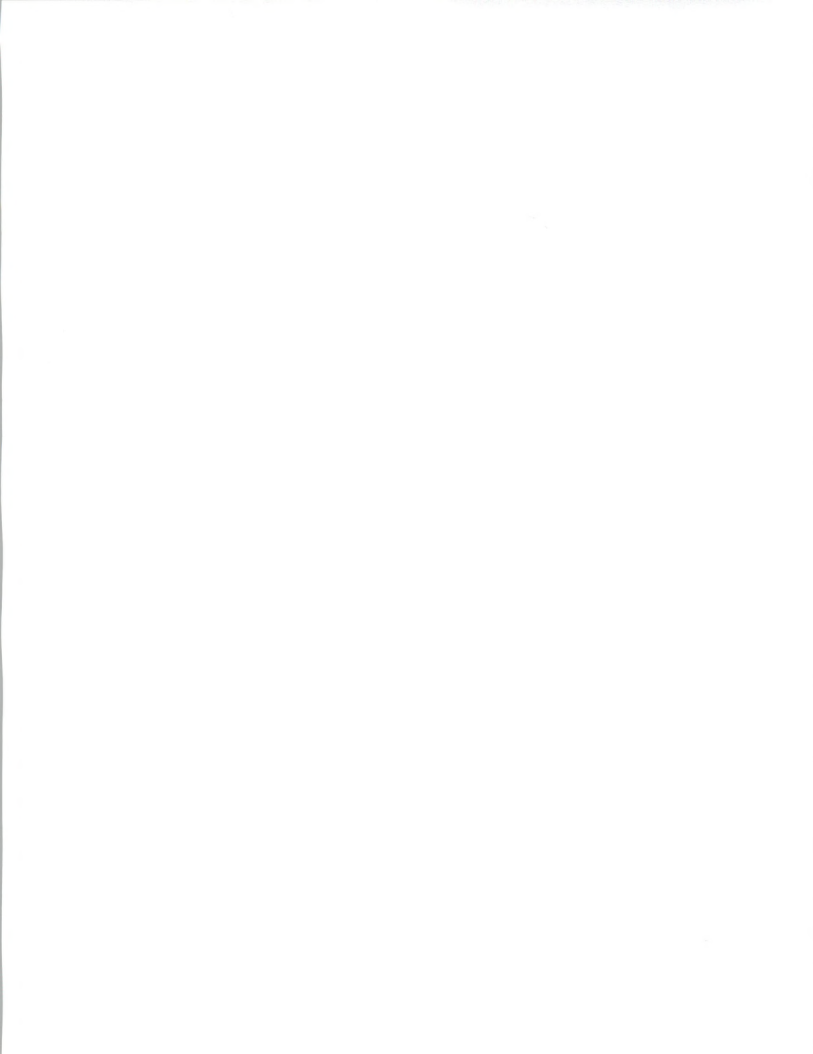
conversions are completed, causing continued payment of software maintenance charges.

b. Minicomputers

Minicomputer applications will continue growth at 12% through 1998. The functionality of these systems has reached a level that gives comfort to buyers. Those who use minicomputer applications are not under the same "downsizing" pressures as mainframe users. Replacing the functionality and cost of minicomputer applications will take time, thus software maintenance revenue streams will continue to be received by the minicomputer application vendors. Additionally, there are some vendors presently delivering systems on IBM AS/400s who expect to continue in that environment.

c. Workstation/PCs

High growth is forecast for workstation/PC applications. At $340 million in 1992, a CAGR of 25% is expected to bring the market to just over $1 billion in 1998.

Exhibit IV-4 gives an interesting view of the planned changes among our survey respondents and their platform of choice for the new systems.

EXHIBIT IV-4

Process Manufacturing
Top Applications in Process Manufacturing

Applications Description	Number Applications	Number C/S*	Percent C/S
Manufacturing Operations	50	22	44
Order Entry/Management	32	18	56
Inventory	25	9	36
Financial Reporting	22	10	45
Manufacturing Planning	19	8	42
Payable/Receivable	19	5	26
Payroll	14	4	29
Purchasing	13	6	46
General Ledger	12	2	17
Desktop Software	9	7	78
Systems Software	9	4	44

*C/S = Client/Server

All major vendors are redeveloping systems for the workstation/PC environment. Nearly all the entries and "up-and-comers" have introduced systems with strong functionality for workstations/PCs. 4GLs, RDBMS, and CASE tools are being used, making implementation, customization, and integration easier. The insistence by users that open systems be considered will continue the push toward workstations/PCs.

The continuing existence of Legacy systems and need for full functionality levels will be the only restrains on this segment. As maturity comes to the applications and the client/server environment becomes a necessity for business re-engineering, those two negatives will pale. At present the software vendors are lagging the market need by at least two years, and catch-up is not expected until 1996, when the next iteration of applications will begin to appear.

A question in this segment is the fragmentation in the market. New entries are expected because entry costs only look low—they aren't. Some of the current major vendors are trying to be all things to all companies, i.e., offering both discrete and process functions, or offering mainframe as well as minicomputer and workstation/PC applications. They are diluting the primary requirement of users that specific manufacturing industry expertise must be present on the vendor staff. With such a large market available, INPUT expects that leadership and dominance will occur in small niches and in very narrow applications areas.

7. Turnkey Systems

Turnkey systems offer an anomaly in the process sector. Although several companies are offering "total solutions", they are also offering compatible products from other vendors at the time of sale. If the product of an alliance partner is used, and outside implementation resources are employed, then the offering is not truly "turnkey". Also, new systems developments by some major vendors, like ASK and SAP, have been much slower getting to market than originally planned. Turnkey systems should continue growth at 10% through 1998, to $1.1 billion, although there are uncertainties in the ability of some new vendors to deliver a quality product.

Turnkey systems represent delivery of a complete system by one vendor. All elements, including hardware, application software, systems software, and professional services are delivered and serviced through implementation by that vendor. This mode will change during the next decade as niche application solutions are developed for an open systems environment. It remains to be seen how vendors will form alliances and/or compete. There is some indication that new entrants with specific solutions will attempt alliances with the current major turnkey vendors. Conversely, there is a move among major users to gain "software solution vendor independence," much like hardware and RDBMS independence. The feeling among those users is that one company cannot offer the total expertise needed to best utilize solutions.

V

Vendor Competition

A
Introduction

This chapter presents a description of information services vendors serving the process manufacturing sector. The chapter is divided into the following sections:

- Competitive Climate
- Competitive Positioning
- Leading Vendor Profiles

INPUT conducts extensive analyses of vendor revenues. In order to present useful and accurate information for the process manufacturing market, U.S. revenues were subtracted from worldwide revenues, and revenue was split between discrete and process manufacturing sectors in instances where an IS vendor served both sectors.

B
Competitive Climate

The competitive climate in process manufacturing is influenced by changes in technology and shifts in strategic focus for information systems. In recent years there have been improvements by vendors of packaged software products developed specifically for the process manufacturing market. As these products are introduced and successfully installed, there will be a shift of dollars from internal budgets to the purchase of "outside" products and services.

The climate for competition offers a cloudy picture. While most of the vendors are moving towards open systems, not all have adopted a clear strategy. Several of the leading vendors are either dedicated to serving markets outside the process manufacturing market, or are presently attempting to expand into other markets. The defined markets for all the

competitors are the Fortune 500, or even narrower. This means that competition will increase rapidly along with a pressure on prices. Many products are relatively new and the developers are struggling to complete refinements.

Most vendors in this vertical market are struggling to issue third-generation products that are multiplatform and use client/server technology. The time needed to develop new products is lengthening and product life cycles are shrinking. Resulting redevelopment and support costs are ballooning, shrinking critical research and development budgets as a percentage of revenue. Also, the UNIX operating system is coming to the forefront in this market, as almost every vendor is rewriting its products to run in a UNIX environment with a 4GL relational data base.

There's a race shaping up as software companies position themselves as offering fully functional open systems products.

The strategic focus for information systems projects is integration. Systems vendors must now offer solutions that tie the whole enterprise together, moving from manufacturing resource planning (MRP) to EnterpriseWide Resource Planning (ERP). Information systems and services vendors participating in this marketplace are quickly forming alliances with other vendors who are targeting the same markets with complementary products. As alliances take place, the sales process, the implementation process and the postsale support requirements become more complex. Vendors are already experiencing a shortage of experienced personnel who can address the specific needs of the process manufacturing market, especially when two or more vendor products must be integrated.

C

Competitive Positioning

Participating vendors in the process manufacturing segment report that the market is characterized by increased competition. "Legacy" product companies are competing with new market entrants, leading to exacerbated product-pricing pressure. The size and growth of this market invites new entries and a strong push by the leaders to increase market share.

Companies are hampered by competition for trained sales personnel. Attempts to capture market share are resulting in heady price discounting and frequent over-commitment on product capabilities. Training for personnel is becoming critical for competitive positioning as clients ask vendors for demonstrable industry and technical expertise. It is also necessary for successful implementations and building of vendor images.

Some significant activity has occured on the acquisition front, Marcam, one of the leading vendors to the process manufacturing market, has purchased the rights to the IBM Mapics product, gaining a substantial customer base for future sales. It has also purchased Varnet, a small MRP II vendor, giving it access to 4 GL and Relational Data Base Management capabilities. An interesting development has occured at ASK, which introduced a new 4 GL, RDBMS product based on the foundation of a competitor, Baan Products International. Due to the cost of entry into this market and the investment required to maintain current technology, additional acquisition, merger, and alliance activity is to be expected.

Finally, process manufacturing vendors can be considered in the following segments:

1. Traditional MRP

ASK
American Software
Andersen Consulting
Cincom
Datalogix
Marcam
Ross Systems
SAP America
Systems Software Associates

2. Cell Controllers

US Data
Fastech

3. Manufacturing Execution Systems (MES)

Consilium
IBM

D

Participating Vendors

1. Applications Software Vendors

Requirements for CAD applications to have both powerful software and high-performance graphics makes CAD/CAM one of the best uses of specialized open-design software and turnkey systems in process manufacturing. Although CAD/CAM was once the leading application product for turnkey systems in process manufacturing, there is a concerted move toward open systems that has unbundled CAD/CAM software from
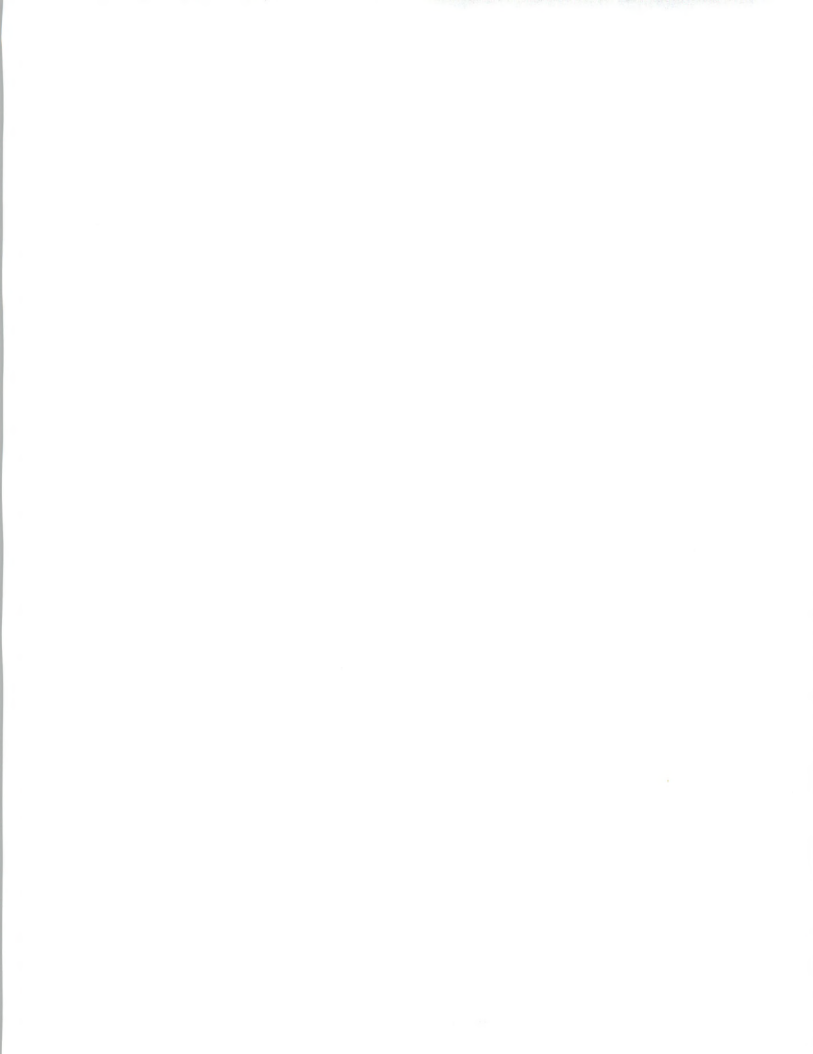
traditional platforms. Exhibit V-1 lists the leading applications software vendors in process manufacturing. CAD/CAM software firms are not listed as they are part of the INPUT report on cross-industry engineering applications. Cell controller vendors are listed because they have become an integral part of the re-engineered business, and they have the abililty to assist in the integration of plant devices with other business systems. Most process manufacturers have made extensive use of Statistical Process Control (SPC) and automated product movement devices, and those devices can now be integrated more easily with the use of packaged products.

2. Professional Services Vendors

Exhibit V-2 presents the leading professional services vendors in process manufacturing.

EXHIBIT V-1

Process Manufacturing
Leading Applications Software Vendors, 1992

Vendor	Market Share (Percent)
ASK Group	5
System Software Associates	5
Marcam	5
American Software	2
SAP America	2

EXHIBIT V-2

Process Manufacturing

Leading Professional Services Vendors

- Analysts International
- Andersen Consulting
- Computer Sciences Corp
- Computer Task Group
- Coopers & Lybrand
- EDS
- Ernst & Young
- IBM

The vendors in the professional services market are extremely diverse, including Big 6 firms, subsidiaries of industrial firms, computer hardware makers, and vendors devoted solely to professional services.

The professional services market is the largest service mode in process manufacturing, and there are no vendors with a significant market share; the market is extremely fragmented.

3. Leading Systems Integrators

Systems integration services offered to the process manufacturing market are characterized by increased competition and high margins of return. The systems integration market is growing fast. Critical factors for vendors are knowledge of the key business issues in manufacturing and experience in implementing solutions in the industry. Exhibit V-3 lists the leading systems integration vendors in process manufacturing.

EXHIBIT V-3

Process Manufacturing

Leading SI Vendors

- Andersen Consulting
- Computer Sciences Corporation
- Computer Task Group
- Coopers & Lybrand
- Deloitte Touche
- EDS
- KPMG Peat Marwick
- Price Waterhouse

4. Leading Systems Operations Vendors

This segment is also marked by an absence of clear leaders. Exhibit V-4 lists the larger systems operations vendors in process manufacturing.

EXHIBIT V-4

Process Manufacturing

Leading System Operation Vendors

- Andersen Consulting
- Computer Sciences Corporation
- EDS
- IBM
- Litton Automation

Growth and effective alliance positioning have made each of these companies a strong competitor in the process manufacturing market.
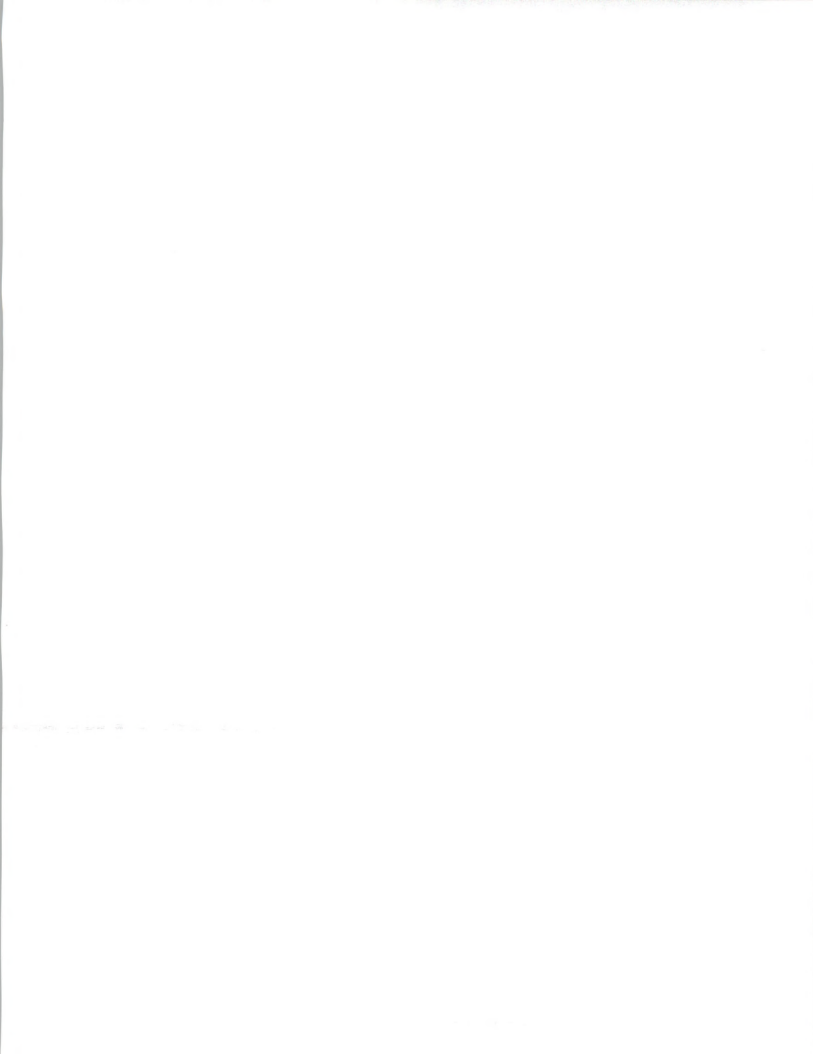
E
Vendor Profiles

1. SAP

International Court One
100 Stevens Drive, Suite 350
Lester, PA 19113
(215) 521-4500
Executive Vice President: Klaus Besier
Wholly Owned Subsidiary of SAP AG
Total Employees: 200
Total Revenue: $50,000,000
FYE: 12/31/92

a. Company Background

SAP America, Inc. markets and supports the R/2 System, a fully integrated
mainframe applications software system designed to integrate the informa-
tion needs of Fortune 500 companies. SAP America operates as a wholly
owned subsidiary of SAP AG, developer of the R/2 System. SAP
America was established in January 1988 to market the R/2 System in the
U.S.

SAP AG was founded in 1972 in Walldorf (Germany) by four former IBM
engineers.

In 1985 SAP International was formed in Biel (Switzerland) to support the
marketing and sales activities of SAP AG's international subsidiaries.
SAP International's operations were consolidated into SAP AG's head-
quarters in Walldorf in April 1992.

b. Strategy

• Expand its international coverage and customer base

• Exploit opportunities in Eastern Europe

• Introduce new product ranges offering greater portability and distributed
  computing

• Extend market coverage to small and medium-sized organizations

To address the needs of large and midsized corporations that require integrated applications systems using an open systems, client/server strategy, SAP has announced the R/3 System. Moreover, R/2 and R/3 can run concurrently and can be integrated to optimize both environments.

- Like the R/2 System, the R/3 System will provide a range of on-line, real-time, integrated business applications. Also like R/2, R/3 customers can address specific applications needs while laying the foundation for a single, enterprisewide strategy.

- The product is currently available in Europe and North America. R/3 supports UNIX environments on IBM, Hewlett-Packard, DEC, Siemens-Nixdorf, and Bull platforms.

c. Products and Services

The R/3 System is an integrated set of ten business applications modules that manage a range of strategic business applications for data-intensive corporations with numerous locations and operations.

- The R/3 System runs on IBM 370 and compatible mainframes.

- The core of the R/3 System is the Basis System, which contains development tools for the system and provides interface capabilities that allow users to access data base information in any module from anywhere in the company.

- R/3 System modules include:
- RF: Financial Accounting
- FA: Fixed Assets
- RK: Cost Accounting
- RK-P: Project Planning and Control
- RV: Sales-RM-PPS: Production Planning and Control
- RM-MAT: Material Management
- RM-QSS: Quality Assurance
- RM-INST: Plant Maintenance
- RP: Personnel Management

Modules are available and priced separately. Pricing on the Basis System starts at $100,000, depending on configuration.

d. Key Issues

- SAP America has various strategic alliances and relationships with companies that augment its sales and support efforts in the U.S. SAP Alliance partners include Andersen Consulting, CAP Gemini America, Coopers & Lybrand, Computer Task Group, Deloitte Touche, Electronic Data Systems, and Price Waterhouse.

- SAP has just beaten D&B Software to the market in delivering its R/3 client/server-based applications software three months ahead of schedule.

- One hundred percent of SAP America's revenue is derived from the U.S.

2. System Software Associates

500 West Madison Street 32nd Floor
Chicago, IL 60661
Phone: (312) 641-2900
Fax: (312) 641-3737
Chairman, President, and CEO: Larry J. Ford
Status: Public
Total Employees: 781
Total Revenue: $228,000,000
Fiscal Year End: 10/31/92

a. Company Background

System Software Associates, Inc. (SSA), founded in 1981, develops, markets, and supports BPCS (Business and Planning Control System), an integrated line of business software for manufacturing, financial and distribution management applications designed to run on IBM's AS/400 and System/3X midrange computers. SSA's revenue is derived primarily from the discrete manufacturing, process manufacturing, and distribution industries. SSA sells and supports its products through its affiliate network, a major accounts organization, and branch offices.

b. Strategy

During fiscal 1990, SSA introduced three computer-aided software engineering (CASE) software products, including AS/SET, a CASE tool designed exclusively for software applications design, development, and maintenance on the IBM AS/400.

During 1991, SSA introduced an electronic data interchange (EDI) product line for IBM AS/400 environments. SSA's product strategy incorporates a cooperative processing architecture, compliance with IBM's SAA, graphic user interface capabilities, and seamless integration to other technologies. SSA's products are currently marketed worldwide through SSA's major accounts division, SSA branch offices, and an affiliate business partner.

c. Products and Services

INPUT estimates that approximately 79% of SSA's fiscal 1992 revenue
was derived from applications software products, 20% from client support
services, and less than 1% from hardware sales. SSA's primary software
product line, Business Planning and Control System (BPCS), consists of
29 integrated products designed for manufacturing, distribution, and
financial applications for IBM AS/400, System/38, and System/36 com-
puters. This set of applications includes EDI applications, CASE applica-
tions, Distribution & Logistics products, MRP products, financial applica-
tions, and decision support products.

3. The ASK Group

240 W. El Camino Real
P.O. Box 7640
Mountain View, CA 94039
Phone: (415) 969-4442
President and CEO: Pier Carlo Falotti
Status: Public
Total Employees: 2,282
Total Revenue: $432,424,000
FYE: 6/30/92

a. Company Description

The ASK Group develops, markets, and supports manufacturing and
financial management applications for HP, DEC, IBM midrange, and
UNIX-based computers that are available as software products or turnkey
systems, and via processing services. As a result of the acquisition of
Ingres Corporation, The ASK Group also provides relational data base
management systems (RDBMS) and application development tools for
open systems.

During the first quarter of fiscal 1992, the company restructured its opera-
tions into The ASK Group, which includes a corporate function and three
decentralized business units, each with worldwide responsibility for
product development, marketing, sales and support, accounting, and
administration for their respective product lines. The three business units
include the following:

- ASK Computer Systems, based in Mountain View, CA, with 700 em-
  ployees, is responsible for manufacturing applications, including the
  MANMAN and MAXCIM product lines for HP and DEC systems, the
  MANMANX system for UNIX systems, and the upcoming ADVANCE
  open systems product family. This unit accounted for 37% ($158 mil-
  lion) of fiscal 1992 revenue.
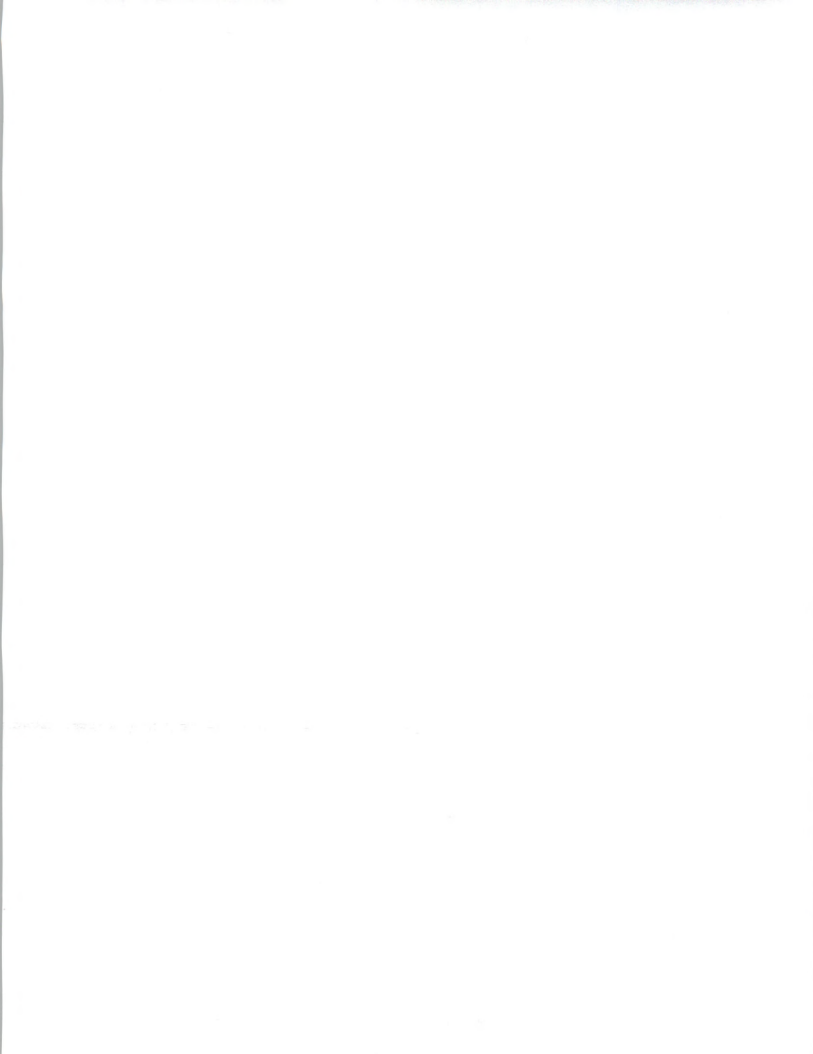
- The Data 3 business unit, based in Santa Rosa (CA) with 120 employees, develops and markets the SIM/400 integrated manufacturing application for the IBM AS/400 market. This unit accounted for 4% ($19.5 million) of fiscal 1992 revenue.

- The Ingres business unit, headquartered in Alameda (CA) with 1,550 employees, develops and markets the INGRES relational data base management system, integrated tools for workstation- and terminal-based programmers, and connectivity products for the open system market. This unit accounted for 59% ($254.9 million) of fiscal 1992 revenue.

b. Strategy

The ASK Group has pursued a strategy of diversification through the development and acquisition of core software technologies, intelligent relational data bases, fourth-generation language (4GL) development environments, application development tools, and open application products, in addition to its traditional manufacturing and financial management applications products for Hewlett-Packard (HP), DEC, and IBM midrange systems.

The company's development plans include moving its applications to an open systems environment with its software operating on all the major hardware platforms. The first such product, MANMAN/X, was released in September 1992.

c. Products and Services

ASK Computer Systems (MANMAN and MAXCIM) - The MANMAN Information System is an on-line, interactive system that consists of integrated products for manufacturing, finance, marketing, customer service, decision support, and computer-integrated manufacturing functions. There are currently over 2,000 MANMAN clients worldwide.

Data 3 - Data 3 markets and supports the SIM/400 customer-responsive Information System exclusively for IBM AS/400 computers. Data 3 is an authorized IBM Business Partner.

- SIM/400 supports manufacturing, accounting, bar code, distributed requirements planning (DRP), sales order management, multiple CPU distributed requirements planning, and EDI functions.

- SIM/Windows, released in fiscal 1992, supports cooperative processing between the AS/400 and PCs. It allows SIM/400 applications to run within the Microsoft Windows environment.

d. Key Issues

- The ASK Group will continue to de-emphasize its hardware reselling activities and focus on its software and services business. Prior to the 1990 acquisition of Ingres, about 80% of revenue was from the U.S. and hardware resales accounted for more than 50% of total business. Now more than 45% of revenue comes from markets outside North America, and more than 80% of revenue is from software licenses and services.

- During the first quarter of fiscal 1993, Pier Carlo Falotti was appointed president and chief executive officer of The ASK Group and Sandra Kurtzig, the company's founder, transferred to Mr. Falotti the day-to-day running of the business.

4. Ross Systems, Inc.

555 Twin Dolphin Drive
Redwood City , CA. 94056
Phone: (415) 593-2500
Chairman & CEO: Dennis Vohs
Status: Public
Total Revenues: $76.9 million
Total Employees: 585
FYE: 6/30/92

a. Company Strategy

Ross Systems, Inc. provides business applications software products and associated support services to users of DEC computers. The company's overall strategy is to build a broad-based DEC application software company through internal development and selective acquisitions.

b. Company Background

Ross Systems was founded in 1972 to provide consulting services. In 1975, the company expanded its business to include software products and processing services. In November 1988, Ross Systems announced a management buyout of the company for an undisclosed sum. The company has since made a number of acquisitions.

Ross Systems' revenues for 1992 were $85 million. Process Manufacturing represented approximately $18 million of those revenues.

In 1991, Ross Systems, Inc. announced that it had acquired Pioneer Computer Group of England in an attempt to extend its operations into the 4GL and process manufacturing software markets. This has allowed the company to become a player in the process manufacturing market by offering Promix, a pioneer product focused on this industry. Ross is currently restructuring its process manufacturing group into a separate entity to better address the market.

5. Marcam Corporation

95 Wells Avenue
Newton, MA 02159
Phone: (617) 965-0220
CEO: Paul Margolis
Status: Public
Total Revenues: $80.3million
Total Employees: 620
FYE: 9/30/92

a. Company Strategy

Marcam is one of the few applications software companies focusing exclusively on process manufacturing. Marcam recognized the unique manufacturing requirements of the process industries, and the lack of software systems designed exclusively for these industries. To meet those needs, the company developed and currently markets PRISM, an integrated manufacturing, financial, logistics, and cost accounting software product.

Marcam worked very closely with more than 50 process manufacturers, many of which are among the Fortune 100, to develop the product. Marcam also provides implementation support, custom programming, and systems integration services for a total process manufacturing solution. As a result, the company has gained a good deal of respect from the process manufacturing industries and is recognized as understanding the specific problems that exist within those industries. The company has cultivated this image, and is reaping the rewards of being a vendor with a very close relationship to process manufacturing.

b. Company Background

Marcam was founded in 1980 as an applications software company. It distributed and provided add-on products and consulting services to MAPICS, IBM's manufacturing system for midrange computers, prior to developing the PRISM product.

In April 1991, Marcam acquired ShawWare Incorporated of Burlington (Ontario, Canada), a supplier of maintenance and materials management applications software. The acquisition resulted in the addition of six modules to the PRISM product line. The company's FY 1992 revenues reached $80.3 million, a 53% increase over fiscal 1991 revenue of 52.3 million.

Marcam recently purchased the rights to IBM's Mapics, giving it a large customer base. That moved Marcam into the discrete manufacturing market for the first time, and one challenge will be to keep its attention on its primary domain, the process market. Marcam has also purchased Varnet, a small MRPII type vendor, giving it access to a product and expertise in the UNIX, 4th GL and ROBMS environments.

c. Products and Services

The PRISM product family, introduced in 1986, includes an integrated planning and control software system targeted to process manufacturers. The software is designed for IBM AS/400, IBM system/38 and IBM PCs and compatible systems. Marcam has licensed over 3,600 PRISM modules for use at more than 650 sites worldwide. PRISM consists of 28 announced modules that are organized into four product lines—Production Series, Logistic Series, Maintenance Management Series, and Financials Series—as well as common functions or enablers.

6. Consilium, Inc.

640 Clyde Court
Mountain View, CA 94043
Phone: (415) 691-6100
President and CEO: Thomas A. Thomasseti
Status: Public
Total Revenues: $27.6 million
Total Employees: 280
FYE: 10/31/93

a. Company Background

Consilium provides integrated plant floor management software products and related services to discrete and process manufacturers. The company's Workstream and Flowstream software products run primarily on DEC hardware. DEC and EDS are investors in Consilium.

Consilium was incorporated in October 1978 to provide consulting services, primarily to semiconductor, aerospace and defense industries. Its first product, Workstream, developed for the semiconductor industry, began delivery during fiscal 1983. Consilium's newest product, Flowstream, was developed as an open system, and addresses a variety of process manufacturing environments.

b. Strategy

Consilium's approach to sales and marketing is directed at the plant floor as a manufacturing execution system (MES). The company uses its expertise to provide customers with extensive consulting and implementation services to assure the best use of its products' capabilities. It is common for vendors of complementary products (like Marcam) to work towards integration with Consilium.

Consilium's primary competition comes from the in-house development departments and from systems integrators like Andersen Consulting and IBM. It also receives competition from Promis, Inc. which has a similar approach to implementations.

Consilium's competitive strength lies in its experience and expertise in the manufacturing industries. Its latest product, Flowstream, should give it significant competitive technical advantages as the market moves towards open systems.

c. Products and Services

The Flowstream product should address both the functional and technical requirements of most process manufacturers and should position Consilium well for future product integration needs.

d. Key Issues

The major issue facing Consilium is its ability to continue sales growth and regain profitability. Its approach to sales has not changed to meet lengthening sell cycles. Its association with no-growth situations (DEC, defense, aerospace), have also added to a two-year stagnation. Profits have escaped the company during those two years, but the investment in Flowstream should begin to show returns in the near future. Revenues from Flowstream began in 1992, and it produced $1.5 million, 6% of Consilium's total.

(Blank)

VI
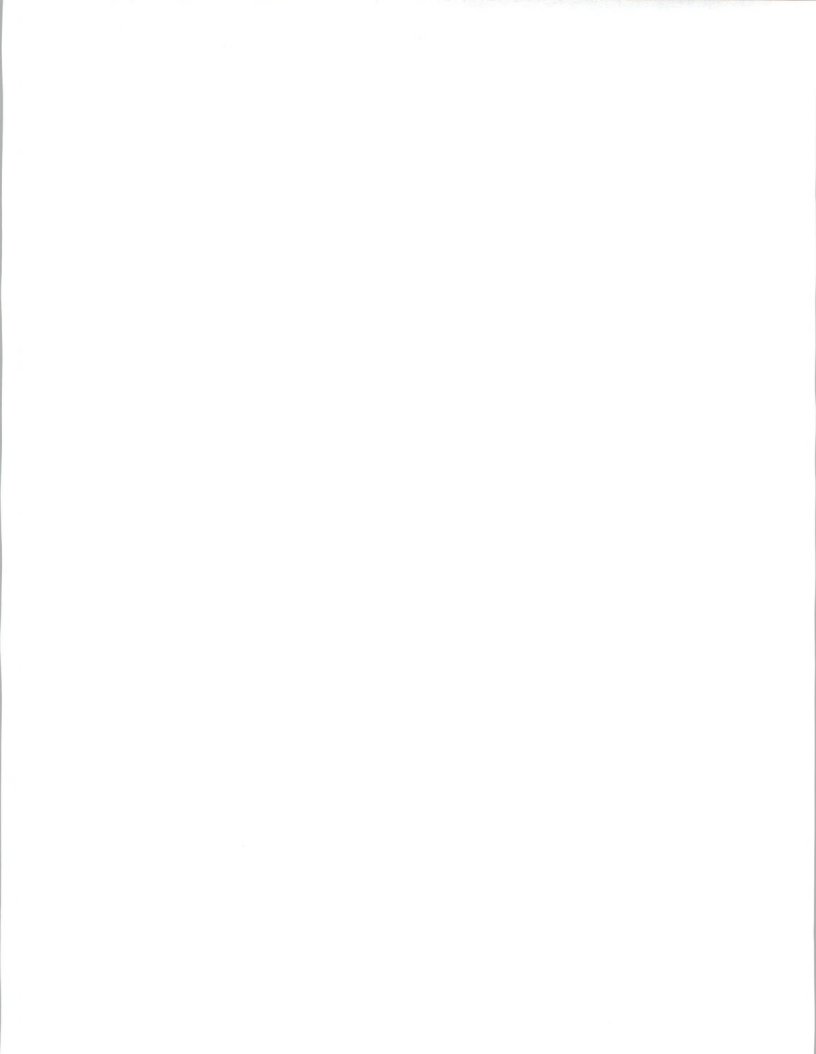
Conclusions and Recommendations

A
Overview

The process manufacturing industries have held their own during the recession and are poised to continue growth, even though these are mature markets. While they are moving forward, businesses are changing their infrastructure (re-engineering) to attempt to achieve higher levels of customer service and quality. To attain those objectives, companies must move decision-making ability to the points of opportunities and problems. Such decision-making requires current and accurate information, both for the opportunity or problem at hand and for related conditions at other locations, such as intra-company sites, vendor, and customer sites. These information needs present excellent opportunities for the vendors of information services.

Process manufacturers are approaching new information services expenditures slowly and with caution. As companies moved toward creating islands of information and automation through necessity, they created highly customized and inaccessible systems. There is a need for complete integration of those systems to achieve a status of real-time sharing of data within a company.

Applications are now expanding and refining functionality to more precisely meet user needs. The challenge is to use current technology to incorporate the best parts of past actions (automated production, computerized quality control) and eliminate the "islands" isolation syndrome. The considered application of current technologies will now allow the complete integration of data and abet the desire to achieve flattened management hierarchies. True decision-making information can be in the hands of the "empowered"worker.

The next cycle in the systems evolution is on the horizon. Totally open, totally integrated and totally comprehensible systems will begin to appear by 1995-1996. They will use object-oriented programming concepts. They will be data base-independent, platform-independent, and also vendor-independent. Users will be able to choose the best parts of various

products and incorporate them into use to support daily operations. System modifications, required for changing business conditions, will be made with relative ease. Users will be able to understand programs and objects.

As usual, the knowledge required to effectively utilize current technology is lagging the market need, and it will be the end of the decade before the extent and importance of the next cycle (or iteration) in the application of technology to the process manufacturing environment becomes evident. The companies in this sector will no longer be able to "wait and see" before they take advantage of current capabilities; their world is too competitive.

B
Recommendations for Users

Users can receive significant benefits by taking advantage of the products and services currently available. For investment protection, there are several issues to consider:

- Define objectives and needs carefully, using outside expertise if necessary.

- Survey the competitive environment to identify three vendors who are successful in your industry. Insist on industry experience and expertise.

- Insist on an open systems approach from the vendor. This would usually involve UNIX, but truly open systems are not available yet. The vendor should have a consistent plan for achieving an open-system environment. This is extremely important for those companies in the market who have developed highly customized systems, and for those who have implemented highly automated factory floor systems.

- Organize carefully for the three keys to a successfully implemented solution: careful and complete objectives and requirements definition, through analysis leading to purchasing a solution, and rapid, effective implementation of the solution.

- Try to keep customized development to a minimum.

- Carefully define the network environment: avoid building isolated islands of application automation..

- Establish benchmarks, based upon current conditions, prior to any solution implementation.

- Examine and be satisfied with a vendor's financial viability. Hopefully, you will share a long and mutually beneficial relationship.

• When making a change, make it quickly. Make the decision quickly. Implement rapidly. Attain benefits rapidly. The more rapidly a significant move is made, the higher will be the return and the more employees will be positively involved.

These user recommendations are summarized in Exhibit VI-1.

EXHIBIT VI-1

Process Manufacturing

Recommended User Actions

• Define requirement

• Select industry-proven vendors

• Evaluate "openness" of systems

• Minimize customization

• Avoid building "islands"

• Move quickly when making changes

C
Recommendations for Vendors

There is an excellent market available to vendors of information services to the manufacturing industry. The market is fragmented, with no dominant vendor in any segment. The following are issues which must be addressed to achieve significant market share:

• Target narrow market segments.

- Industry expertise is a key ingredient, according to users surveyed. This is especially so in the process manufacturing environment.

- Achievement of segment leadership will assure a vendor's frequent involvement in decisions made by users seeking vendor products.

- Training of vendor staff is critical, and training is easier by narrow segment.

- Specific features and functions must be developed for specific segment needs.

• Institute internal training programs. The industry seems to have abandoned the sales, consulting, and implementation training which brought successes in the late 1970s and early 1980s. Users seldom rely on the

vendors for expertise. Critical decisions are often made without vendor involvement.

- Begin the migration toward an open systems environment. There are numerous excellent application solutions available or being developed in narrow niches (customer response systems, for example). Inability to interface these solutions without costly customization can be expensive for both the business and the vendor. *Invest aggressively in research and development.* To accomplish this goal, investment is painful but mandatory for survival. At least 5% of revenues should be allocated to product development functions.

- Develop alliances with niche solutions vendors. Again, this is critical in the process sector. There will be very specific solutions in areas like distribution logistics, finite scheduling and customer support where the developers may not have a market large enough to support a direct sales effort.

- Develop a sales approach that emphasizes project management skills and stresses decision support capabilities.

- Understand and leverage the concepts of business re-engineering, total quality management, and value-added integration. Old problems (such as inaccurate data, unlocked storerooms, lack of management involvement) are being eliminated through by fast-paced change.

- Develop an internal total customer responsiveness program.

- Accept the fact that information systems product prices may continue to drop before stabilizing. Too many vendors with too little money, desperate for sales, are causing price erosion. Some products are becoming commodities. The next iteration of products will bring shakeup and consolidation.

Vendor recommendations are summarized in Exhibit VI-2.

EXHIBIT VI-2

Process Manufacturing

Recommended Vendor Actions

- Target narrow market segments
- Invest in internal training
- Invest in open systems
- Understand the concept and implications of re-engineering
- Beware price erosion

A

Forecast Data Base and Reconciliation

User expenditures for information services in 1992 were on target with the INPUT forecast. This occurrence is significant in that the recession lasted several months longer than was anticipated. The process manufacturing markets will continue significant growth through the forecast period—with an overall CAGR of 14%, upgraded from last year's forecast of 13%.

Recent developments in the process markets for applications software products and professional services account for the predicted increased growth. Many Enterprise-Wide Resource Planning (ERP) packages, such as those from Ross Systems, Andersen Consulting and Marcam are now accepted and are replacing custom-developed systems. Several companies, like Andersen and Computer Services Corporation have initiated training and consulting services groups for specific subsegments, i.e., pharmaceuticals, food and beverage, etc. As new packages are implemented, some customization will be necessary, and the downsized companies will hire that work from outside contractors.

Additional packages are being developed and marketed to the process sector. Products that have succeeded in the semiconductor market, such as those from Consilium and Promis, have been refined for use in the process industries. Controls packages and tools, such as those from Fastech and US Data, are already well-accepted and their use is expanding rapidly. Again, the use of these packages will require some major customization efforts for specific company requirements and integration to various company functional system.

Until recently, the process manufacturing markets have been virtually untapped by information services vendors. As highlighted throughout this report, the moves to client/server to address new company structures will open the process markets to more outside services expenditures.

Additionally, the desire to operate on a very moderate in-house MIS budget should offer opportunities for various types of contract services.

EXHIBIT A-1

Process Manufacturing Sector
Market Size by Delivery Mode, 1992-1998

Delivery Modes	1992 ($M)	Growth 92-93 (%)	1993 ($M)	1994 ($M)	1995 ($M)	1996 ($M)	1997 ($M)	1998 ($M)	CAGR 93-98 (%)
Sector Total	6,203	13	7,003	7,920	8,997	10,131	11,679	13,353	14
Professional Services	2,330	14	2,662	3,042	3,491	3,998	4,583	5,260	15
- IS Consulting	580	15	667	767	882	1,015	1,165	1,340	15
- Education & Training	335	6	355	375	399	423	448	475	6
- Software Development	1,415	16	1,640	1,900	2,210	2,560	2,970	3,445	16
Systems Integration	384	12	431	492	564	646	743	849	15
- Equipment	148	12	166	189	216	245	280	320	14
- Software Products	38	13	43	50	57	65	74	85	15
- Applications Software	26	15	30	35	40	46	52	60	15
- Systems Software	12	8	13	15	17	19	22	25	14
- Professional Services	180	12	202	230	265	306	355	405	15
- Other	18	11	20	23	26	30	34	39	14
Systems Operations	510	15	588	682	796	926	1,084	1,270	17
- Platform Operations	173	11	192	212	235	258	285	315	10
- Applications Operations	224	15	258	301	352	410	480	560	17
- Desktop Services	63	17	74	87	103	122	144	170	18
- Network Management	50	28	64	82	106	136	175	225	29
Processing Services	740	4	770	795	820	845	870	890	3
- Transaction Processing	740	4	770	795	820	845	870	890	3
Network Services	938	15	1,079	1,246	1,438	1,666	1,940	2,265	16
- Electronic Info. Svcs.	807	13	915	1,040	1,180	1,340	1,520	1,725	14
- Network Applications	131	25	164	206	258	326	420	540	27
Applications Software	683	16	793	916	1,068	1,149	1,466	1,728	17
- Mainframe	178	8	192	203	214	225	235	245	5
- Minicomputer	230	13	260	293	326	365	409	458	12
- Workstation/PC	275	24	341	420	528	559	822	1,025	25
Turnkey Systems	618	10	680	747	820	901	993	1,091	10
- Equipment	295	10	325	355	385	420	460	500	9
- Software Products	223	10	245	270	300	331	367	406	11
- Applications Software	193	10	212	235	261	289	320	355	11
- Systems Software	30	10	33	36	39	43	47	51	9
- Professional Services	100	10	110	122	135	150	166	185	11

EXHIBIT A-2

Process Manufacturing Sector
1993 MAP Data Base Reconciliation

Delivery Modes	1992 Market				1997 Market				92-97 CAGR per data 92 Rpt (%)	92-97 CAGR per data 93 Rpt (%)
	1992 Report (Fcst) ($M)	1993 Report (Actual) ($M)	Variance from 1992 Report		1992 Report (Fcst) ($M)	1993 Report (Fcst) ($M)	Variance from 1992 Report			
			($M)	(%)			($M)	(%)		
Total	6,181	6,203	22	0	10,881	11,679	798	7	12	13
Professional Services	2,324	2,330	6	0	3,678	4,583	905	25	10	15
Systems Integration	360	384	24	7	686	743	57	8	14	14
Systems Operations	509	510	1	0	1,086	1,084	-2	0	16	16
Processing Services	743	740	-3	0	939	870	-69	-7	5	3
Network Services	949	938	-11	-1	2,070	1,940	-130	-6	17	16
Applications Software	683	683	0	0	1,433	1,466	33	2	16	17
Turnkey Systems	613	618	5	0	989	993	4	0	10	10

(Blank)

About INPUT

Since 1974, information technology (IT) users and vendors throughout the world have relied on INPUT for data, objective analysis, and insightful opinions to support their plans, market assessments and technology directions particularly in computer software and services. Clients make informed decisions more quickly and save on the cost of internal research by using INPUT's services.

Call us today to learn how your company can use INPUT's knowledge and experience to grow and profit in the revolutionary IT world of the 1990s.

Annual Subscription Programs

North American and European Market Analysis

Analysis of Information Services, Software and Systems Maintenance Markets
5-year Forecasts, Competitive and Trend Analysis

- 15 Vertical Markets   • 9 Categories of Software and Services   • 7 Cross-Industry Markets
- The Worldwide Market (30 countries)

— U.S. —

- Outsourcing
- Client/Server
- Systems Integration
- IT Vendor Analysis

- EDI / Electronic Commerce
- U.S. Federal Government IT Procurements

— European —

- Outsourcing
- Systems Integration
- Customer Services

Custom Consulting

Many vendors leverage INPUT's proprietary data and industry knowledge by contracting for custom consulting projects to address questions about their specific market strategies, new product/service ideas, customer satisfaction levels, competitive positions and merger/acquisition options.

INPUT advises users on a variety of IT planning and implementation issues. Clients retain INPUT to assess the effectiveness of outsourcing their IT operations, assist in the vendor selection process and in contract negotiation/implementation. INPUT has also evaluated users' plans for systems and applications downsizing.

INPUT Worldwide

San Francisco—1881 Landings Drive
Mountain View, CA 94043-0848
Tel. (415) 961-3300 Fax (415) 961-3966

New York—400 Frank W. Burr Blvd.
Teaneck, NJ 07666
Tel. (201) 801-0050 Fax (201) 801-0441

Washington, D.C.—1953 Gallows Rd., Ste. 560
Vienna, VA 22182
Tel. (703) 847-6870 Fax (703) 847-6872

London—17 Hill Street
London W1X 7FB, England
Tel. +44 71 493-9335 Fax +44 71 629-0179

Paris—24, avenue du Recteur Poincaré
75016 Paris, France
Tel. +33 1 46 47 65 65 Fax +33 1 46 47 69 50

Frankfurt—Sudetenstraße 9
D-35428 Langgöns-Niederkleen, Germany
Tel. +49 6447-7229 Fax +49 6447-7327

Tokyo—Saida Building, 4-6, Kanda Sakuma-cho
Chiyoda-ku, Tokyo 101, Japan
Tel. +81 3 3864-0531 Fax +81 3 3864-4114