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    - ☐ Required reading
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    - ☐ New product development
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	Extent		Usefulness (1=Low, 5=High)				
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Complete report	☐	☐	☐	☐	☐	☐	☐
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Cover Title—Exactly how it is to appear on the report cover:
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2nd Line

3rd Line

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Estimated number of pages: <100 ☐

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Executive Overviews: 150-200 ☐
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DRAFT

DISCRETE MANUFACTURING REPORT
TRANSMITTAL LETTER

Dear Colleague: *EXPANDED*

Enclosed is INPUT's new report on the *Discrete Manufacturing Market, 1993-1998*.
This is the first ~~enriched~~ vertical market report to be issued as part of the new 1993
Market Analysis Program. It is unusual in that it combines survey and forecast
efforts by INPUT staff with industry-specific analysis, commentary and
recommendations from an expert in the discrete manufacturing industry, retained by
INPUT specifically to help in the preparation of this report.

INPUT believes that the participation of such a highly knowledgeable and
experienced outside consultant has enriched this report, by providing an objective
analysis of trends, events and issues and offering experience-based observations and
recommendations.

In the next 60 days, a number of other INPUT vertical market reports will be
produced using the combined skills of INPUT staff and experienced outside
consultants. They include market reports for:

> Banking and Finance
> Health Services
> Human Resources
> Insurance
> Process Manufacturing
> State and Local Government
> Telecommunications
> Transportation
> Utilities
> Wholesale Distribution

We believe that these ~~shorter~~ full vertical reports offer increased insight into the
markets for information services in each of the noted market sectors, but we also
want *your* response to these new reports. Accordingly, I would appreciate receiving
your comments by telephone, mail or fax at any time.

I would also like to thank you for your participation in INPUT's *Market Analysis
Program*.

Sincerely,

Robert L. Goodwin
Manager
Market Analysis Program

Attachment

MAP0610.DOC

Dear Colleague:

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Health Services	Telecommunications
Human Resources	Transportation
Insurance	Utilities
Process Manufacturing	Wholesale Distribution

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Sincerely,

Bob Goodwin

Robert L. Goodwin
Manager, Information Services Market Analysis Program

Enc.

VERTICAL MARKET ANALYSIS

DISCRETE MANUFACTURING

1993-1998

**U.S. Information Services
Market Analysis Program**
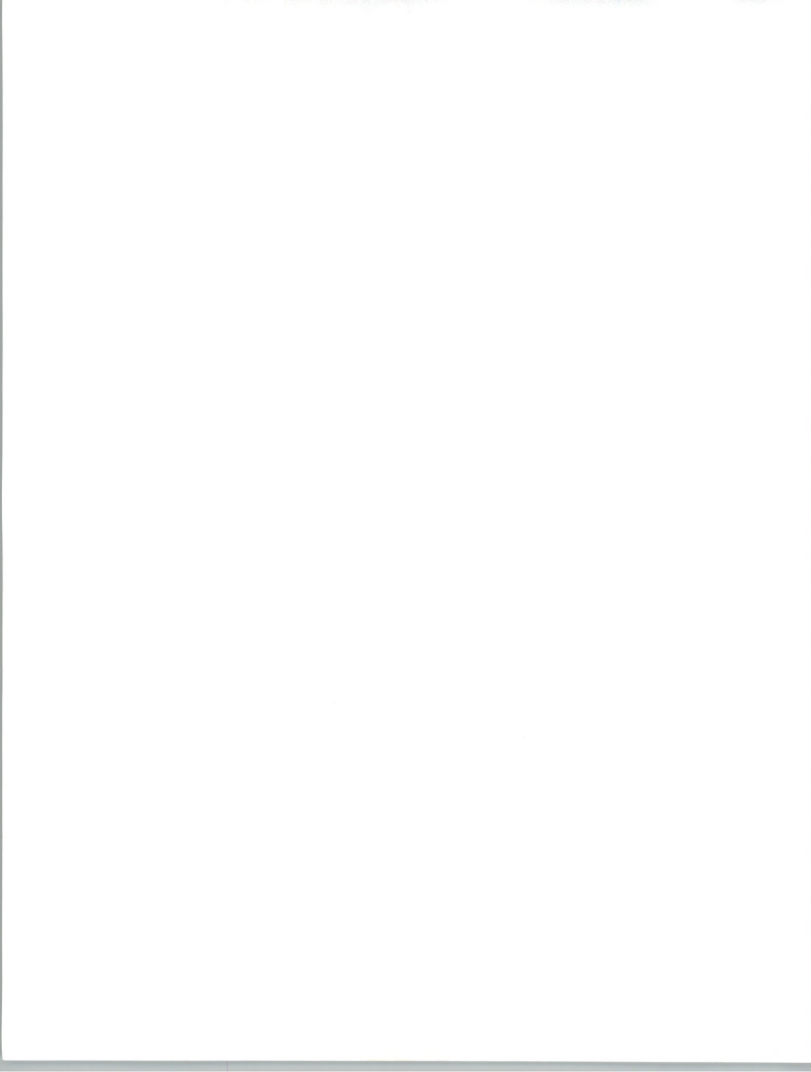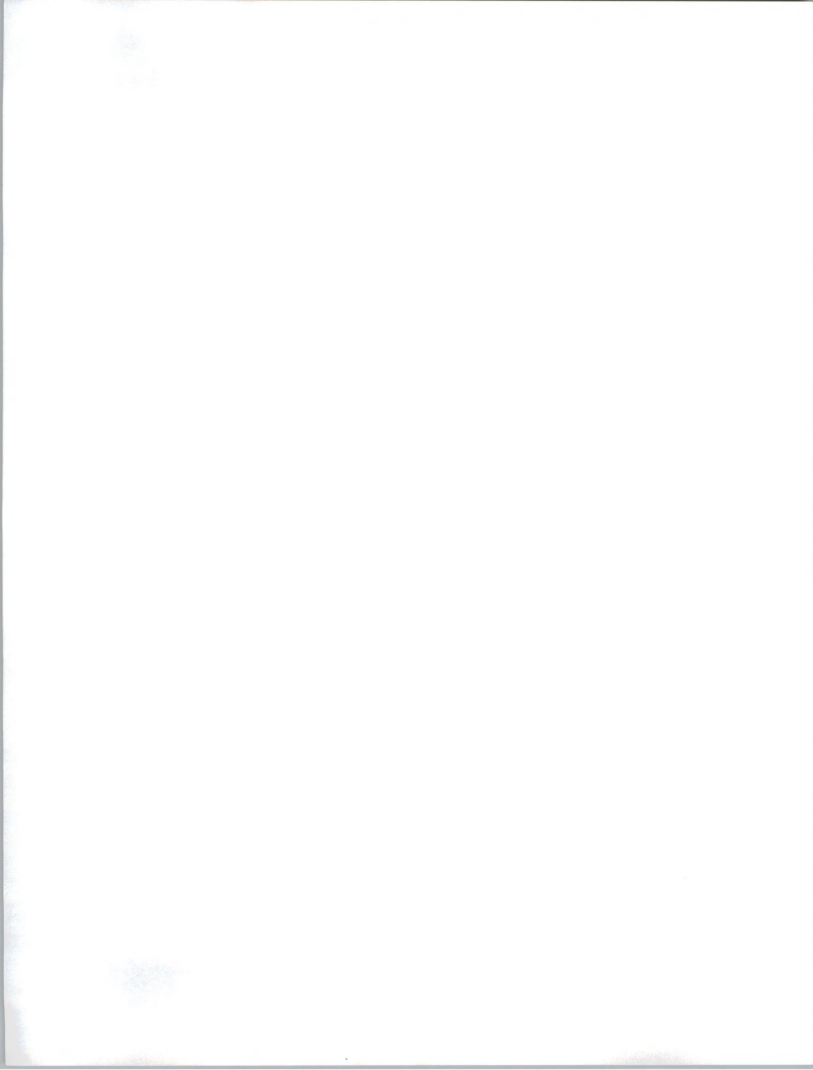
DISCRETE MANUFACTURING

INFORMATION SERVICES
OPPORTUNITIES & TRENDS
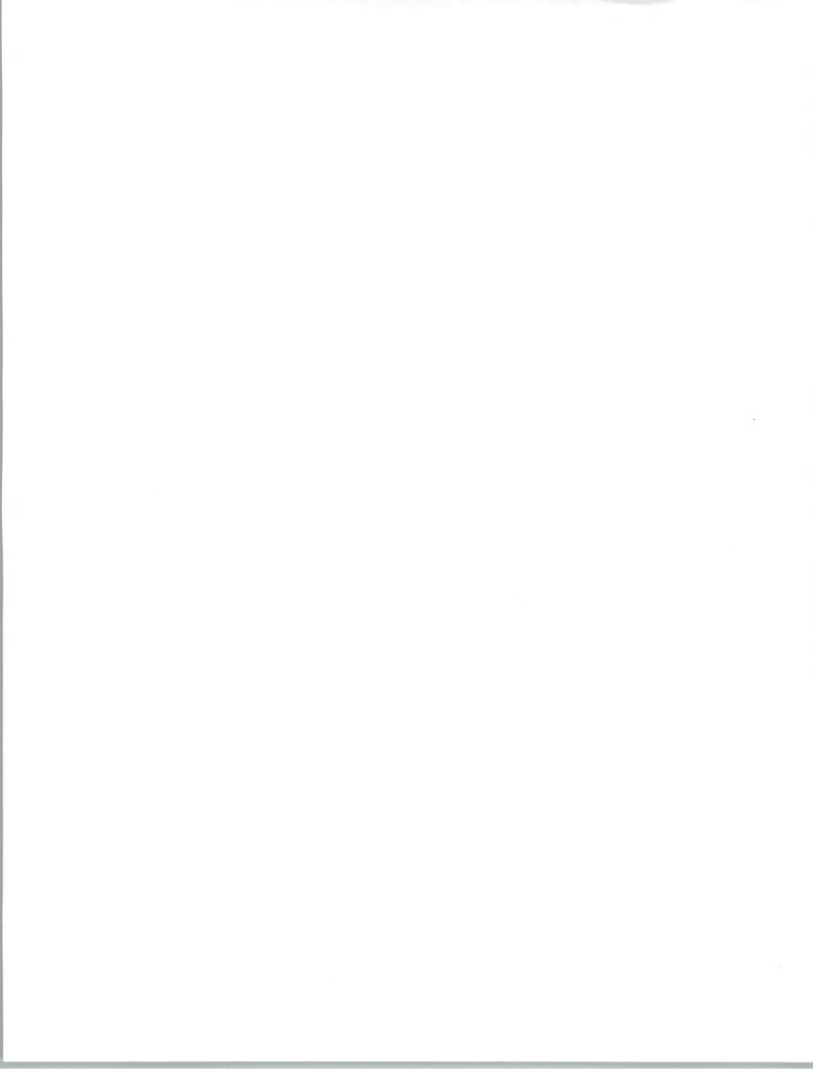
1993-1998

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

Information Services Market Analysis Program
(MAP)

Discrete Manufacturing

Information Services Opportunities & Trends
1993-1998

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Exhibits (Continued)

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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 *discrete 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 discrete sector of the manufacturing industry. The 1993 INPUT forecast for this sector is included.

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

- Companies that fall within the Standard Industrial Classification (SIC) Codes of 23xx, 25xx, 27xx, 31xx, and 34xx-39xx, shown in Exhibit I-1, are defined by INPUT to be in the discrete manufacturing sector. INPUT's definiton also includes some hybrid companies, i.e., those companies that incorporate both discrete and process operations to produce their products.

- A discrete operation is most easily defined by following the form of the material used at the beginning of the manufacturing process and noting if its form has changed after use. It is typically assumed that a purely discrete operation is one of assembly. 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.

Discrete Manufacturing Sector

SIC Code	Description
23xx	Apparel and other finished products
25xx	Furniture and fixtures
27xx	Printing, publishing and allied industries
31xx	Leather and leather products
34xx	Fabricated metal products, except machinery and transportation equipment
35xx	Industrial and commercial machinery and computer equipment
36xx	Electronic and other electrical equipment and components, except computer equipment
37xx	Transportation equipment
38xx	Instruments; photo/med/optical goods; watches/clocks
39xx	Miscellaneous manufacturing industry

- 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.

Key Issues—Market issues influencing the potential for the use of information services that are discussed in the report 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 structure and the team approach to continuous improvement

  - Separation of the planning, execution, and control functions as those activities apply to achieving TQM objectives
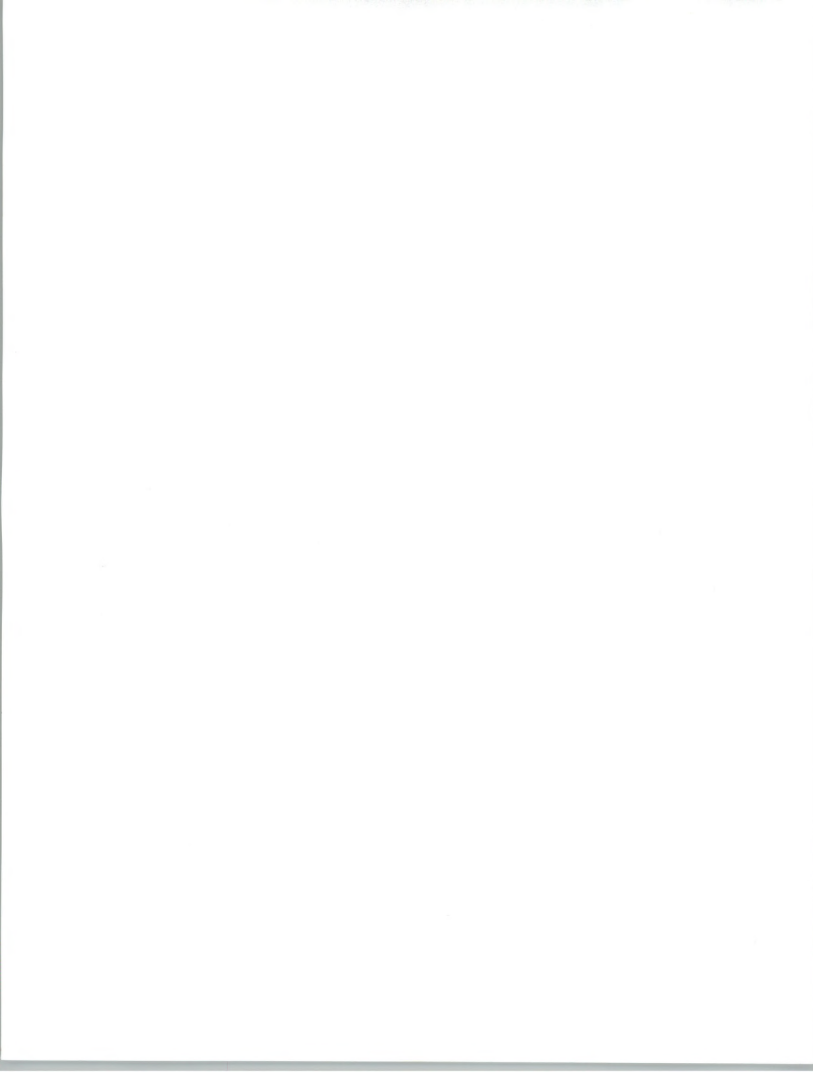
- Outsourcing and building vendor relationships, both in information services delivery and partnering for manufacturing operations and the purchase of services and materials

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

- For users, the questions of "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.

• The markets are being influenced by conflicting forces:

  - Foreign competition and new markets
  - Global needs and concerns with easier communication
  - Spill-over 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 aerospace and defense-related 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 companies, 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 is relatively quiet, but the new administration has made many promises, and De Facto self-regulation appearing in the form of ISO 9000 requirements in the European Community and Baldrige Award competition in the U.S., and there are emission controls and worker protection to consider in selected industries.

• The proven new business practices inherent in TQM and CIM offer significant opportunities to the companies in marketplace. The two elements necessary to achieve continuous improvement—tools and training—are available, but are they fully understood and will businesses invest fast enough to reap the benefits?

• There is a recognized need 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. Is the knowledge available to take advantage of these resources?
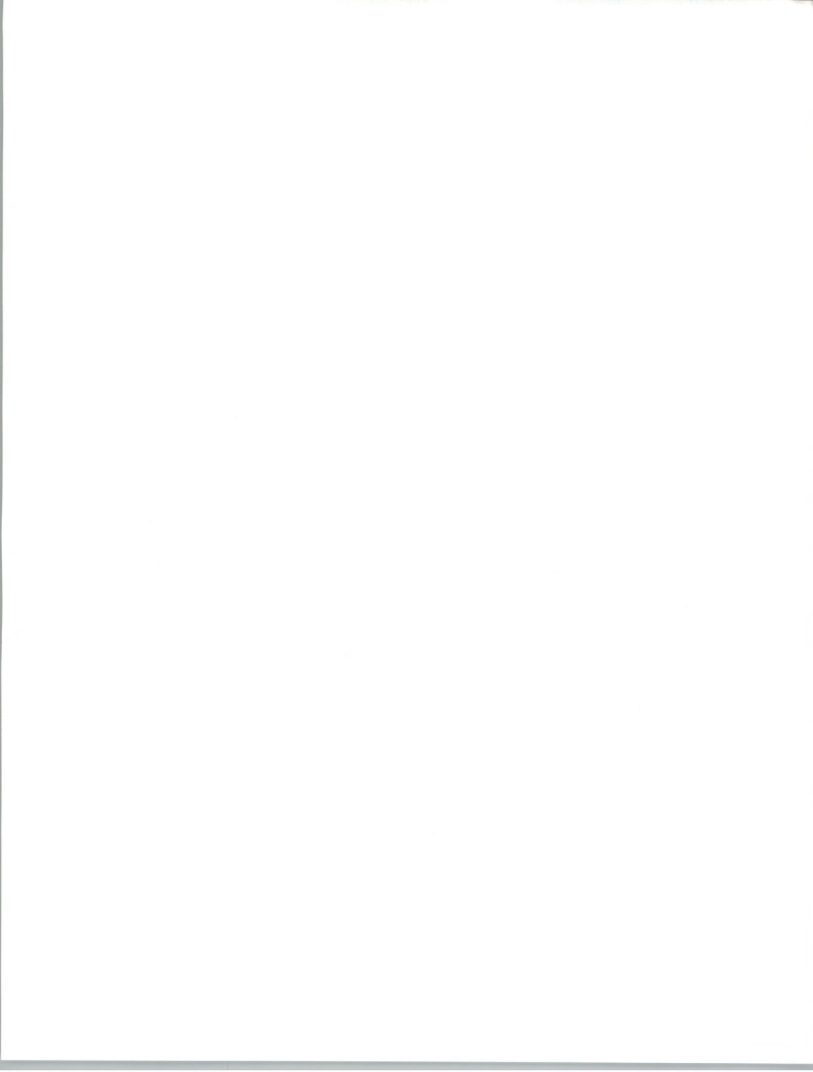
- Can and will the vendors use the best technology to achieve an "open systems" status—a necessary attribute to take advantage of the broad range of niche products?

- Does the concept of downsizing make sense? How does one go about downsizing, and is the payback significant and/or fast enough to justify 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 discrete manufacturing sector that can have an impact on the current and future use of information services.

- Chapter III, *Information Systems Environment*, presents an analysis of the expenditures for information services, by delivery mode and sub-mode, for the U.S. discrete manufacturing market.

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

- Chapter V, *Vendor Competition*, discusses key industry issues and considers the competitive positioning of major vendors. It also identi-fies 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 discrete manufacturing market.

- Appendix A, which contains the forecast data base, presents a detailed forecast, by information services delivery mode and submode, for the discrete manufacturing vertical market. A reconciliation to the previous forecast is also provided, together with a list of related reports of pos-sible 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 discrete manufacturing industry
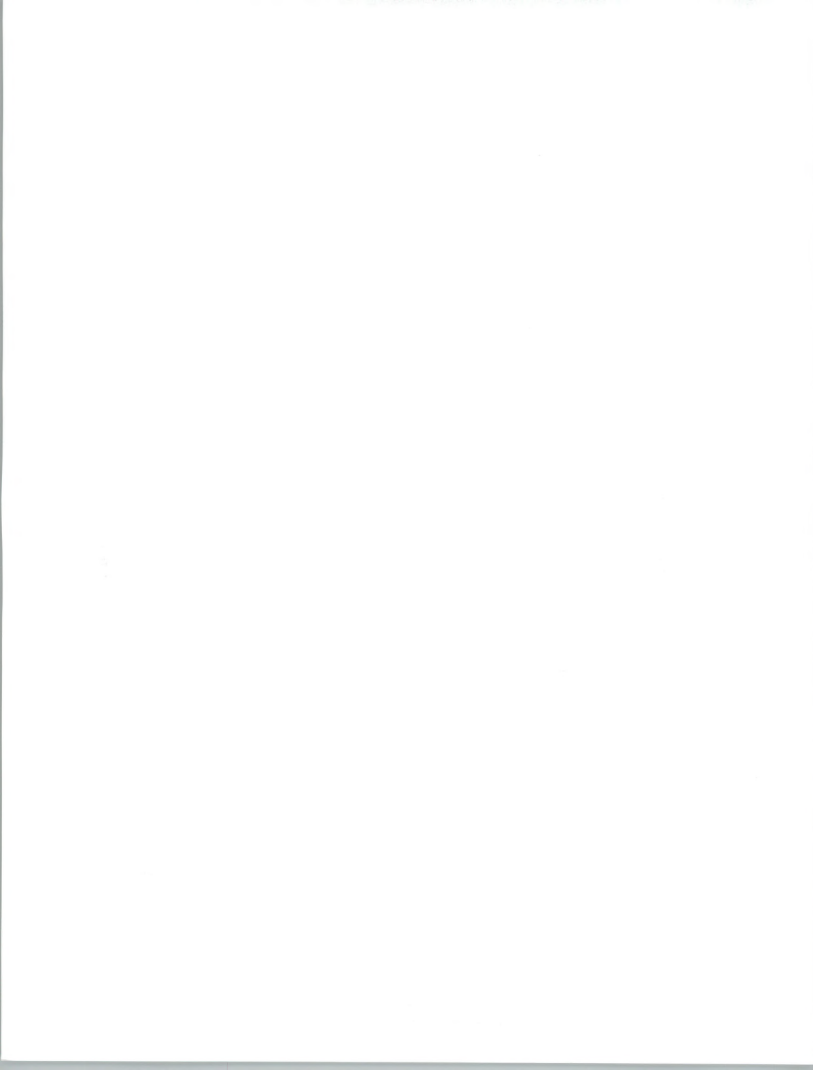
and the IS vendors serving the industry. INPUT maintains ongoing relationships with, and a data base of, all users and vendors that it interviews. Interviewees for the research portion of this report were selected from this data base of contacts.

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.

Rounding - When displaying market forecast values in bar and column charts, INPUT rounds these amounts for ease of visual reference. Markets of $1 billion or more are rounded to the nearest $50 million; $100 million to $999 million to the nearest $10 million; and $50 to $99 million to the nearest $5 million. Actual values are shown in charts for markets of $49 million or less, in Appendix A tables, and in chapter text.

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 undesirably high levels-a condition fueled primarily by corporate restructuring and defense industry cutbacks. Even though discrete 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
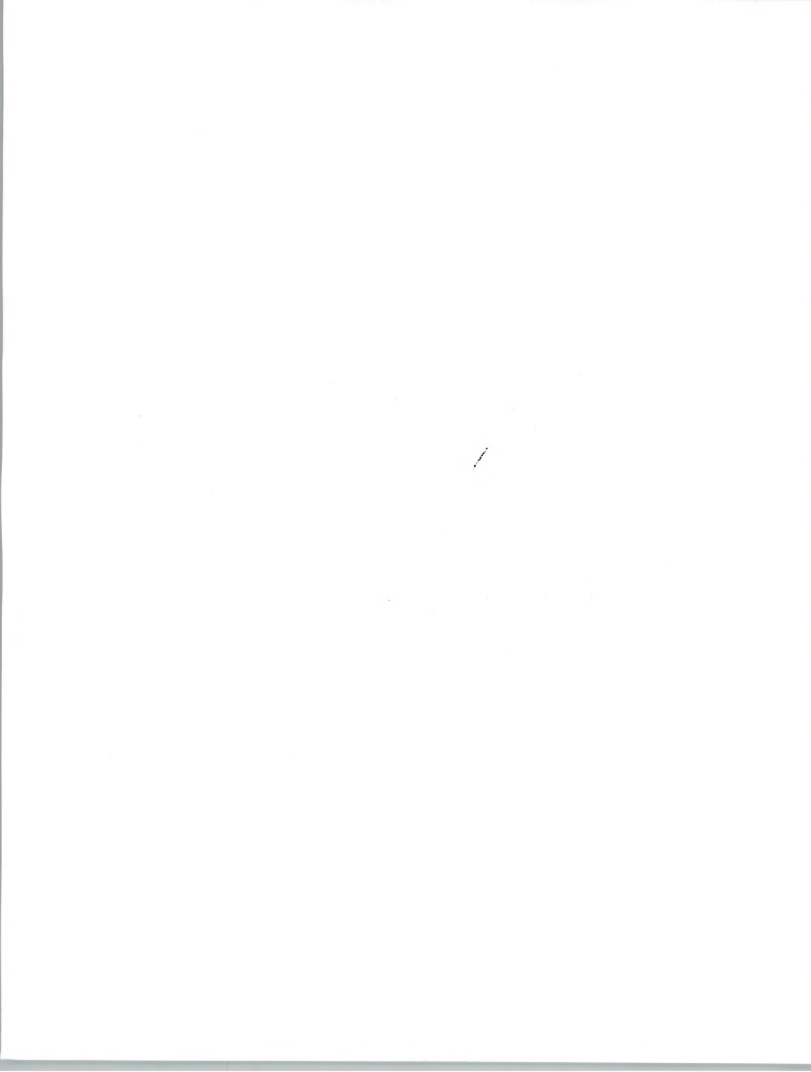
Trends, Events, and Issues

This chapter presents the significant trends, events, and issues affecting discrete manufacturers in the U.S. The conditions explored include the economy, the competitive picture, and the current business practices of re-structuring/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 discrete manufacturers as they re-engineer and implement TQM.

A

The Economy

As mentioned in the introduction, current analyses indicate a modest and prolonged recovery from the recent recession. With the exception of aerospace and defense-related industries, all major segments of the discrete manufacturing sector are predicted to return to revenue growth and profitability in 1993, with even brighter prospects through the following five years. The expected growth in revenues is accompanied by very modest increases in employment, especially in larger companies. The difference between the modest revenue and very modest employment growth rates forecasts productivity increases that are abnormally high, even for a recovery period.

During the latter part of 1992 many of the leaders in each market subsector absorbed huge "restructuring" losses (IBM alone wrote off $6 billion). If the write-offs were totally related to restructuring, then those companies should be prepared to advance rapidly in a growth economy. Combined losses of over $10 billion were reported by just four market leaders (Digital Equipment, Ford, General Motors, and IBM) in 1992.

Such losses tend to dominate the economic picture and can prolong recessionary trends, especially when the announcements include huge employment reductions. The numbers can easily distort the representation of profits for an entire industry segment.

Exhibit II-1 shows the 1993 estimates for the top ten segments of the discrete manufacturing sector. The segments are chosen by logical grouping rather than by strict SIC code. For instance, the entire 37XX code could be distorted by the predicted shrinkage in aircraft sales, which covers only code 3721. Conversely, all electronics (367X) would show greater than expected growth if semiconductors (3674) were included.

EXHIBIT II-1

1993 Market Forecast Data—Discrete Manufacturing
Logical Groupings, Ten Largest

SIC Code	Description	1993 Shipments ($ Billions)	1992-1993 Growth (Percent)
3711	Motor vehicles and car bodies	137.5	6.8
371X	Automotive parts and accessories	96.3	6.1
357X	Computers and peripherals	65.0	8.2
275X	Commercial printing	49.7	3.0
3721	Aircraft	41.4	-6.0
384X	Medical, dental, surgical equipment and supplies	38.7	8.2
366X	Telephone, radio, and TV communications equipment	36.2	2.0
3674	Semiconductors	35.6	12.0
367X	Electronics (not semiconductors)	35.1	3.9
3812	Search and navigation equipment	30.8	-3.1

Source: Department of Commerce

This report gives an overall picture of the opportunity for competitors in the marketplace and for vendors selling information services to the market's members. Evaluation of specific segments within the broadly defined sector can be performed separately. However, to identify the "hot" areas by rate of growth, Exhibit II-2 lists the ten fastest-growing
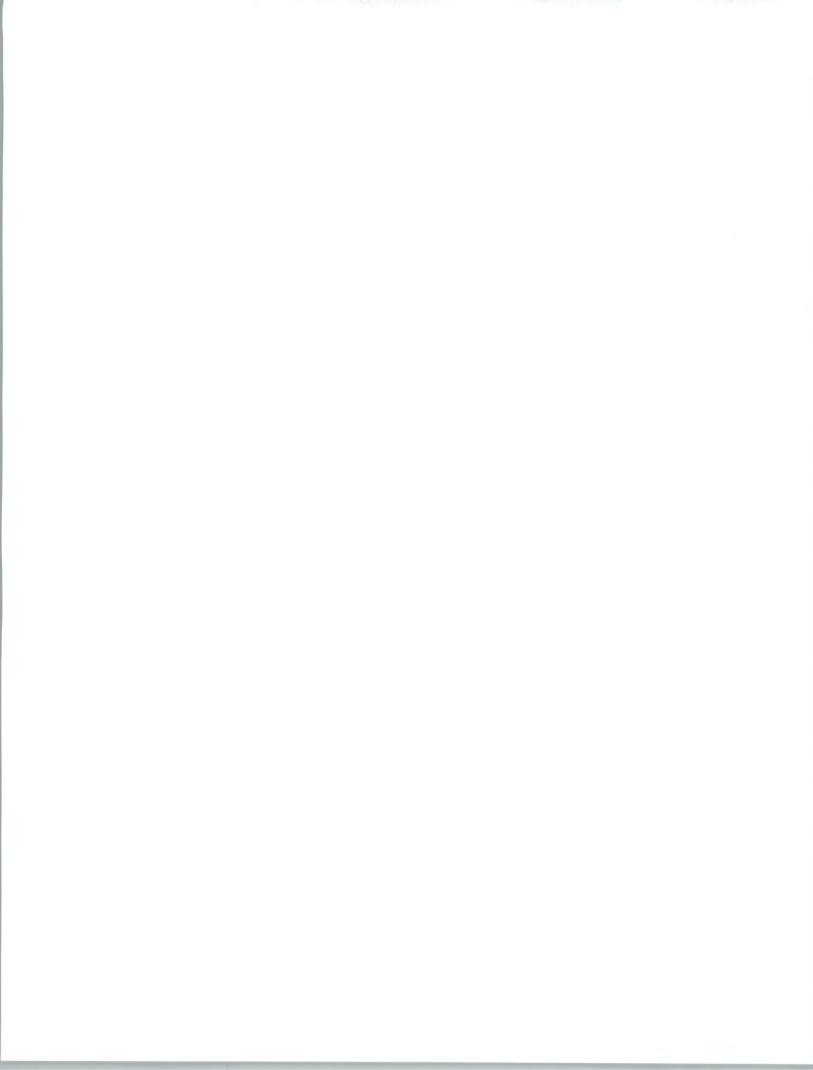
manufacturing industry subsegments (by percent growth) as identified by Department of Commerce data. Very narrow groupings are used here to eliminate any illusions created by abnormal performance in a particular SIC code.

EXHIBIT II-2

Discrete Manufacturing

Narrow Segmentation—Ten Fastest-Growing

SIC Code	Description	1993 Revenues ($ Billions)	1993 Growth Rate (Percent)
3674	Semiconductors	35.6	12.0
3841	Surgical and medical instruments	13.1	8.5
3842	Surgical appliances and supplies	13.5	8.5
357X	Computers and peripherals	65.0	8.2
3845	Electromedical equipment	7.3	7.8
3711	Motor vehicles and car bodies	137.5	6.8
3633	Household laundry equipment	3.4	6.7
3632	Household refrigerators and freezers	4.2	6.5
371X	Auto parts and accessories	96.3	6.1
3844	X-ray apparatus and tubes	3.3	5.6

Source: Department of Commerce

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. Certain parts of Southeast Asia are booming, partly as a result of U.S. companies outsourcing their production requirements to areas with lower labor costs. The opening of markets by the European Community offers excellent opportunities for capital equipment sales, particularly where high technology is involved, and in consumer non-durables markets.

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

- Tremendous cuts in the defense budget will be made, possibly affecting over 1,000,000 civilian jobs that surround military bases, and certainly causing a reduction in direct orders for defense equipment.

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

- Taxes will be increased substantially for businesses, particularly for 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 are poised to capitalize on emerging competitive opportunities. Responding to 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 competitive price, and assuring customer satisfaction. The approach mandates responsiveness to individual customers and to entire market needs; thus, a truly market-driven business will prosper.

The overriding trend in discrete 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.

- The semiconductor industry, after losing major market shares, began restructuring in the mid-1980s. It has now regained the number one world-wide market position from the Japanese and has become the fastest-growing narrow-industry segment in the U.S.

- The domestic automotive industries, after eight years of declining market share, are showing a resurgence. By far the largest industry in the U.S. and theoretically operating in mostly "mature" markets, they are expecting combined growth of $14.3 billion (6.5% rate) in 1993.

- The computer and computer peripheral companies are maintaining strong competitive postures. An 8.2% growth prediction for 1993 is higher than earlier expectations and especially positive when consideration is given to the eroding positions of the traditional market leaders.

- Heavy capital equipment, after a decade of market share loss, will regain profitability in 1993. This is a domestic industry which was considered dead *prior* to the recession.

- Instrumentation companies, especially in the medical fields, will continue strong growth, and appear to be making inroads against previously stronger foreign competition.

As companies in the discrete sector began fighting foreign competition with new practices, they found themselves in "market leader" positions. Now other companies are joining the march toward "excellence".

The new principles are proven; they are being used and they are being implemented. 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.

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 discrete manufacturing companies. Although it has many elements, the major factors are listed in Exhibit II-3.

EXHIBIT II-3

Discrete Manufacturing

Facets 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.

                                          MVD

The use of cellular concepts in manufacturing has brought positive change to the work environment. The old hierarchical structure is noted in Exhibit II-4. The old structure has given way to a new way of conducting business activity, as shown in Exhibit II-5.

EXHIBIT II-4

Discrete Manufacturing

Old Hierarchical Structure

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

  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
  │Corporate sales│  │  Corporate   │  │  Corporate   │
  │    staff      │  │   control    │  │  engineering │
  └──────────────┘  └──────────────┘  │    staff     │
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┌────────┐ ┌──────────┐ ┌────────────┐ ┌──────────┐ ┌────────┐
│Customer│ │ Product  │ │ Plant staff│ │  Plant   │ │ Plant  │
│service │ │  sales   │ │ management │ │engineering│ │control │
└────────┘ │  staff   │ └────────────┘ └──────────┘ └────────┘
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                    │ management,  │
                    │ all products │
                    └──────────────┘

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│Receive,│ │ Assembly,│ │Store, inventory│ │ Ship │ │ Report │
│  test  │ │   test   │ │   control   │ └──────┘ └────────┘
└────────┘ └──────────┘ └────────────┘
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EXHIBIT II-5

Discrete Manufacturing

Re-Engineered 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, from design to movement out of the cell!

The new cellular structure leads to worker empowerment and accountability. With quality and service as the key watchwords, the ability to react must reside at the point of opportunity or problem.

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

• Product life cycles are shortening dramatically, and "time to market" for new products is keeping pace with the change. Companies like Ford, Hewlett-Packard, Motorola, and Xerox all report reductions of 50% or more in the time required to go from concept to market introduction of new products. Much of the reduction is due to concurrent/simultaneous engineering methods being used. Products are also being designed for easier manufacturing.

• Order-receipt-to-shipping cycles have contracted. Motorola pagers went from three weeks lead time to two hours. A General Electric controls plant dropped from six months lead time to three weeks. Aside from better customer service, these improvements also offer financial benefits in terms of lower inventories and fewer returns.

• Quality improvement reports are staggering. Scrap reductions typically are improving from the 3-5% range to less than .5%. "Rework" in companies like Hewlett-Packard has been reduced to almost insignificant numbers.

• Cycle reductions and improved quality lead to customer satisfaction. Add the ability to use computers and automation to track production lots and serial numbers, and the manufacturer has the means to continue satisfaction through better and quicker service *after the sale*.

The 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) with a positive effect on overall performance. Operations that don't fit a company's normal practices are often outsourced. Product lines are being sold to implement redefined cororate strategies. General Dynamics is the best example; also IBM removing itself from most applications software businesses. Professional services are being contracted out rather than adding internal personnel. Middle management jobs are being eliminated. There are numerous reasons for all this:

- In the past, heavy taxes (50%) and high profitability made an employee's cost appear to be lower. 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 many diverse businesses, too much duplicated overhead, and heavy debt burdens (often causing losses simply due to interest charges). Streamlining and downsizing became necessary for survival.

- The Japanese have proven that high quality, fair prices, and customer satisfaction are all achievable on a profitable basis.

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. The projects are leading to a re-emergence of the importance of computer-integrated-manufacturing (CIM). The original attempts at implementing CIM were 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 for networking (local area networks and client/server approaches), operating systems standards, and relational data bases are bringing true CIM closer to reality.

D

Regulatory Issues/Events

The main change on the regulatory front for discrete manufacturers is the trend toward self-regulation. In order to sell to many larger companies, it will be necessary to demonstrate a willingness to implement the new TQM practices. Companies like Ford, Motorola, and U.S. West require such programs, and they often require (by contract) that a vendor apply for the Baldrige Award. The entire European Community will require conformance to ISO 9000 standards (similar to requirements for Baldrige Award competition, plus delineation of operations and processes). 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
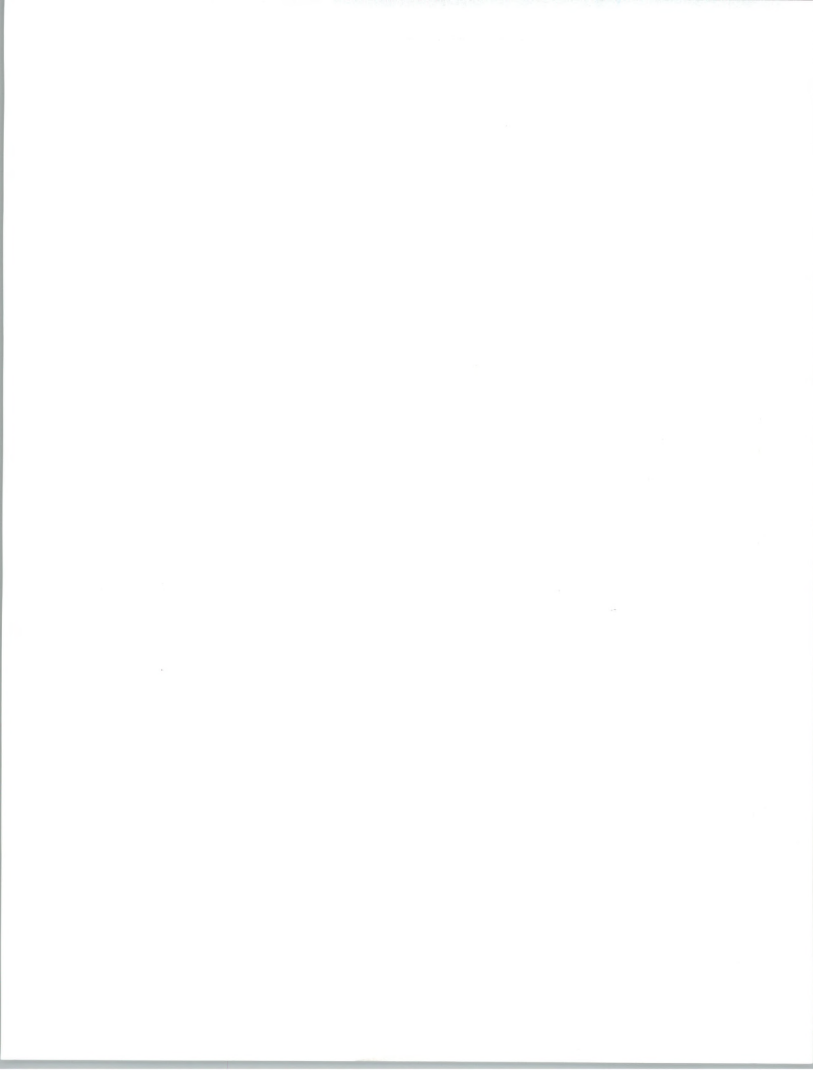
Information Systems Environment

With the emergence of a brighter 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, recent INPUT user surveys show 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% of 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. Exhibit III-1 offers an example of a downsized evironment.

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	1. Data capture/editing	1. Automated processes
2. Knowledge-based	2. Report preparation	2. Secure processes
3. High-resolution I/O driver	3. Personal data bases	3. Data entry and editing
	4. Personal productivity	4. Information retrieval
	5. Continuous Learning	

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 packaged software are regarded by the majority of survey respondents as of equal or greater importance than corporate IS.

III-2   MVD

EXHIBIT III-2

Discrete Manufacturing
Source of Development Resources

Source

Source	Number of Responses
Divisional IS	81
Packaged Software	75
Corporate IS	75
End-User Staff	66
Other Services	32
Systems Ints.	17

Number of Responses
0   20   40   60   80   100
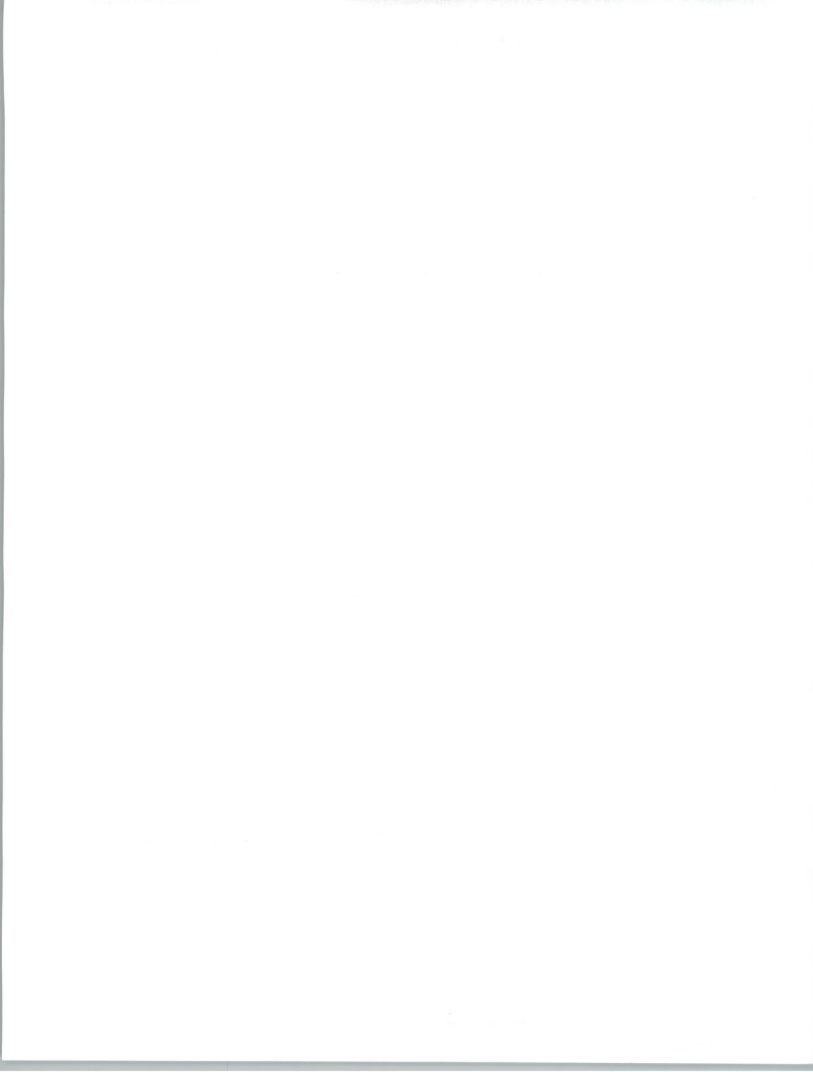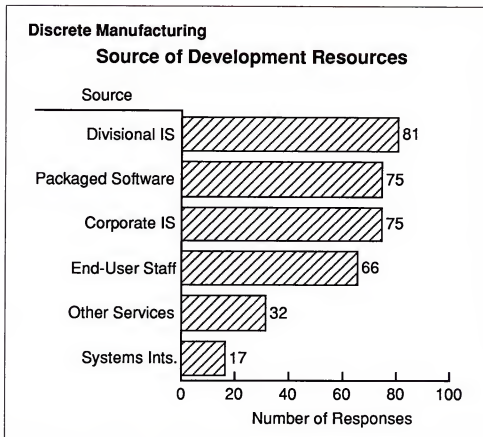
Several advances in technology have added to the ability to move information to the end-user in a manufacturing environment. These include:

• Reduction in computing costs.

• Increased local-area network (LAN) power.

• The advent of relational data base management systems (RDBMSs).

• The adoption of some standards for "open systems;" UNIX is 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-3 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-3

Discrete Manufacturing

Old Manufacturing Control Hierarchy

Left column	Diagram	Ref
Corporate Management	Corporate/division computer — Corporate CAD computer — DB	1
Plant staff management	Plant computer — DB	1,3
Line management (Matls., Operations, Mfg. Eng., OC, Finance)	Line computer / Line computer / Line computer — DB / WAN or LAN	1,2,3,4
Area Supervision (Prod./Inv. control, Assembly, Test, Receiving, Warehouse, Shipping, Dist.)	DB — Area computer / Area computer — DB / LAN	1,2,3,4
Production Resources (People, Tools, Equipment)	Material handling / Tools / Decision support / SFC / Work-station mgmt. / Preventative maint.. / Data collection	1,2,3,4

1 = Software integration
2 = Hardware integration
3 = Plant scheduler
4 = Quality monitor

DB = Data base
WAN = Wide-Area Network
LAN = Local-Area Network
SFC = Shop Floor Control

Current concepts being used, as business re-engineering takes place, are much simpler in structure, as shown in Exhibit III-4.

EXHIBIT III-4

Discrete Manufacturing

CIM in the Re-Engineered Business
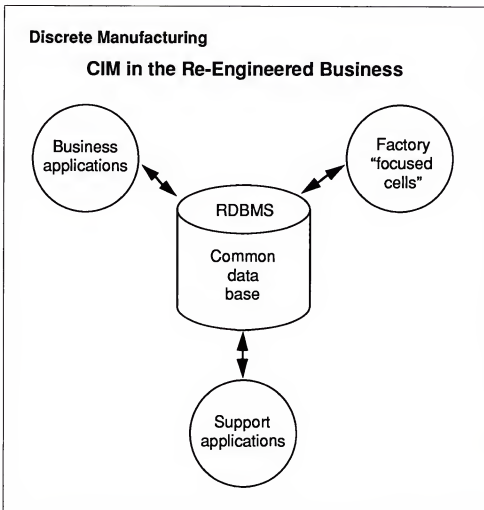
Each focused cell can now access the data it needs and information is shared by all. Exhibit III-5 shows the relationship of new IS structures to the re-engineered business. It also shows the opportunities for the use of information services for a variety of purposes, and all in a totally integrated environment.

EXHIBIT III-5
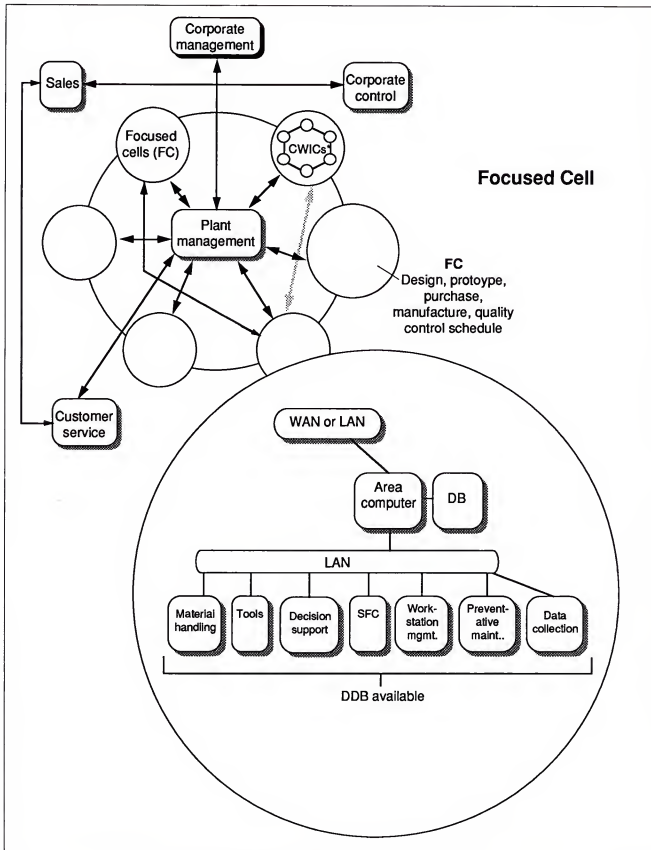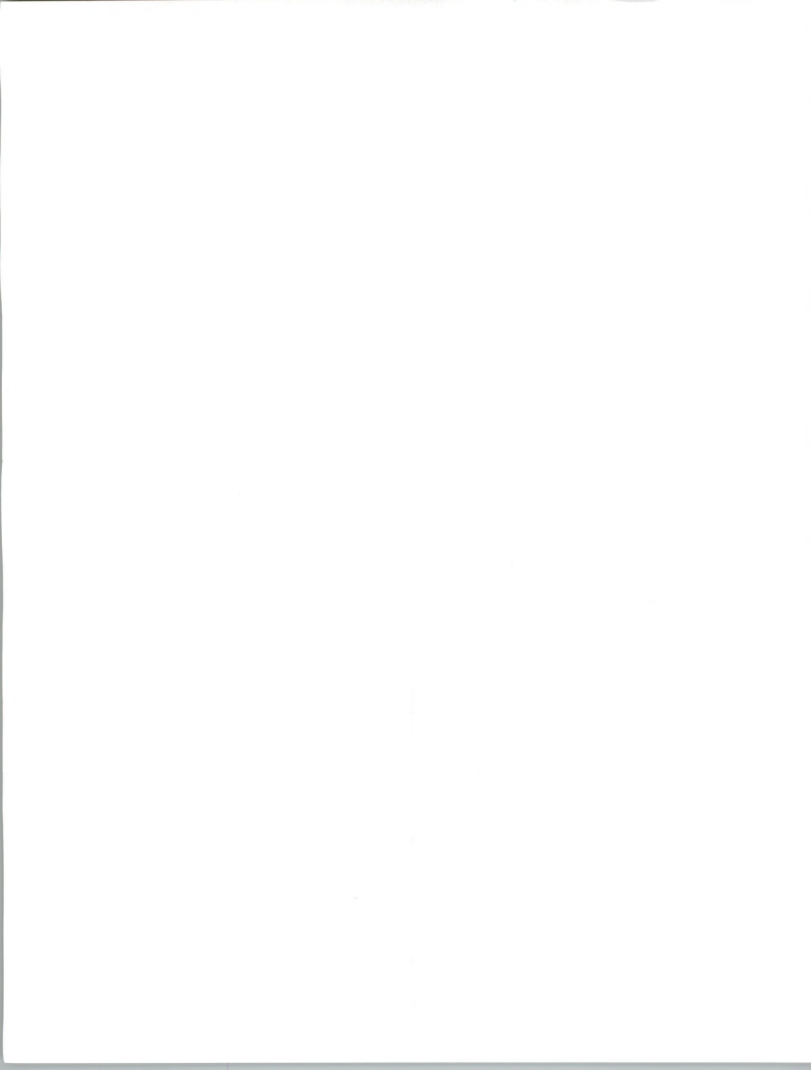
C

CIM and Open Systems

The obvious need is for "interconnectivity" and "interoperability" or, as the market responds, "open systems."

As noted in Exhibit III-6, respondents to an INPUT survey were asked to indicate the primary target platform (C/S-workstation/PC, minicomputer, or mainframe) for each application. Multiple responses were permitted. Exhibit III-6 shows the response levels for each category and indicates that approximately 50% of all the applications under development for the industry will utilize some sort of C/S, workstation or mini-based strategy for implementation. We relate this to an "open systems" beginning.

EXHIBIT III-6

Discrete Manufacturing

Target Platforms—Discrete Manufacturing

Platform

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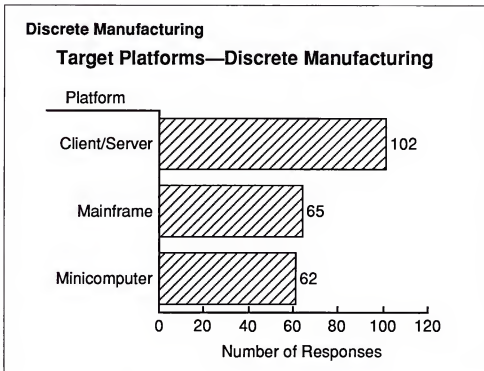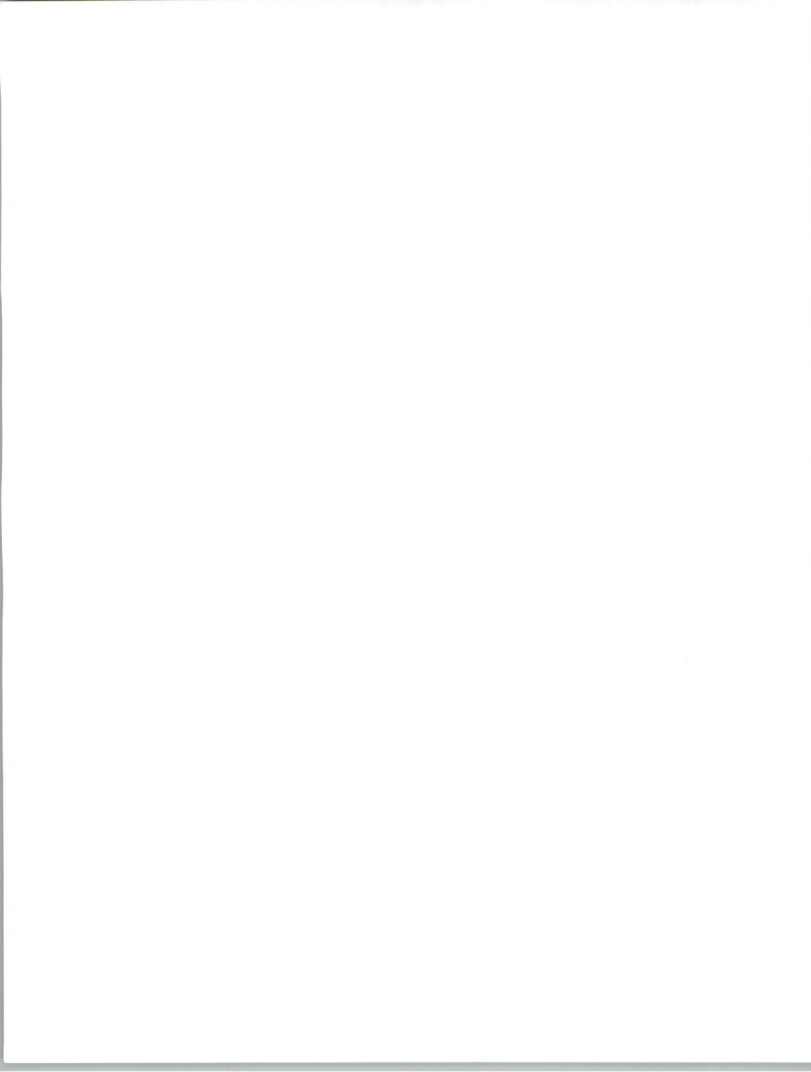
Little needs to be discussed concerning the lower costs of computers and the increases in their power and speed. The trend is expected to continue indefinitely as the semiconductor industry improves its products.

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 decline. It will be necessary for the RDBMS vendors to create a "co-existence" environment, because users will implement multiple RDBMS applications 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 is 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 shows 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.
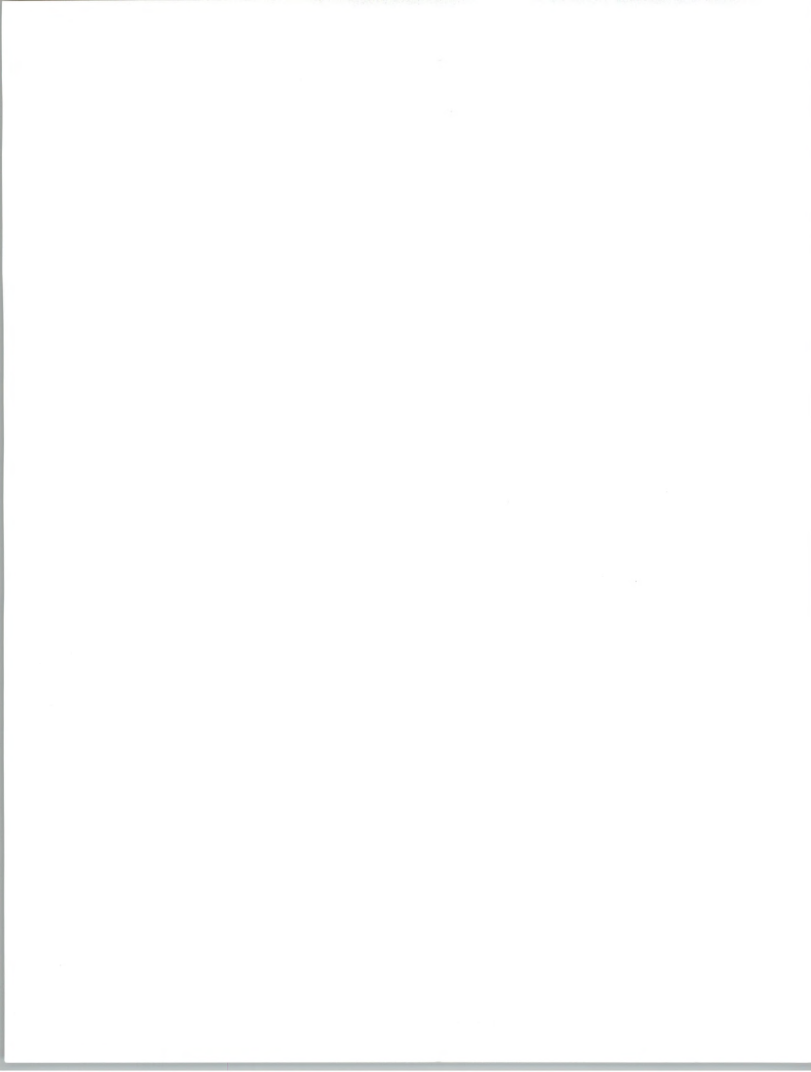
- EDI, begun in the early 1980s by the automotive industry, has become a necessary component of the manufacturing systems environment. Many large companies like Ford, Motorola, and Sears have informed vendors that EDI must be used or the clients's business will go elsewhere. EDI capabilities are moving 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 that were interviewed agreed that object-oriented programming (OOP) is the wave of the future in working toward 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 were redesigning or developing for one or more products, and OOP principles were 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.

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
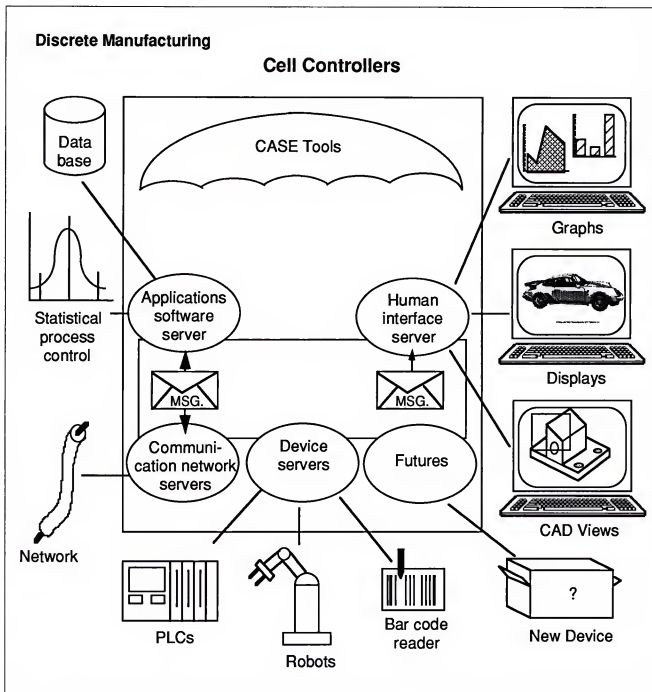
Exhibits III-8, III-9, III-10, and III-11 show where opportunities for specific expertise and applications should appeal in the 1990s. The areas are divided into those functional separations which are derived from re-engineered structures. As open systems proliferate, so will the opportunities for specific applications development.

EXHIBIT III-8

Application Use by Discrete Manufacturers
Strategic and Planning

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

EXHIBIT III-9

Application Use by Discrete 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
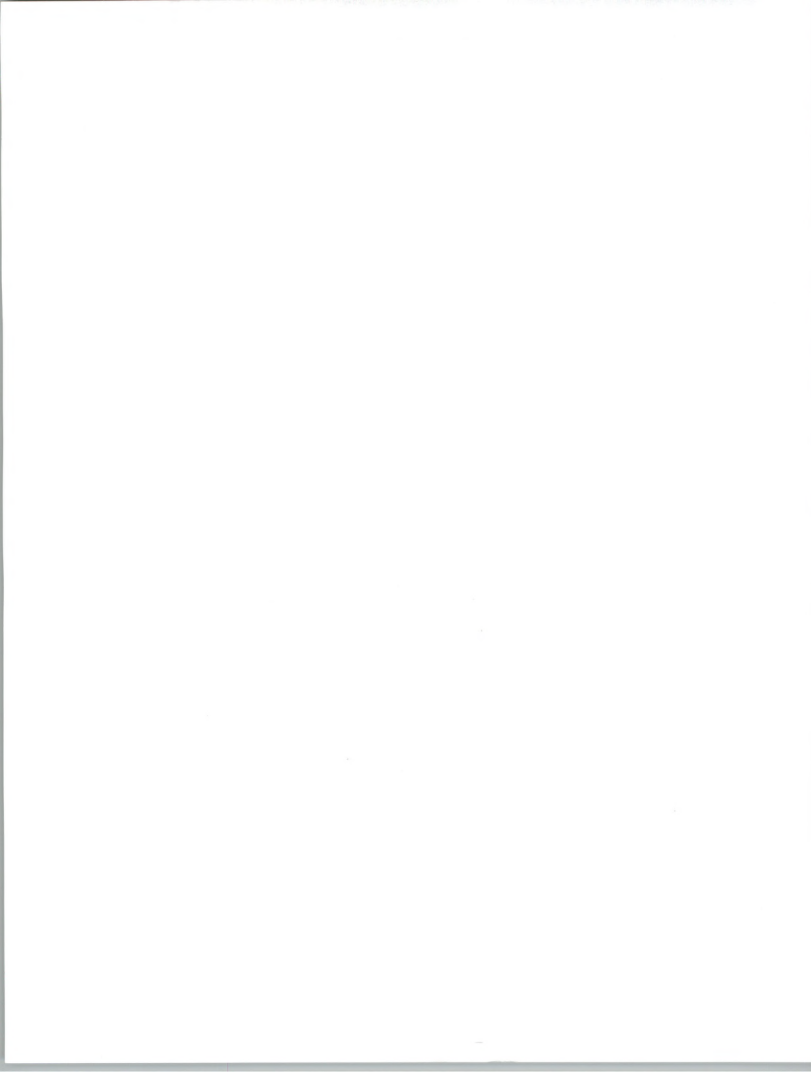
About INPUT

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.

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Analysis of Information Services, Software and Systems Maintenance Markets
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- 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.

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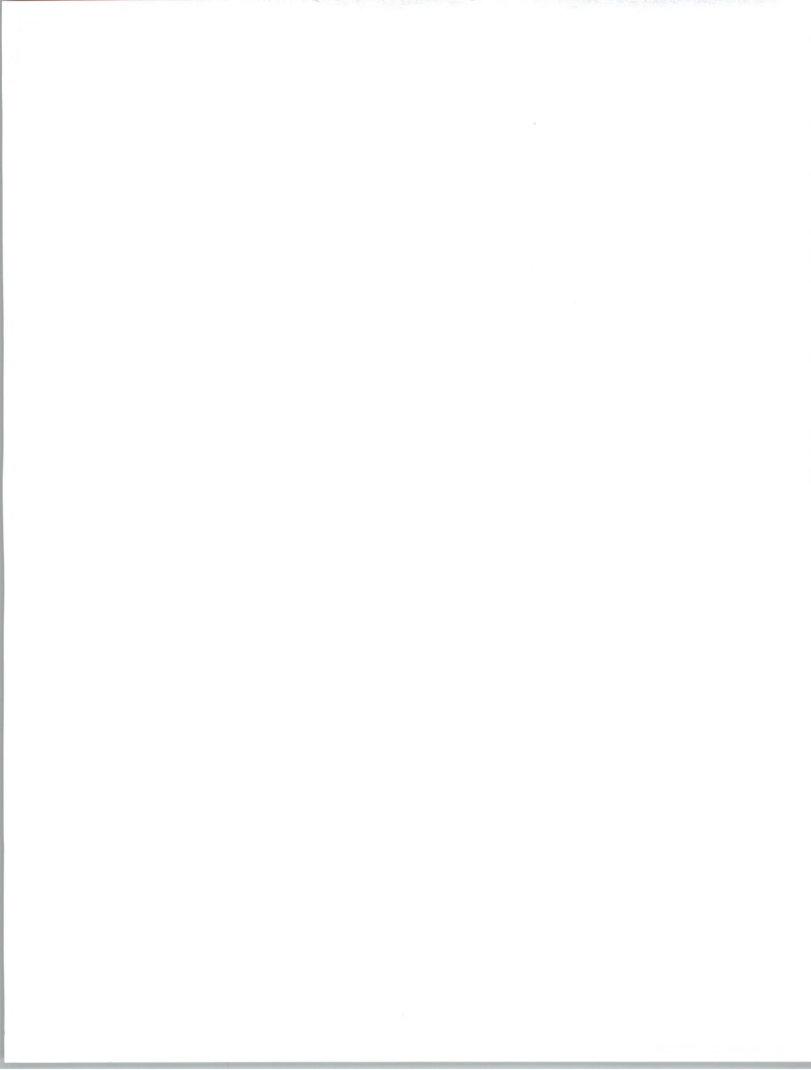
EXHIBIT III-10

Application Use by Discrete Manufacturers
Control and Accounting

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

EXHIBIT III-11

Application Use by Discrete Manufacturers
Support

- Customer service
  - Serial and lot control by site
  - Maintenance scheduling
  - Call handling
  - Follow-up
- Engineering
  - Design
  - Prototype
  - 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 parts 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

- Keeping lot numbers and serial numbers (from production) associated with customer data, especially for servicing after delivery.

- Call handling and follow-up.

- Maintenance scheduling, both preventive and emergency.

There are other elements to the concern for responsiveness that nearly all discrete manufacturers are facing. The most difficult one is "configuration." With all companies keeping inventories at a minimum, a common desire is to wait until the last minute to configure an assembly. Many companies are using an artificial intelligence (AI) approach to solve the problems faced when promising delivery. As an example, Ford Motor plant has installed a product that can select from over 500 options within 15 seconds. The AI program can logically determine mutually inclusive and exclusive options, compare inventory availability, and give a delivery time without human intervention. A Harris Corporation Division uses a similar program to select from over 2,000 options for communication devices.

A surprising number of companies are anticipating a complete change in their Manufacturing Resource Planning (MRP) II packages. Nearly all of 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. 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. Since the typical client/server MRP II system is sold by "seat" (number of concurrent users), it can be relatively inexpensive to start up a new system and then add seats as the implementation matures.

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

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.

There are significant differences in the plans for IS, based on the size of a company. Size segmentation can normally be divided by annual revenues as follows:

Small   =   < $20,000,000
Medium   =   > $20,000,000 < $50,000,000
Large   =   > $50,000,000 (or division of large company)

The smaller companies are not covered in this analysis. The differing characteristics between large and medium companies are noted in Exhibit III-13.
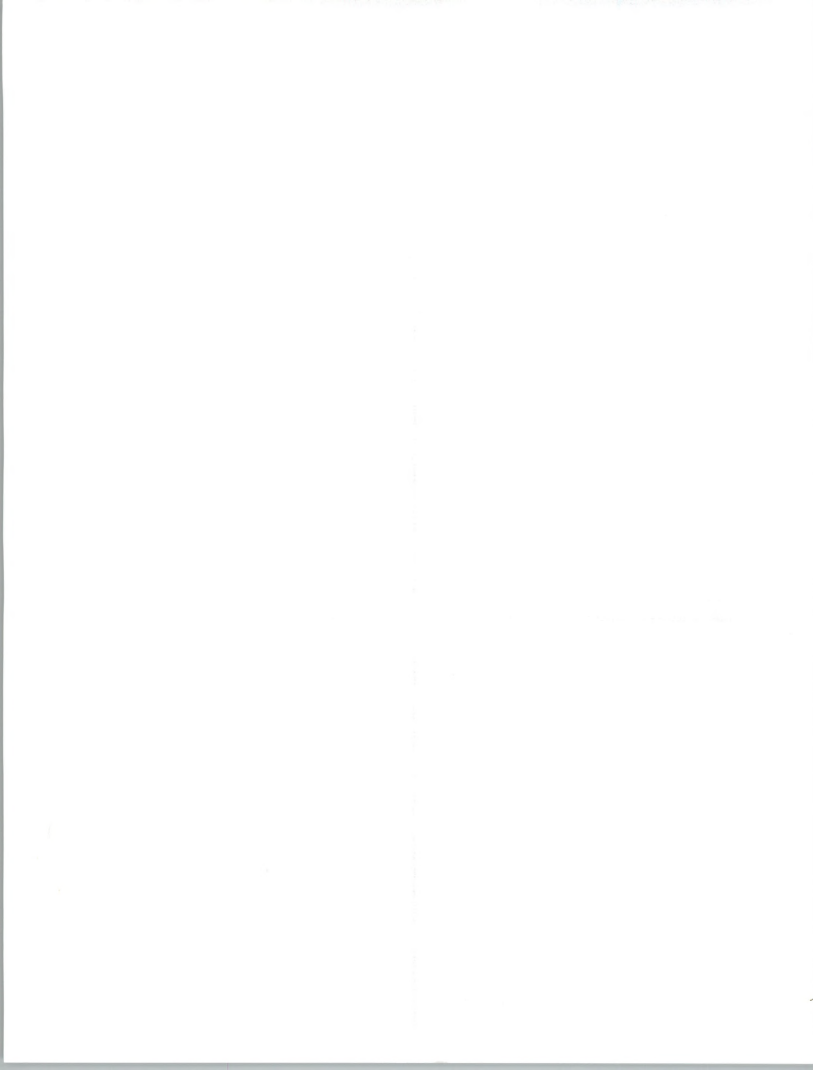
EXHIBIT III-13

Discrete Manufacturing

Characteristic IS Plans
Large and Medium-Sized Companies

Large	Medium

• Protect legacy systems
 	
  - Need "open" systems
 	
  - Buy fewer services from software
    vendor
 	
• Maintain IS staff
 	
• Is closer to final TQM
 	
• Take longer to buy
 	
• Has stringent requirements
 	
• Is less likely to be able to quantify
  benefits quickly
 	
• Does committee buying
 	
• Heavy use of third-party consulting
 	
• Not as concerned about vendor stability
	• Top executives involved in purchases.
	  Can apply benefits quickly
	
	• Decide more on intuition than on total
	  productivity concerns
	
	• Look for industry expertise/experience
	
	• Install quickly
	
	• Look for total solution from one source
	
	• Buy more technical contract services
	
	• Will want a lot more as time passes

The differentiation between the sizes is important to both the buyer and the seller of application software products. Industry expertise will be a key in both segments. For large companies, the expertise can be in a particular niche within the company's industry, i.e., customer support requirements are markedly different for consumer products than they are for business products. For smaller companies, general business *and* manufacturing industry expertise are valuable because when they buy a total solution, they have just "bet the business" on a successful implementation.

IV
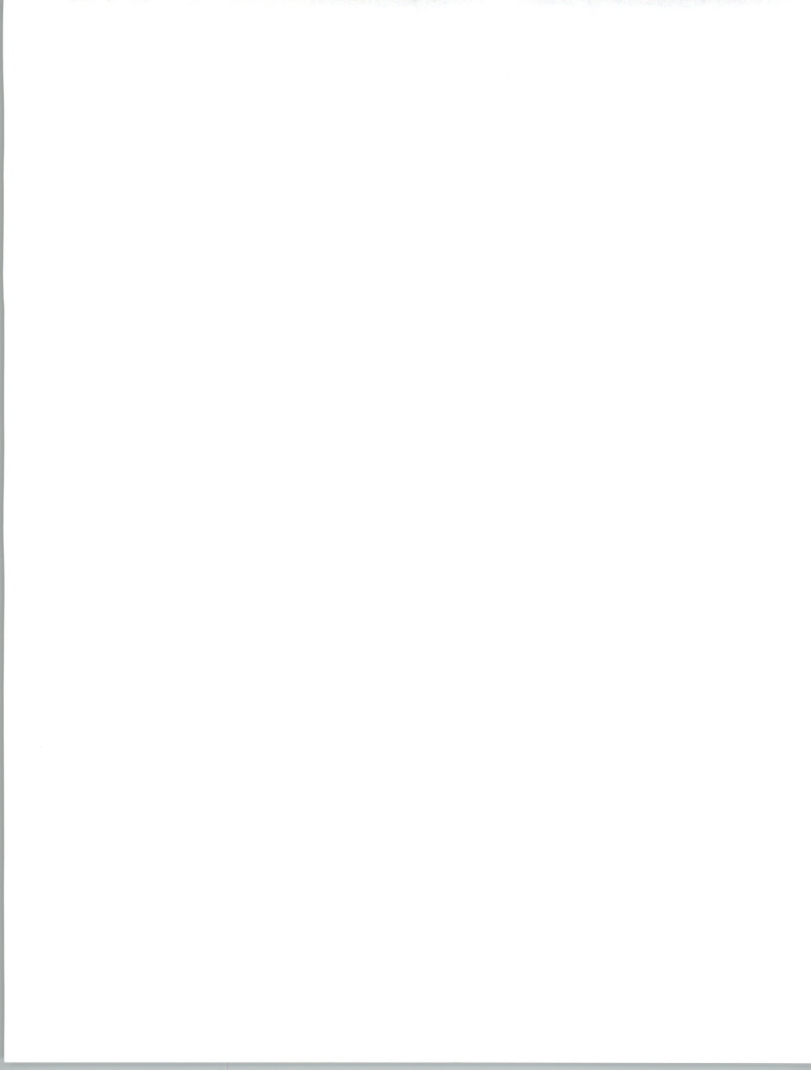
Information Services Market

A
Overview

The market for information services in the discrete manufacturing sector is expected to continue to have healthy growth through 1998. The analysis in this chapter is presented by seven delivery modes. They are:

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

As shown in Exhibit IV-1, the total market for these services is forecast at $14.6 billion in 1993 (a 12% growth over 1992), expanding to $28 billion in 1998, for a compound annual growth rate (CAGR) of 14%.

There are a number of reasons for the projected growth in the discrete sector. INPUT's surveys show that 50% of those 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 category of new expenditures by the market members. Only 70% of the respondents were actually eliminating the mainframe applications entirely, so downsizing bespeaks 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 corporate financials, and will also perform double duty as a "super-server" in the client/server environment.

Discrete Manufacturing Sector Information Services Market, 1993-1998
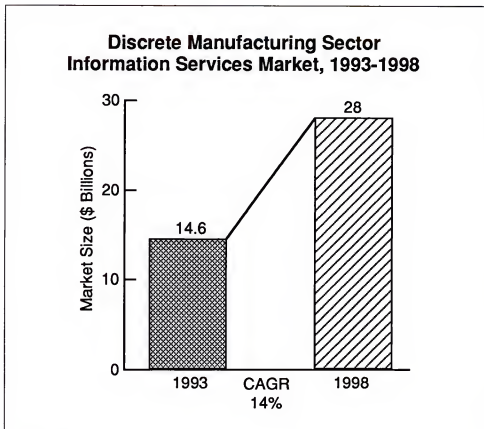
A late-1992 study by Deloitte & Touche noted that manufacturers spend, on average, 2.5% of revenues on information services. For purposes of this analysis, we do not include expenditures for hardware or "cross-industry" applications (such as financials, CAD/CAE, office systems, or human resources), and those items typically represent 60% of the total information services budget. That leaves 1% of total revenues available for services expenditures in the seven delivery modes analyzed in this report.

INPUT anticipates expanded growth rates during the latter part of the forecast period As changes to company infrastructures occur, the IS function will be playing catch-up. For example, in the next iteration of change, object-oriented programming (OOP) will become a standard for program development. The 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

Re-engineering - The re-engineering of business processes is the major force behind change and growth in the IS 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 migrating to line roles. The move to client/server environments is compatible with this new structure.

Competition - Strong competition among the vendors is aiding growth in the IS market. All participants are developing systems or offering products/services in an embryonic open systems mode. In each delivery mode category there are several vendors with strong capabilities and, in general, no single vendor that has gained dominance. With the addition of many new vendors in the last decade, the lack of differentiation among products, and the lack of dominant vendors, there is a scramble for market share that leads to price reductions. Such price reductions for system solutions, when added to significant hardware price reductions, make for easier purchase justifications and are contributing to the market's rapid expansion.

User knowledge - User knowledge is an important aspect of IS 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 niche expertise.

2. Growth Inhibitors

Customization - Although strong market growth is predicted for most delivery modes, it would be stronger if truly open systems were being deployed. The requirement for customization of products to achieve integration slows both the implementation of systems solutions and the recognition (and realization) of benefits. While professional services vendors and systems integrators will benefit from such customization, total market expansion would occur more rapidly if there were less need for product modification. The allocation of dollars, by category, should change over the forecast period toward more product sales as open systems become available.

Training - Training personnel to use new product systems in the re-engineered business is taking longer than expected. Product vendors, pressured by price competition, are not conducting the in-depth training programs that they would like for their own personnel. In addition, the expertise required to buy, sell, implement, and use systems solutions is often not present. To implement new systems, many decisions are required of users, and they are frequently "committee" decisions. With the combination of untrained buyers, untrained sellers, untrained implementors, and "look-alike" products, decisions can be delayed beyond reasonable time periods, while committees perform seemingly endless evaluations. Third-party consultants are often hired to assist in the evaluations, adding another element to 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 and difficult implementation cycles.

Replacement Systems - Most systems solutions being purchased today are replacement systems. This type of purchase is essentially a re-allocation of budget dollars rather than new IS market growth. During the forecast period, however, budgets will expand to include additional new, rather than just replacement, purchases.

B
Delivery Mode Analysis

Exhibit IV-2 displays expenditures and growth rates by delivery mode.

1. Professional Services

The largest category of information systems expenditures is professional services. At $5.2 billion, and growing at 8% throughout the forecast period to $7.5 billion, it represents a substantial market. This service mode is comprised of three components.

a. Consulting

Consulting services are offered in numerous ways. There are large firms, like IBM and CSC, that offer complete services for business re-engineering. Firms, like the "Big-Six," offer specific services for the purchase and implementation of solutions. Many smaller companies and individuals offer expertise in niche areas and/or geographic locales. 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. INPUT sees growth continuing at 12% to 13% through 1998.

EXHIBIT IV-2

Discrete Manufacturing Market Size by Delivery Mode, 1993-1998

Delivery Mode	1993	1998	CAGR (Percent)
Professional Services	5.2	7.5	8
Applications Software Products	2.7	7.2	22
Turnkey Systems	3.3	5.7	12
Systems Integration	1.6	4.0	20
Processing Services	0.9	1.0	3
Systems Operations	0.9	2.2	21
Network Services	0.1	0.3	21

Market Size ($ Billions)

Note: Values are rounded
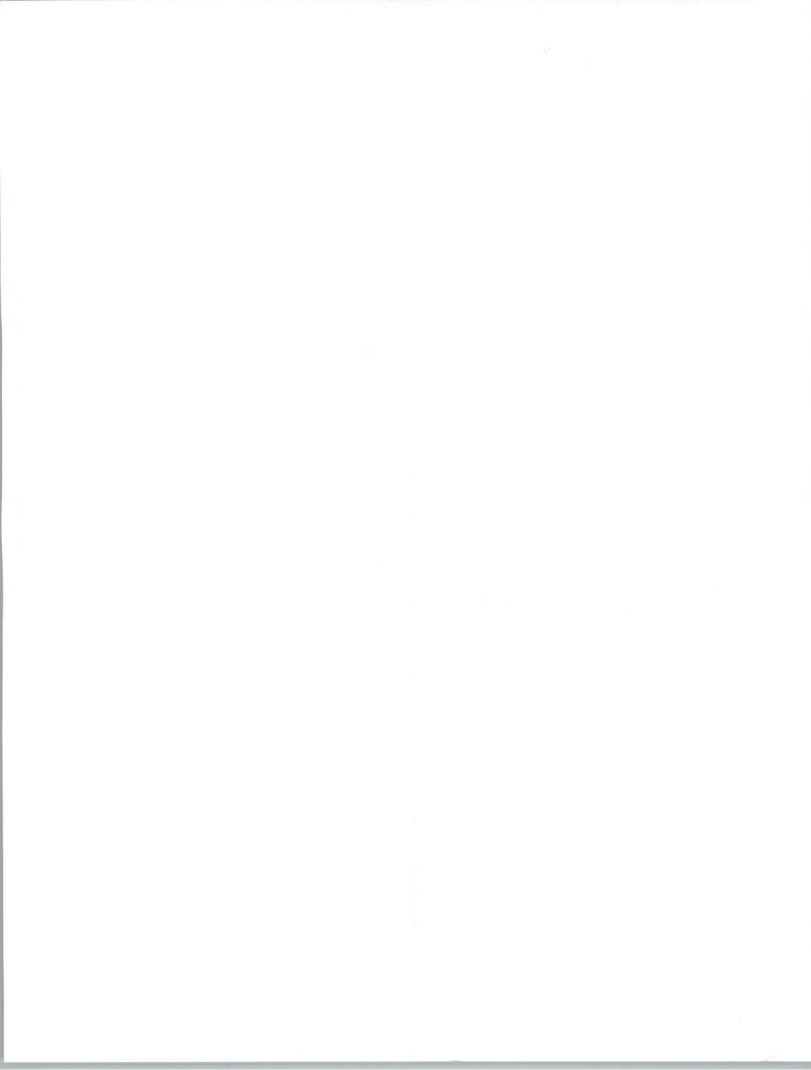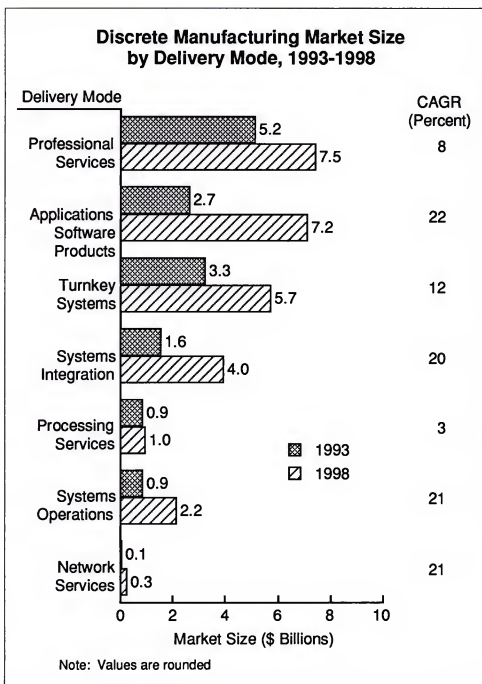
b. Education and Training

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 the industry moves towards open systems and object-oriented programming, INPUT forecasts a continued 10% growth in education and training services, from $500 million in 1992 to $1.3 billion in 1998.
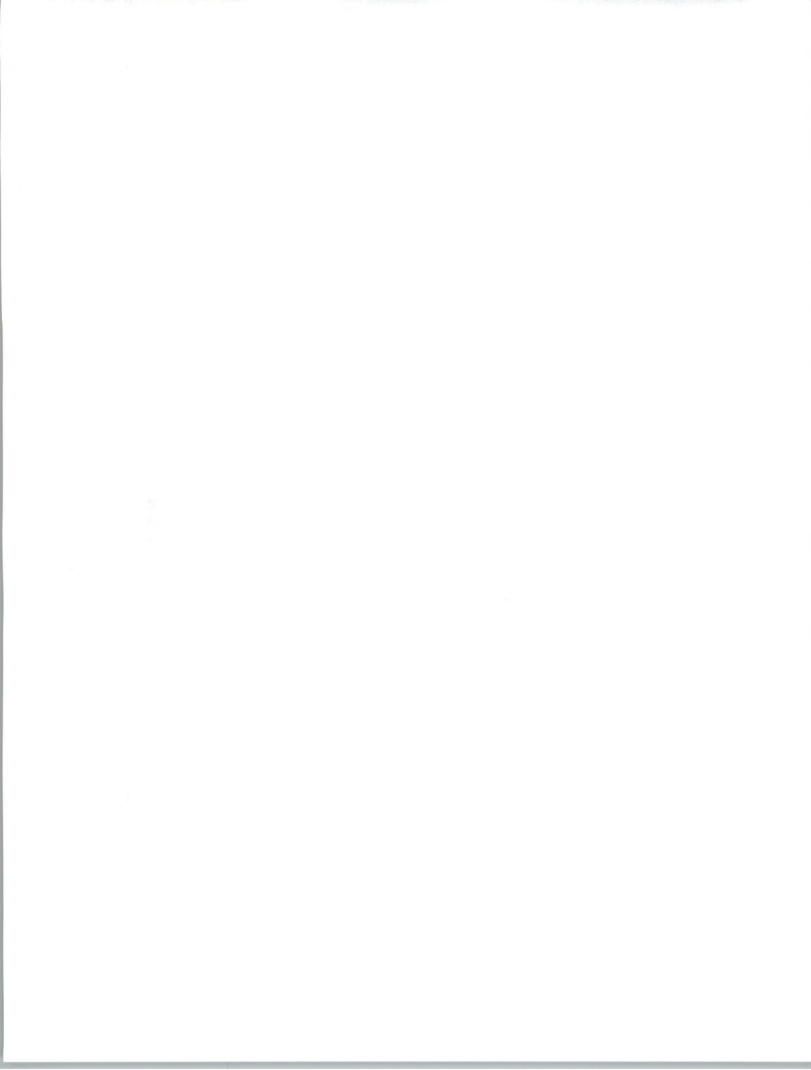
c. Custom Software

The importance of custom software will continue to diminish through 1998. With the advent of CASE tools, 4GLs, and refined functionality from vendor products, budget dollars will move towards the purchase of products and expenditures for custom development will decline.

2. Turnkey Systems

The second largest delivery mode is turnkey systems, at $2.9 billion in 1992, somewhat lower than predicted in INPUT's last report. The prolonged recession, the move to client/server environments, and business re-engineering all contributed to slower growth than expected. New systems developments by some major vendors, like ASK and SAP, have been slower getting to market than originally planned. This mode should continue growth at 12% through 1998, to $5.7 billion.

Turnkey systems represent the delivery of a complete system by one vendor. All elements, including hardware, application software, systems software, and professional services are delivered and serviced by that vendor. This mode will change during the next decade as niche application solutions are developed for the open systems environment. There is some indication that new entrants with specific solutions will form alliances with the present major turnkey vendors, thus adding strength to the already strong. Conversely, there is a counter-move among major users to gain "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 deliver solutions.

The competitive environment , at present, is limiting growth for turnkey systems. This will change as open systems market leaders emerge in the next three to five years. The hardware portion of turnkey system expenditures is expected to maintain a 6% growth rate in spite of dropping prices, mainly due to increased unit purchases in the client/server environment.

3. Applications Software

Applications software will be the fastest-growing delivery mode, at a CAGR of 22% through 1998, although growth is expected to remain at 18% for 1993. Standing at $2.3 billion in 1992, expenditures should reach $7.2 billion by 1998, almost equaling the current delivery mode leader (professional services). Applications software is divided into three segments:

a. Mainframes

The predictions of the total demise of the mainframe business are premature. Mainframes will still be used to perform many application functions in multi-plant environments. They will also be used as superservers in the
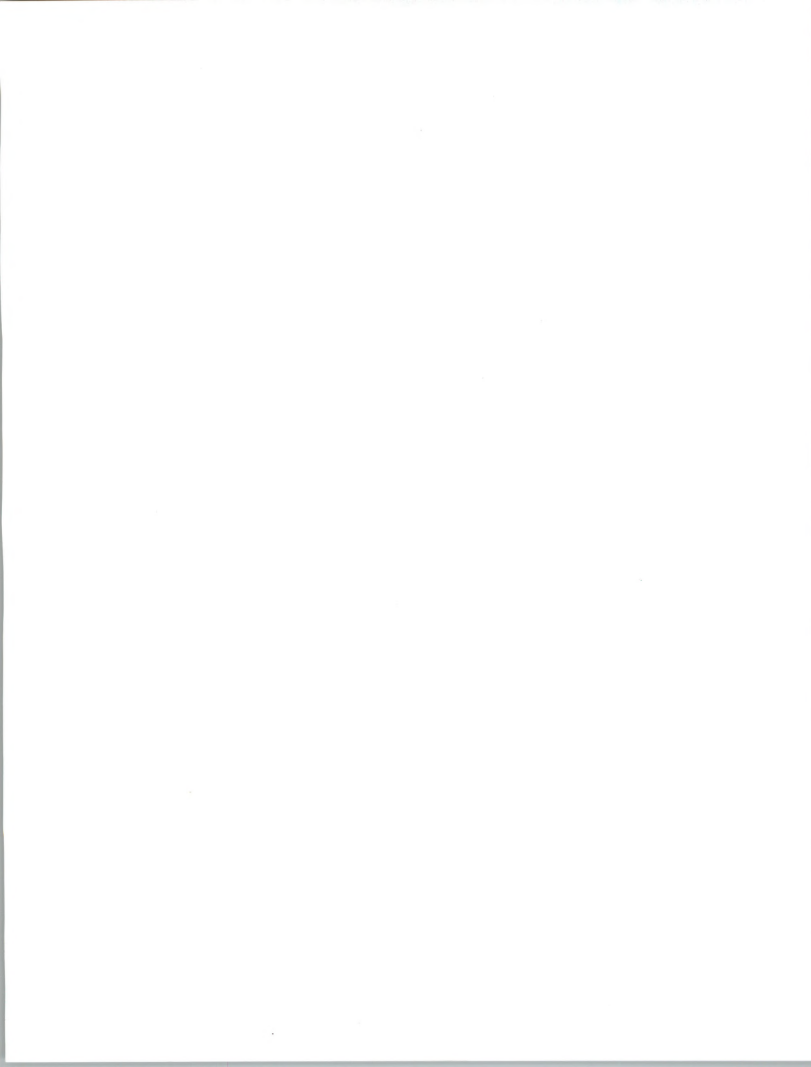
client/server environments and as network managers. Many applications that are planned for migration from mainframes will remain on mainframes until total conversions are completed, causing continuing payment of software maintenance charges.

b. Minicomputers

Minicomputer applications will grow at 11% 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 much of the software maintenance revenues will continue to be received by the minicomputer application vendors.

c. Workstation/PCs

Explosive growth is forecast for workstation/PC applications. At $750 million in 1992, a CAGR of 35% will continue through 1998, yielding a market of $4.5 billion—the largest subsegment of any delivery mode.

Expenditures by platform size are summarized in Exhibit IV-3 .

EXHIBIT IV-3

Discrete Manufacturing
Applications Software Products Expenditures by Platform Size, 1993-1998

Market Size ($ Millions)

Note: Values are rounded

Workstation/PC 1,010 / 4,530
Minicomputer 1,275 / 2,150
Mainframe 410 / 520

1993
1998
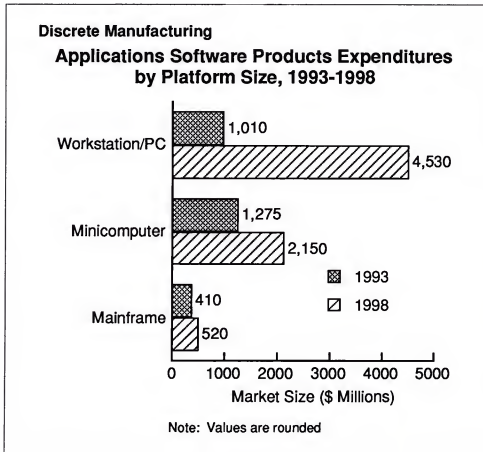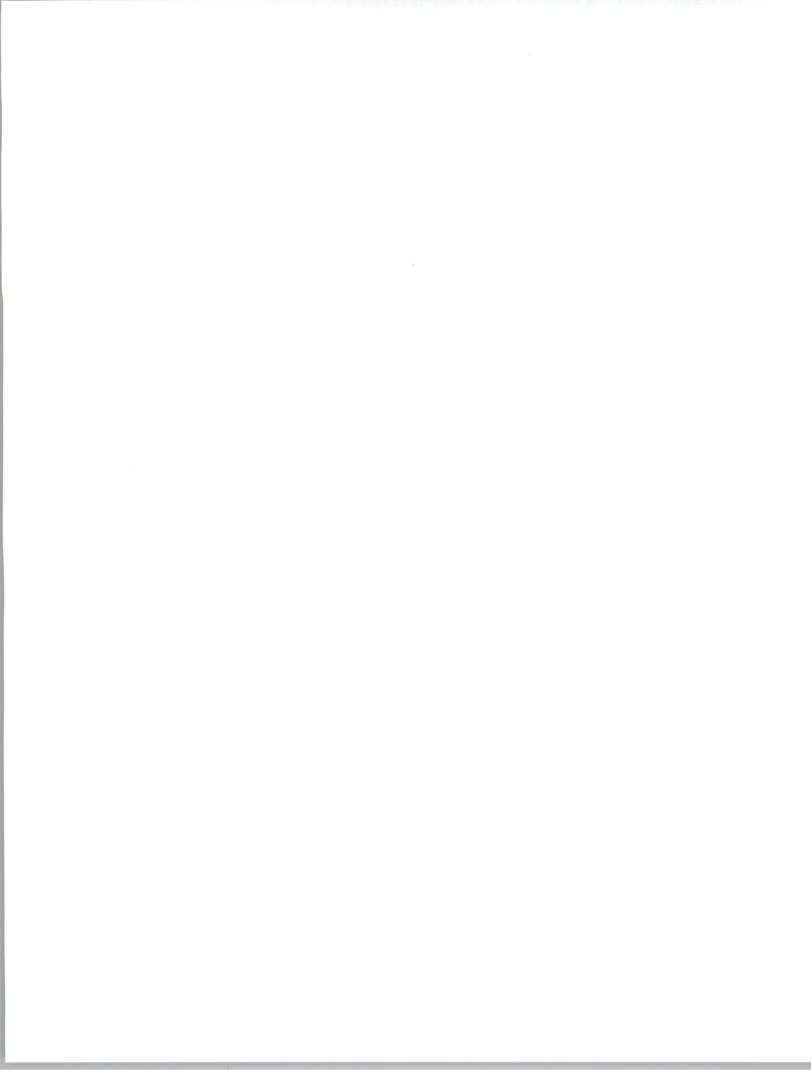
All major vendors are redeveloping systems for the workstation/PC environment. Major players and "up-and-comers" (Avalon, Fourth-Shift, Oracle, Symix, Qad) have all introduced systems with strong functionality for workstations/PCs. 4GLs, RDBMS, and CASE tools are being used, making implementation, customization, and integration easier. The insistence by users that open systems be considered will continue the push toward workstations/PCs.

Legacy systems and functionality levels will be the only drawbacks to this segment. As applications mature and the client/server environment becomes a necessity for business re-engineering, those two negatives become less influential. 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 consolidation should occur just because it makes sense; there are too many vendors selling into the same markets. A number of the major vendors are trying to be all things to all companies, i.e., they offer both discrete and process applications, or mainframe as well as minicomputer and workstation/PC applications. Such vendors are ignoring the major user requirement that the vendor must have specific industry expertise. With such a large market available, INPUT expects that leadership and dominance will occur in small niches and in very narrow applications areas.

4. Systems Integration

The systems integration market is another fast-growing delivery mode—showing a 20% CAGR through 1998 and reaching almost $4 billion in that year. The importance of systems integration at present can't be overstated. The "legacy" build-up 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-house.

There are large companies addressing user systems integration needs—Andersen, CSC, Computer Task Group, EDS, IBM, Coopers & Lybrand, Price-Waterhouse, Ernst & Young, Arthur D. Little, etc. While these firms have the capital to attract personnel who can be employed to satisfy the cross-discipline needs of users, they often fail to adequately train their staff in the area of sales. Cost overruns and missed schedules are common because of optimistic commitments made during the sales process. The problem gets even worse when small, independent integrators are used; they normally don't have the cross-discipline expertise required to analyze the total needs of a complex integration project.

As standards and tools are developed, the systems integration market should begin a slow decline in growth rate towards the end of the decade. In fact, 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) provided by 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, using object-oriented techniques, each discipline can define its own integrated information needs.

5. Systems Operations

Systems operations is divided into platform, applications, desktop services, and network management submodes. Growth in this area is forecast at a 21% CAGR through 1998, from $700 million in 1992 to $2.2 billion in 1998.

INPUT's view is that client/server implementations and downsizing will create needs that can't be served in-house. For instance, there will be some growth among large manufacturers that are using facilities management services for their total operations. Contracts in this market can represent annual expenditures of $100 million and more. The unit volume need not be high to create a large market, so competition for each contract will be fierce.

Growth in systems operations will come from two specialized submodes, desktop services and network management. Desktop services now includes document imaging and publishing. Network management includes WANs and LANs and is a changing area considering the complex client/server and distributed data base resources now available. Until products and knowledge are developed to maturity in these two areas, the market for services will continue its rapid expansion.

6. Processing Services

Processing services is the slowest-growing delivery mode in the discrete manufacturing information services market. Some growth will occur as a by-product of the growth of those companies already using "outsourced" production resources. There will also be some growth as a result of the gradual move away from mainframes, since certain applications will need access to high-powered transaction and/or data base capabilities. As hardware prices drops and parallel processor products mature, pressures will be brought to bear on this market .
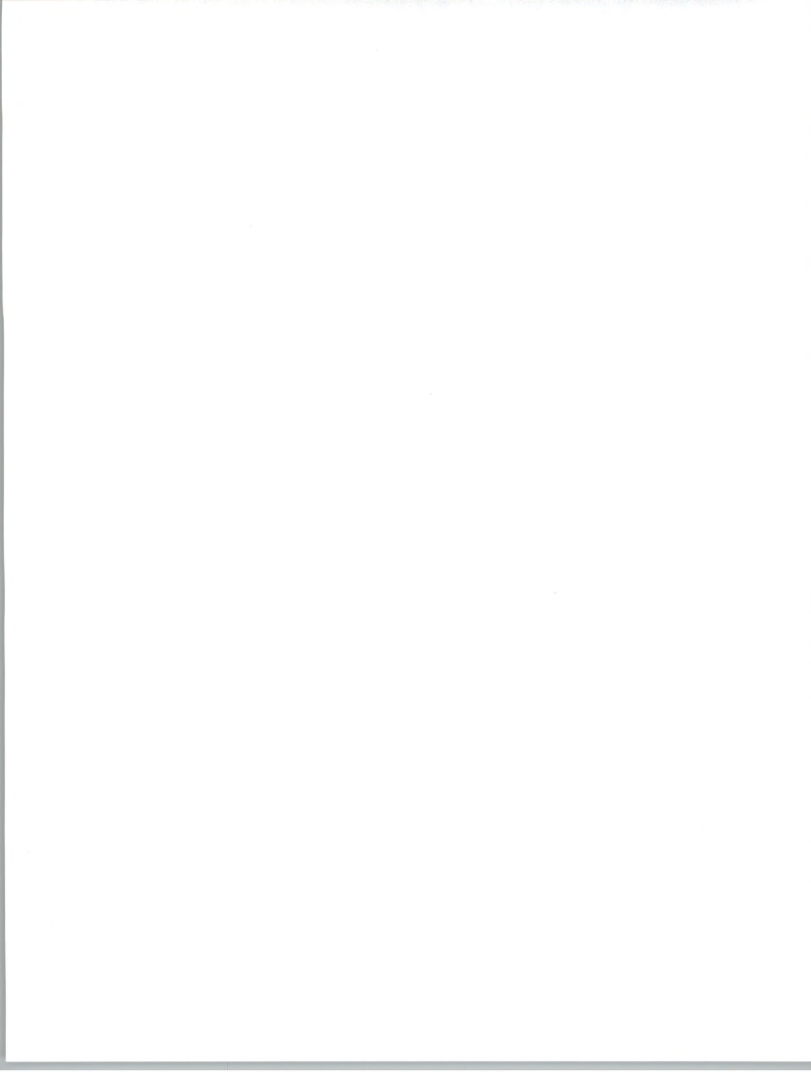
7. Network Services

The smallest of the delivery modes, network services, is made up of electronic information services and network applications. This is a fast-growing submode—INPUT expects a 21% CAGR through 1998—tripling the market from $106 million in 1992 to $334 million by 1998. The largest revenue contribution will come from the expansion of EDI services/applications. There will be continue to be intra-company needs for large, multi-plant companies that are creating focused plants which rely on information from other focused plants. There will also be increased vendor/customer communications assets to manage, as users build partnerships and share more information.

V
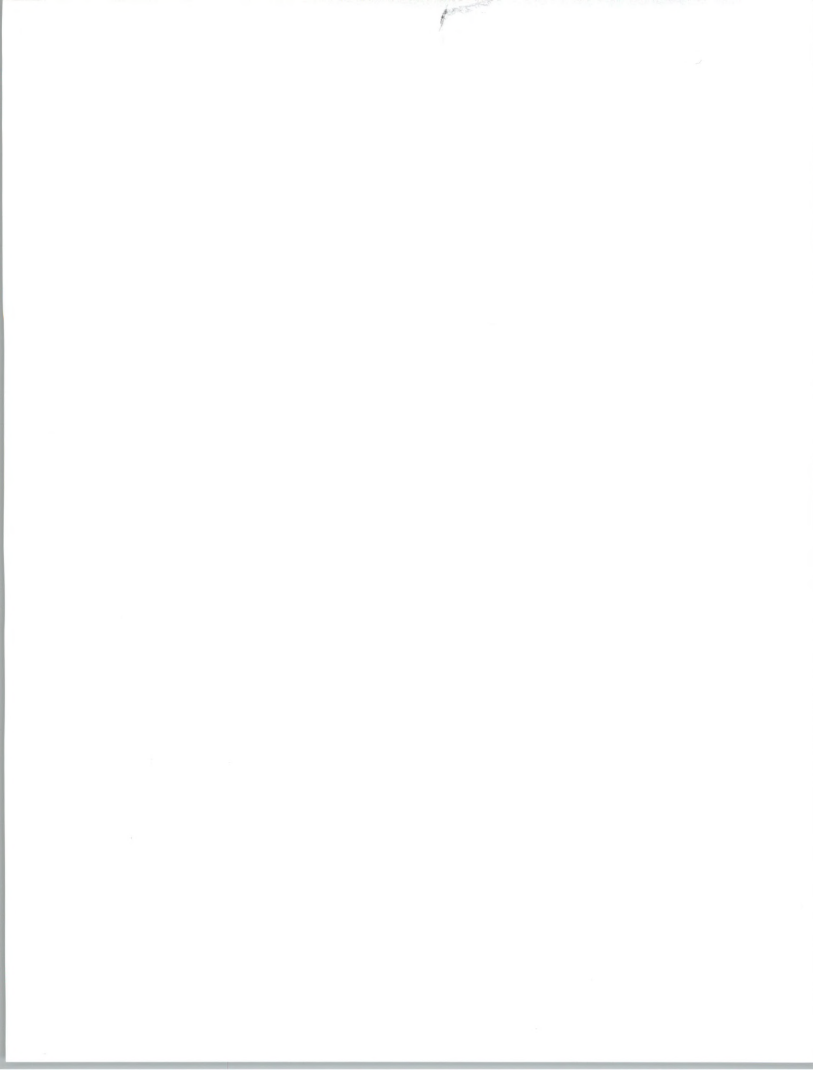
Vendor Competition

A
Introduction

This chapter presents a description of information services vendors serving the discrete 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 discrete 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 discrete manufacturing is influenced by changes in technology and shifts in strategic focus for information systems.

There has been a rapid shift in information systems in the discrete manufacturing market. Vendors known primarily for turnkey solutions are rapidly shifting to offering software that functions in a multiplatform environment, unbundled from its turnkey hardware package.

Every vendor in this vertical market is 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 costs and support costs are balloon-

ing, shrinking crucial research and development budgets. And 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, integration, integration. Systems vendors must now offer solutions that tie the whole enterprise together, moving from manufacturing resource planning (MRP) to Enterprise-Wide Resource Planning (ERP). Information systems and services vendors participating in this marketplace need to understand that systems decisions are being made in the context of business process re-engineering.

C
Competitive Positioning

Participating vendors in the discrete manufacturing segment report that the competitive climate is characterized by increased competition and a crowded market. "Legacy" product companies are competing with new market entrants leading to exacerbated product pricing pressure.

Companies are hampered by competition for trained sales personnel and the use of desperation sales tactics. The increased pressure on pricing has also limited capital investment in new technology and limited investment in training of sales personnel. Training for personnel is becoming crucial for competitive positioning as clients ask vendors for demonstrable industry and technical expertise.

There is also increased alliance and acquisition activity as companies ally themselves to gain product development expertise, market share, and experience in vertical market segments. Some examples of these activities are Marcam's acquisition of IBM's MAPICS and Computer Associates' acquisition of Pansophic.

Finally, discrete manufacturing vendors can be considered in the following segments:
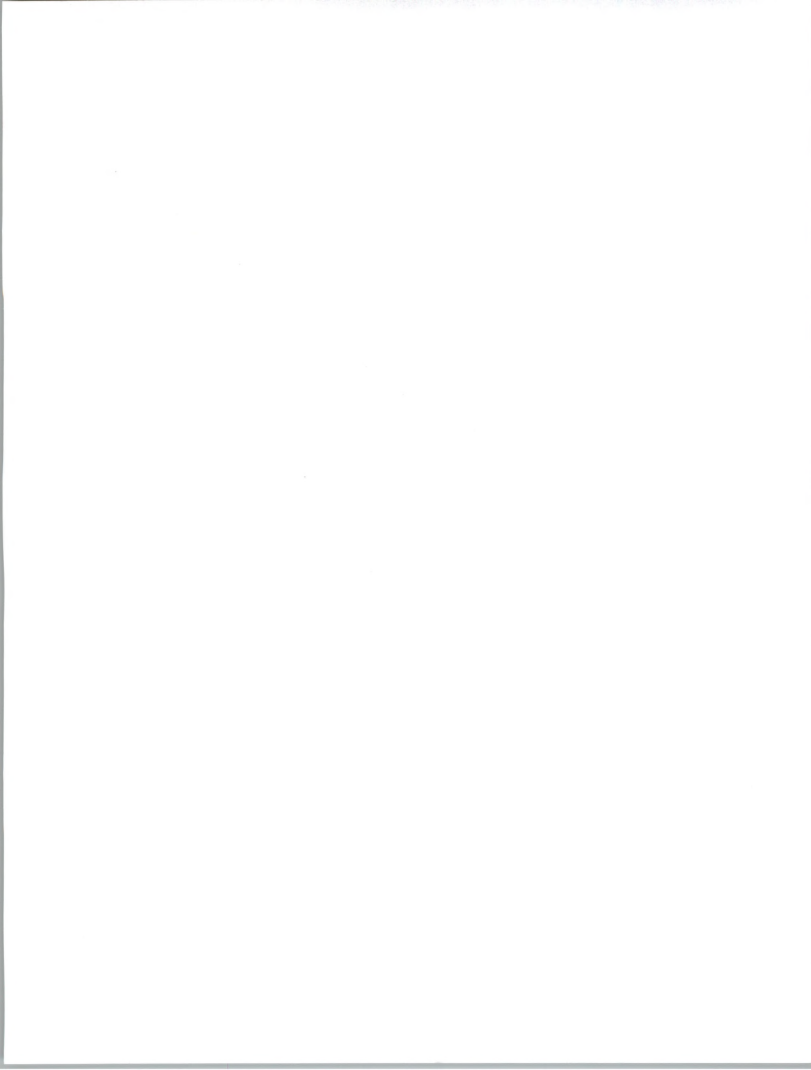
1. Traditional MRP

The ASK Group
American Software
System Software Associates
SAP America
Computer Associates
Cincom Systems
qad.inc.
Symix Systems, Inc.
Andersen Consulting

2. Cell Controllers

US Data
Fastech
Savior

3. Manufacturing Execution Systems (MES)

Consilium
Promis

D
Participating Vendors

1. Applications Software Vendors

Requirements for CAD applications to have both powerful software and
high-performance graphics makes CAD/CAD one of the best uses of
specialized open-design software and turnkey systems in discrete manu-
facturing. Although CAD/CAM used to be the leading application prod-
uct for turnkey systems in discrete manufacturing, there is a concerted
move toward open systems that have unbundled CAD/CAM software
from traditional platforms. Exhibit V-1 lists the leading applications
software vendors in discrete manufacturing. CAD/CAM software firms
are not listed as they are part of the INPUT report on cross-industry
engineering applications.

EXHIBIT V-1

Discrete Manufacturing
Leading Application Software Vendors

Vendor	1992 Market Share (Percent)
Computer Associates	5
The ASK Group	4
System Software Associates	4
American Software	3
SAP America	2
Cincom Systems	2

Note: Numbers are rounded.

2. Professional Services

Exhibit V-2 presents the market shares of professional services vendors in discrete manufacturing.

EXHIBIT V-2

Discrete Manufacturing
Leading Professional Services Vendors

Vendor	1992 Market Share (Percent)
Electronic Data Systems	4
Computer Task Group	2
Andersen Consulting	2
IBM	2
Analysts International	1
Computer Sciences	1
Coopers & Lybrand	1
Ernst & Young	1
NCR	1
AGS	<1
CGA, Inc.	<1
Computer Horizons	<1

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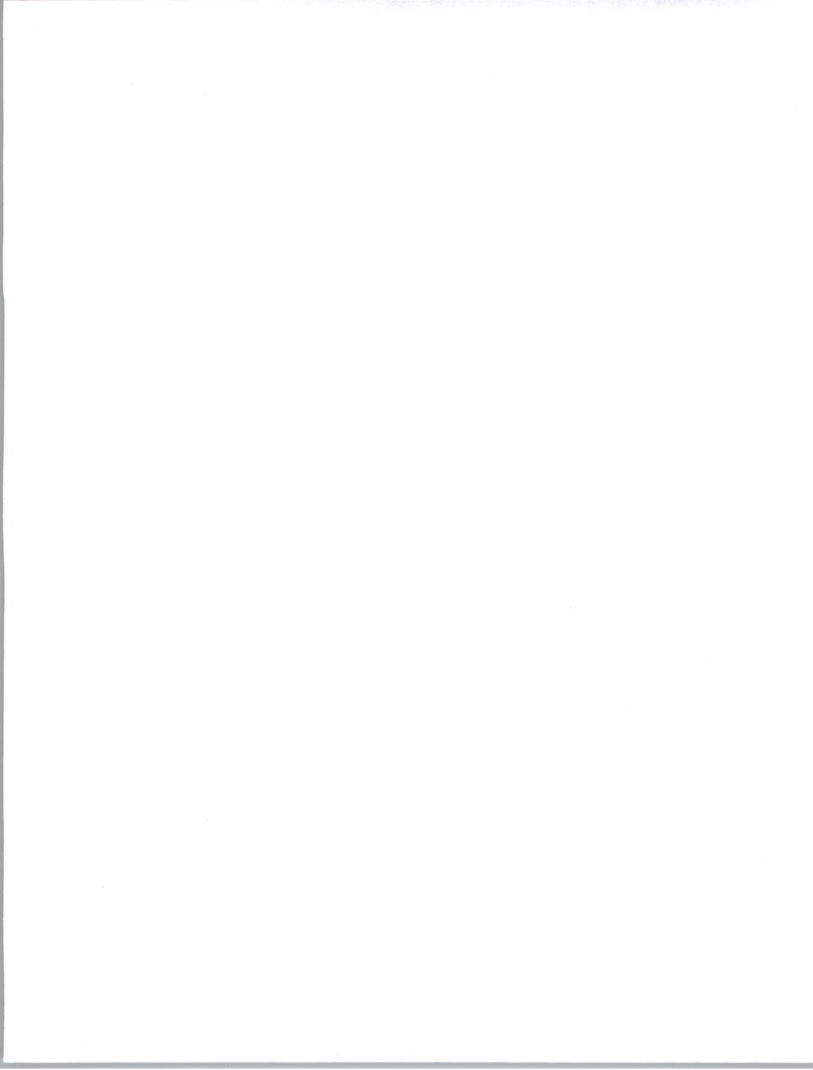
The vendors in the professional services market are extremely diverse and include Big 6 firms, subsidiaries of industrial firms, computer hardware makers, and vendors devoted solely to professional services.

The two leading firms in this mode are professional services vendors.

Because the professional services market is the largest market in discrete manufacturing, and there are no vendors with a significant market share, it is clear that the market is extremely fragmented.

3. Leading Systems Integrators

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

EXHIBIT V-3

Discrete Manufacturing
Leading SI Vendors

Vendor	1992 Market Share (Percent)
Electronic Data Systems	20
Andersen Consulting	12
DEC	3
Technology Solutions Corp.	2
Computer Sciences Corp.	2
Coopers & Lybrand	2
Deloitte Touche	2
KMPG Peat Marwick	2
Computer Task Group	1
Price Waterhouse	<1
CGA, Inc.	<1

Note: Numbers are rounded.
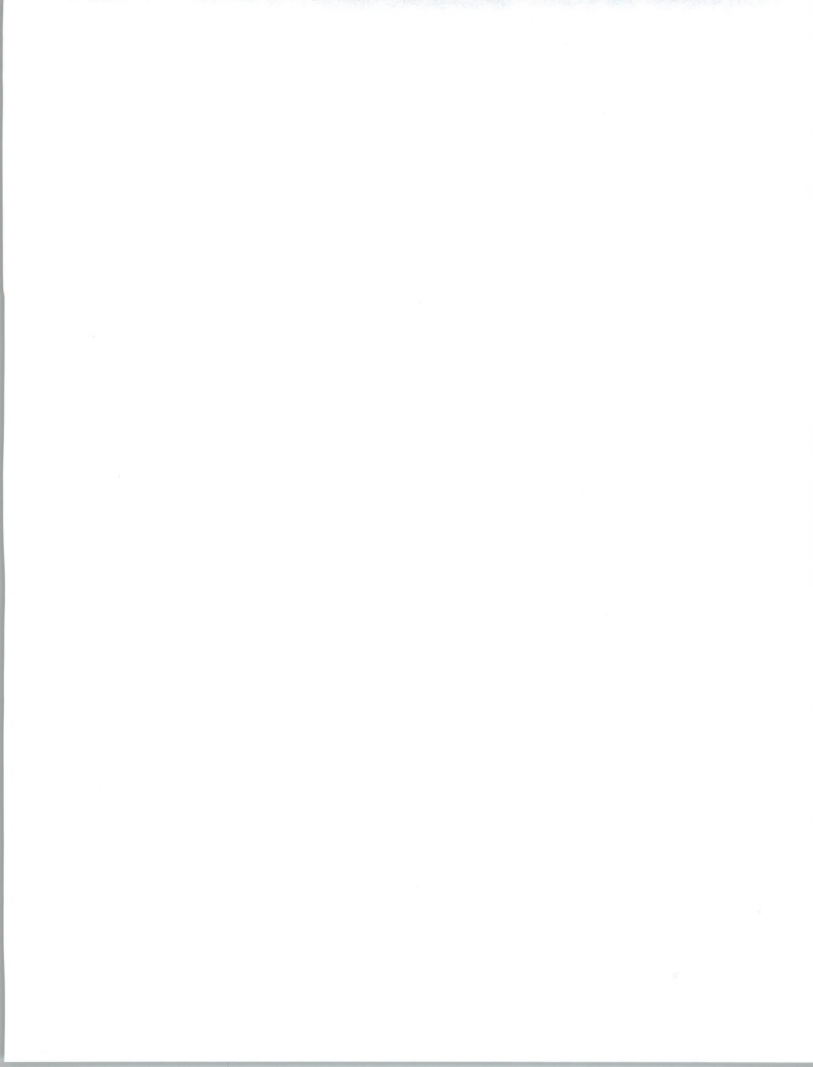
4. Leading Systems Operations Vendors

This segment is marked by a clear increase in market leadership by EDS, confirming its position as market leader. GENIX, one of the leading smaller vendors active in this market, indicates the opportunities available in systems operations. Exhibit V-4 lists the leading systems operations vendors in discrete manufacturing.

EXHIBIT V-4

Discrete Manufacturing
Leading System Operations Vendors

Vendor	1992 Market Share (Percent)
Electronic Data Systems	67
IBM	8
GENIX	5
Andersen Consulting	4
Computer Sciences Corp.	3
Litton Computer Services	1

Note: Numbers are rounded.

5. Up and Coming Vendors in Discrete Manufacturing

Exhibit V-5 list several companies that have positioned themselves to deliver multiplatform open systems solutions to the discrete manufacturing market. They've taken an early position in developing products for the UNIX operating system. New sales growth and powerful alliance positioning have made each of these companies a growing competitor in the discrete manufacturing market.

EXHIBIT V-5

Discrete Manufacturing
Up and Coming Vendors—Application Software

Vendor	1992 Discrete Manufacturing Revenue ($ Millions)
Symix Systems, Inc.	27
qad.inc	25
Oracle Systems Corp.	14
Avalon	9
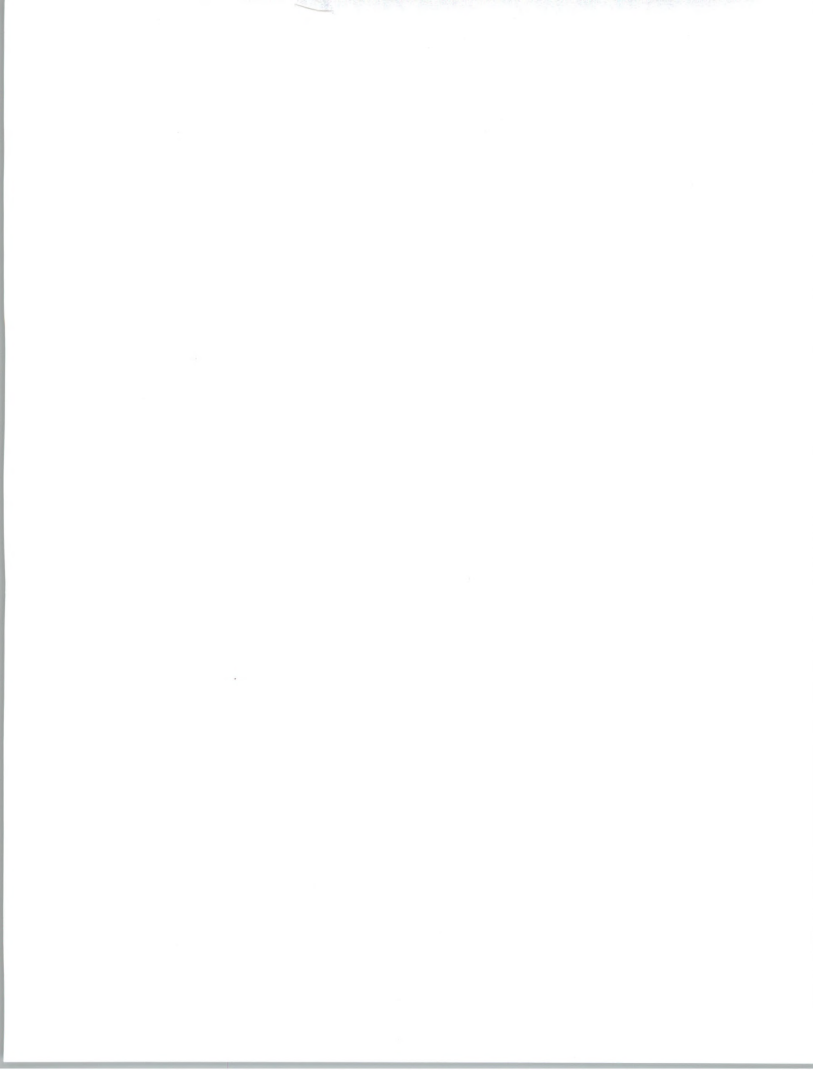
E
Vendor Profiles

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 information 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 headquarters in Walldorf in April 1992.

- SAP AG reported sales of $441 million (U.S.) for 1991, an increase of 41% over 1990 sales of $332.7 million. SAP AG currently has 2,500 employees, 14 international subsidiaries, and more than 1,600 customers worldwide.

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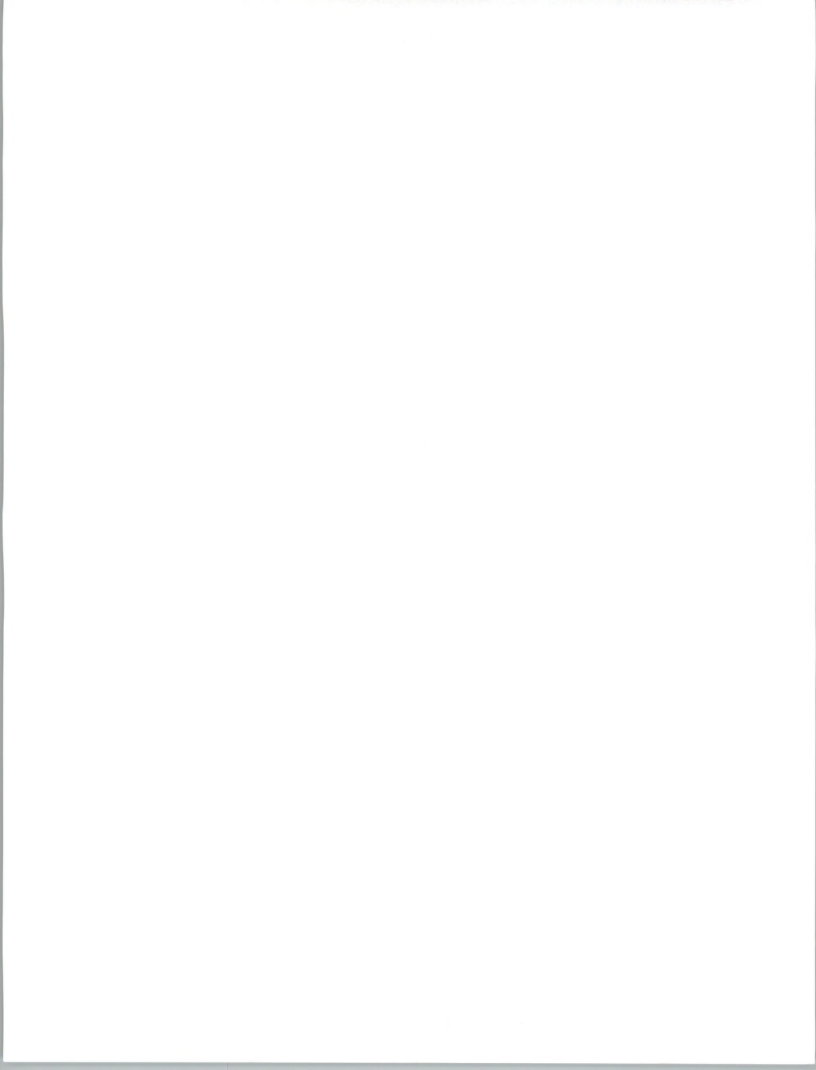
- SAP has just beaten D&B Software to the punch in delivering its R/3 client/server-based applications software three months ahead of schedule.

- 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—known as the 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 computers. This set of applications includes EDI applications, CASE applications, Distribution & Logistics products, MRP products, financial applications, and decision support products.

d. Key Issues

- An increase in sales by existing affiliates and continued expansion of the company's global affiliate network

- Higher sales by SSA's major account units

- Expansion of SSA's client services groups

- The introduction of new BPCS and AS/SET products

- Continued growth of SSA's HelpLine, a telephone support service for SSA's software clients

- The rate of revenue growth from fiscal 1990 to 1992 declined, primarily as a result of weakened economies in SSA's major markets and diminished foreign revenues due to a strengthening of the U.S. dollar.

- Revenue growth was also reduced by the planned reduction in hardware reseller sales associated with SSA's withdrawal from the IBM U.S. Industry Remarketer program.

- Recent SSA acquisitions/joint ventures include the early 1992 acquisition of its Singapore-based joint venture, Comat Services Pte., and its 70 employees. It now operates as SSA Singapore.

- SSA's primary competitors for its BPCS product line include IBM (MAPICS), American Software, Andersen Consulting, ASK Computer Systems, and Marcam. CASE competitors include Synon.

3. Cincom Systems, Inc.

2300 Montana Avenue
Cincinnati, OH 45211-3899
Phone: (513) 662-2300
           (800) 543-3010
Fax: (513) 481-8332
President and CEO: Thomas M. Nies
Wholly Owned Subsidiary of SAP AG
Total Employees: 1,380
Total Revenue: $158,000,000
FYE: 9/30/92
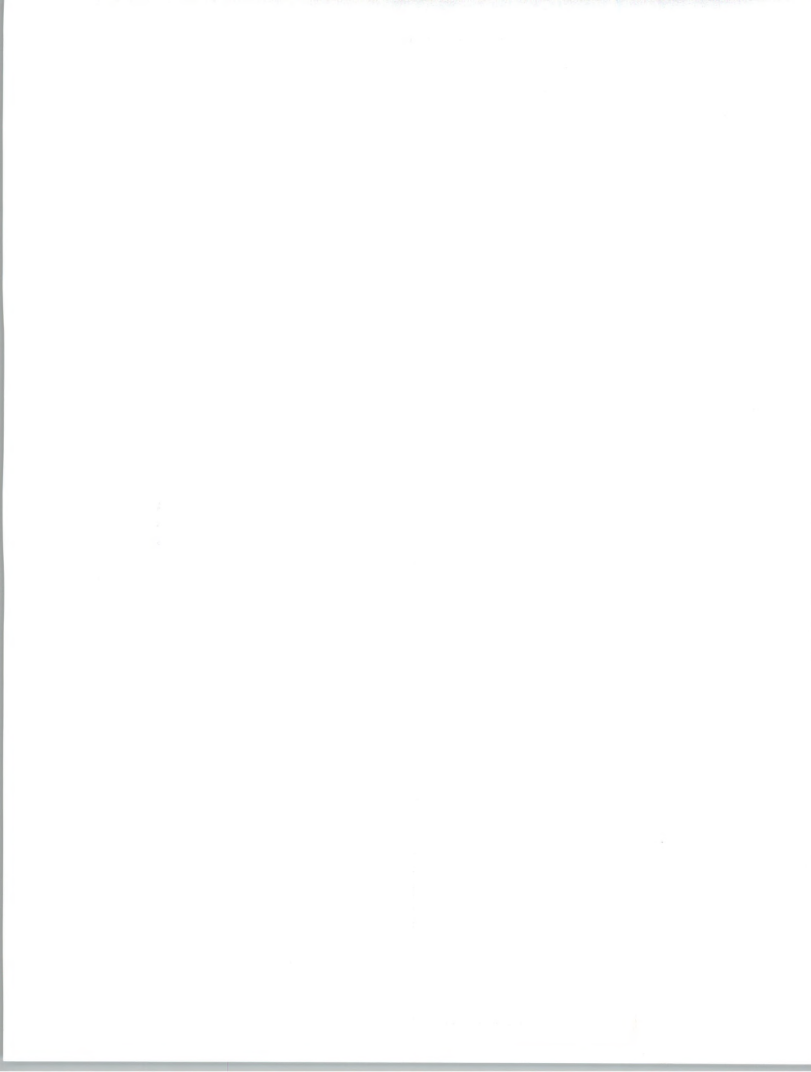
a. Company Description

Cincom Systems develops, markets, and supports systems and applications software products in five major areas: client/server and distributed data base management; manufacturing and financial applications; application development tools; process, resource, and project management; and text management. Cincom software products run under a variety of operating systems, including UNIX, OS/2, MS-DOS, and all the major host-based proprietary and non-proprietary operating systems and support platforms from Hewlett-Packard, Sun Microsystems, IBM, DEC, Data General, Sequent, NCR, Fujitsu, Bull, and Siemens-Nixdorf. Cincom is organized into integrated product-specific divisions. Each division is responsible for the development, support, marketing, and sale of its specific product line.

b. Strategy

- Cincom Systems is a privately-held software company that meets businesses' needs across a range of computing platforms, from the desktop to the data center.

- During fiscal 1992, Cincom formed a number of partnerships with vendors that are integrating their applications software with various Cincom products, including Independent Computer Consulting Services, Inc. (Columbus, OH), Logical Technologies, Inc. (Peoria, IL), Reamdata Inc. (Lebanon, PA), Software Alternatives, Inc. (Toledo, OH), Tidewater Consultants, Inc. (VA), TechGnosis Inc. (Boca Raton, FL), IQ Software Corporation (Atlanta, GA), Mega International (France), and Intelligent Environments.

c. Products and Services

Relational Data Base Management: SUPRA Server (Cincom's current version of SUPRA) is an advanced open data base management system that offers portability across multiple hardware and operating system platforms including IBM, DEC, and UNIX.

Application Development - AD/AdvantageR, introduced in 1991, is a full life-cycle application development system that automates activities in each phase of the traditional application life cycle—analysis, design, building, testing, implementation, and maintenance.

AD/Advantage also includes change management facilities for minimizing the cost of changing and maintaining applications, a tool for building text-based applications and writing application documentation, and a component for planning and managing development activities and projects more effectively.
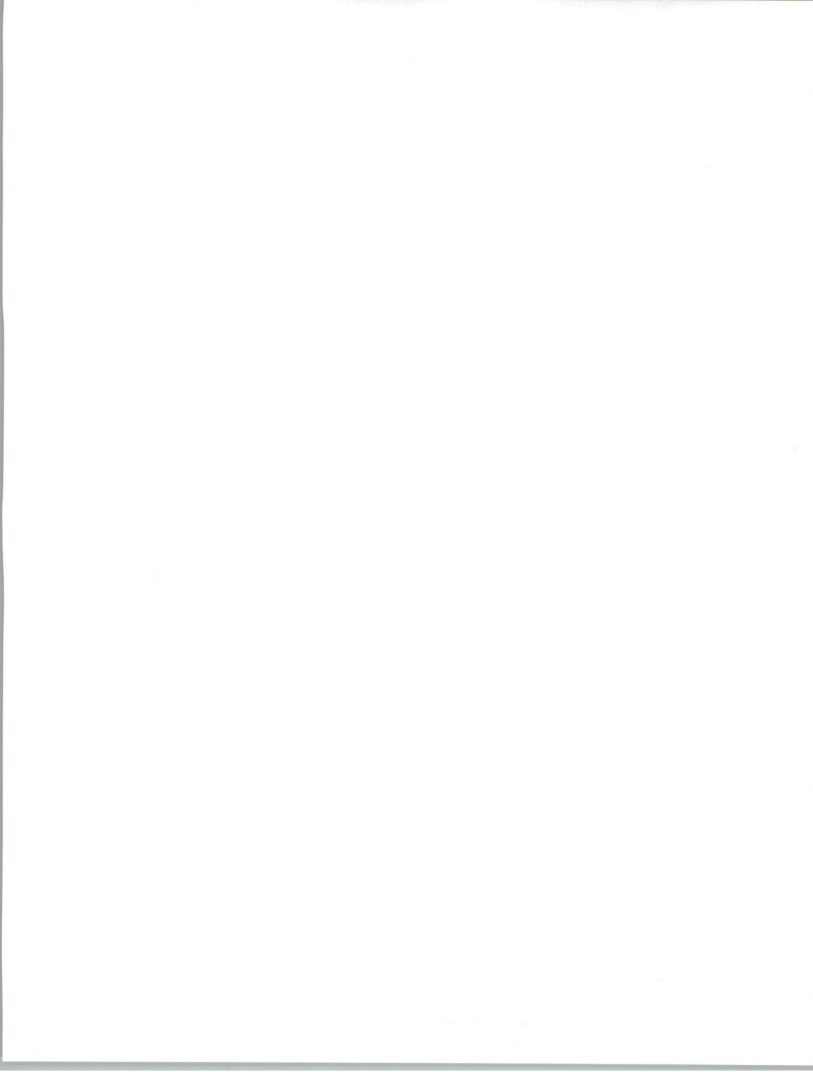
Project Management - CPCS, Cincom's Enterprise Management and Guidance System, introduced in 1990, supports the proactive management and guidance of business objectives through their process development cycles to ensure that projects are planned accurately, developed within budget, and delivered on time. CPCS provides information about all planned, ongoing, or completed work managed within CPCS, including processing, projects, and resources that make up the business objectives.

Manufacturing and Financial Applications - CONTROL: Manufacturing (C:M) is a modular manufacturing control software system that supports distributed, multisite, multinational organizations.

- C:M contains the following modules: Bill of Materials and Routings, Material Control, Master Production Scheduling, Material Requirements Planning, Shop Floor Control, Purchasing, Cost Management, and Order Management.

- Additional modules are available to tailor the system to discrete, project, repetitive, or process manufacturing environments. These additional modules are: Lot/Serial Number Traceability, Engineering Change Control, Project Manufacturing Control, Project Cost Control, and Repetitive Manufacturing Control.

d. Key Issues

- Cincom began its 25th calendar year on January 1, 1993, with an industry record of 24 consecutive years of revenue growth from ongoing operations.

- Among the company's strengths are its international presence—with over 60 offices worldwide and clients in 72 countries—and technologies that support the move away from proprietary mainframe environments to open systems computing and enterprise-wide solutions.

- Over the past three years, Cincom has invested an average of 16% of its revenues each year into developing and enhancing new technologies.

- Cincom has recently been awarded a 5-year contract valued at over $10 million from the Defense Information Systems Agency (DISA) and the Defense Commercial Communications Office (DECCO). These agencies have made Cincom's SUPRA Server open data base management system and related software tools the preferred products for DISA.

- Major recent announcements include SUPRA Server, an open data base management system for UNIX and PC LAN operating environments, the availability of CONTROL: Manufacturing for UNIX platforms, and AD/Advantage, a full life-cycle application development system for a range of platforms, including UNIX, IBM, DEC, Hewlett-Packard, and Bull.

4. The ASK Group

2440 W. El Camino Real
P.O. Box 7640
Mountain View, CA 94039
Phone: (415) 969-4442
President and CEO: Pier Carlo Falotti
Ataus: 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 which 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 (RDBMSs) and application development tools for open systems.

During the first quarter of fiscal 1992, the company restructured its operations 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 675 employees, is responsible for manufacturing applications, including the MANMANR and MAXCIM product lines for HP and DEC systems, the MANMAN/X system for UNIX systems, and the upcoming ADVANCE open systems product family. This unit accounted for 37% ($158 million) 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

Ingres Business Unit - Ingres is a leading supplier of relational data base management, application development, and data access software products to users of Intel-based, DEC, HP, Sun Microsystems, and IBM computers, minicomputers, workstations, and PCs running proprietary and UNIX operating systems. In addition, Ingres products have been ported to operate with a range of computers from other computer system companies.

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 during 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.
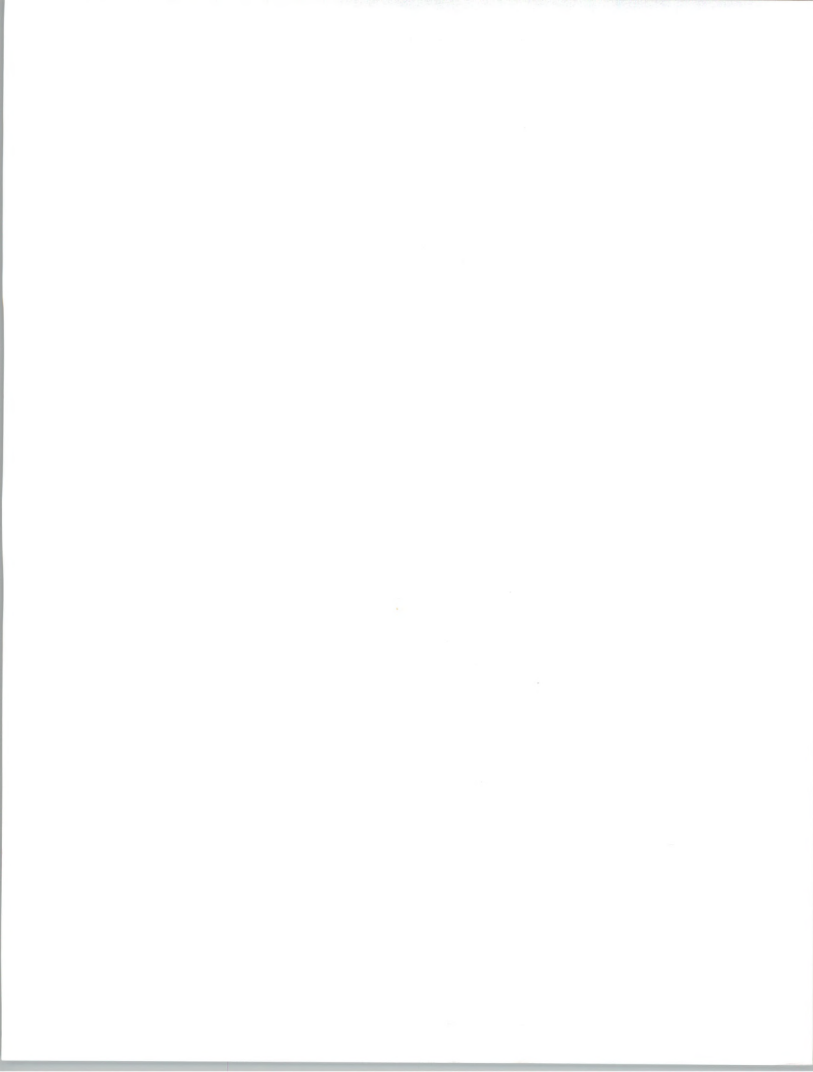
- The company has expanded its client base to include not only manufacturing customers, but also customers in international banking, government, transportation, telecommunications, advanced research, and retail.

- 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.

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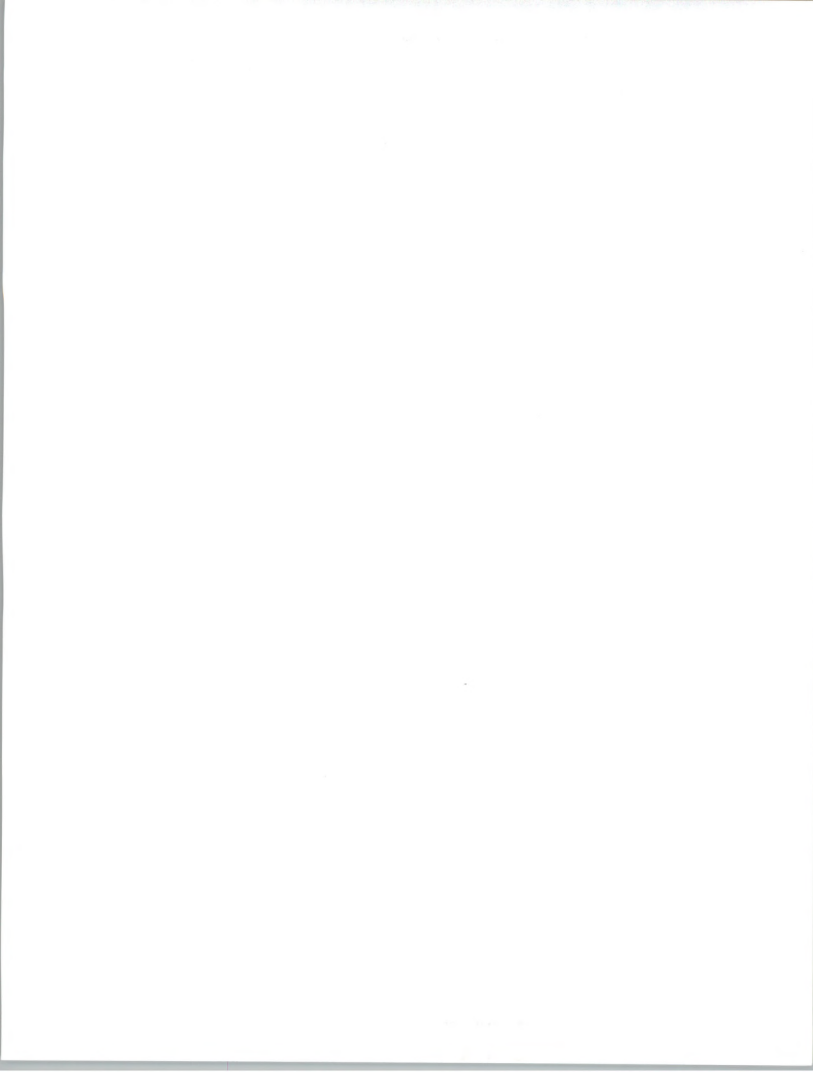
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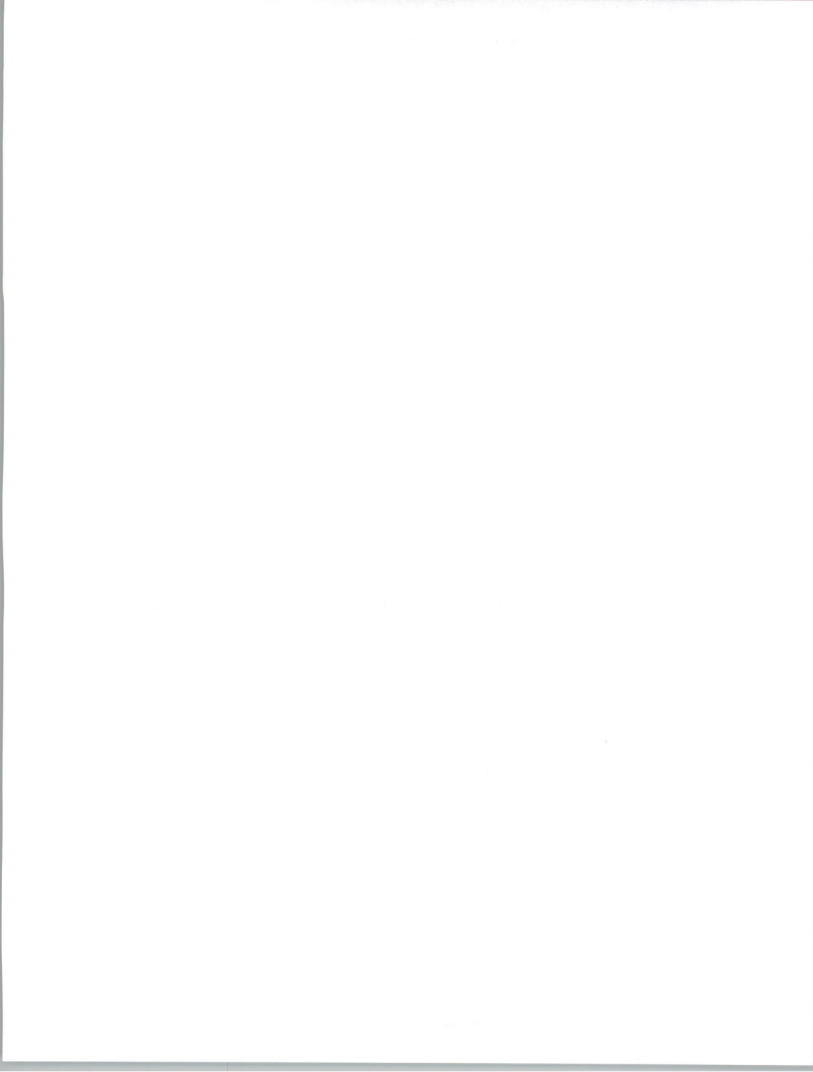
Conclusions and Recommendations

A

Overview

The discrete manufacturing industries are recovering quickly from the recession. While they are recovering, businesses are changing their infrastructure (re-engineering) to attempt to achieve high 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.

Discrete manufacturers are approaching their third system iteration in what has proved to be an evolutionary environment. The first interation, in the early 1970s, was the automation of manual functions and the use of computers to aggregate volumes of data. The best example is MRP, which was first designed to aggregate material needs and time-phase deliveries from vendors (an early just-in-time attempt).

In the second iteration, two events occurred which initiated change. Mini-computers and PCs were developed and offered training in automation to all personnel, contributing to the building of islands of automation/information. Simultaneously, applications were expanding and refining functionality to more precisely meet user needs. Now the challenge is to use current technology to incorporate the good parts of past actions (trained users, functionality, ease-of-use, etc.) 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.

The next cycle in the systems evolution, the third iteration, 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 discrete manufacturing process becomes evident.

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 will not be available yet. The vendor should have a consistent plan for achieving an open-system environment.

- 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 rapidly and effectively and implementing the solution.

- Try to keep customized development to a minimum.

- Carefully define the network environment: Avoid building islands of application isolation.

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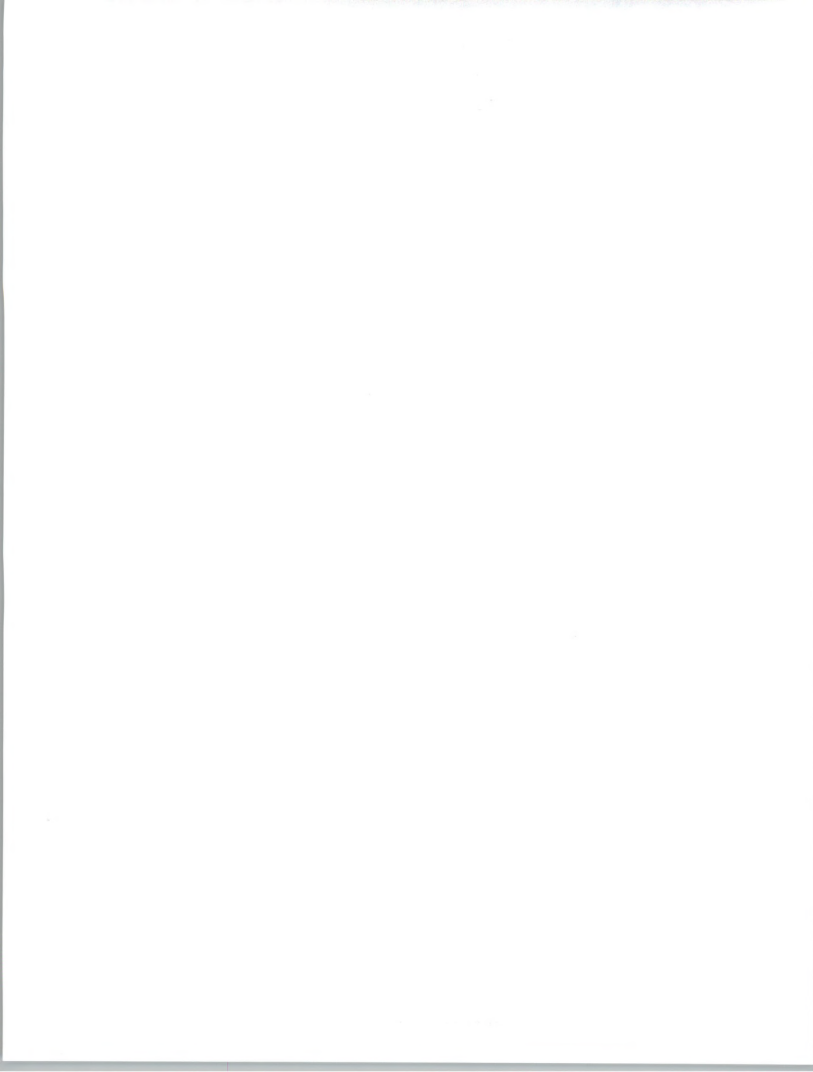
• When making a change, make it quickly. Make the decision quickly. Implement rapidly. Recognize benefits quickly. The more rapidly a significant move is made, the higher will be the return and the more employees will be involved.

These user recommendations are summarised in Exhibit VI-1.

EXHIBIT VI-1

Discrete 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 for discrete manufacturers. 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.

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

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

- Specific features and functions must be developed for specific segment needs.
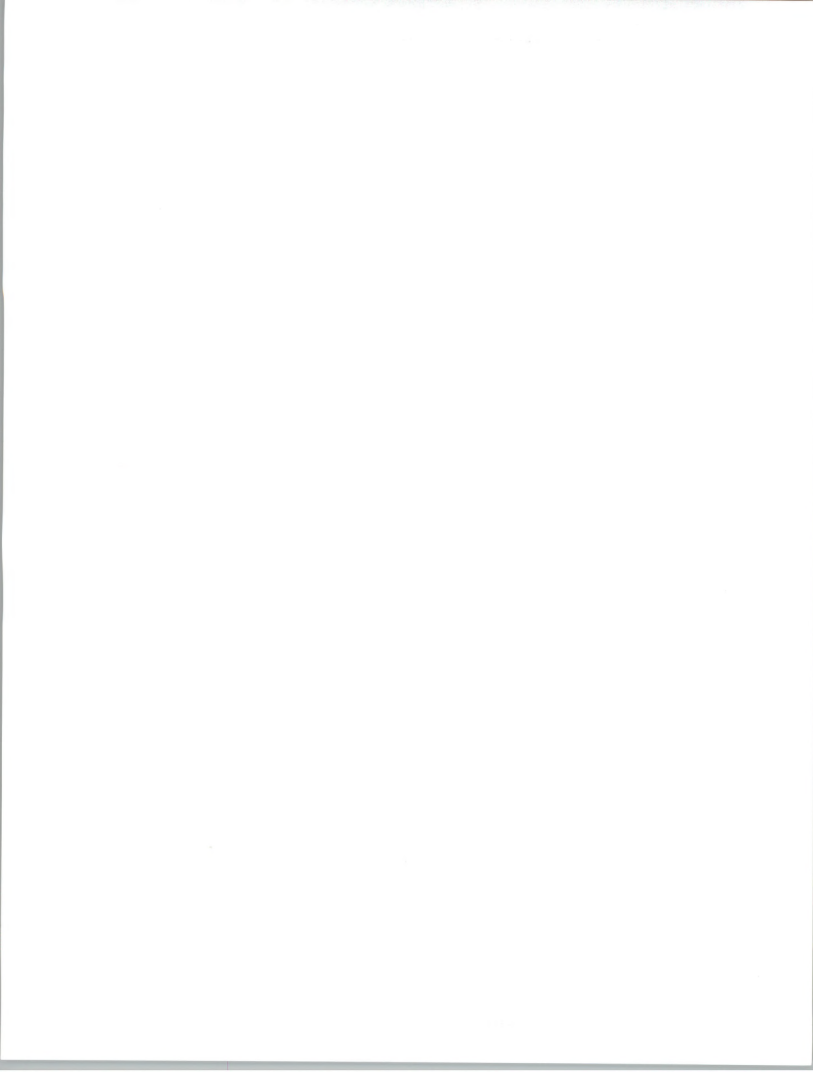
- Institute internal training programs. The industry seems to have abandoned the sales, consulting, and implementation training which brought successes in the late 1970s and early 1980s. Users seldom rely on the vendors for expertise. Critical decisions are often made without vendor involvement.

- Begin the effort toward an open system environment. There are numerous excellent application solutions available or being developed in narrow niches (customer response systems, for example). Inability to interface without costly customization can be expensive for both the business and the vendor. *Reinvest heavily in research and development.*

- Develop alliances with niche solutions vendors.

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

- Understand 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 replaced by fast-paced change.

- Develop an internal total customer responsiveness program.

- Learn to accept the fact that 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.
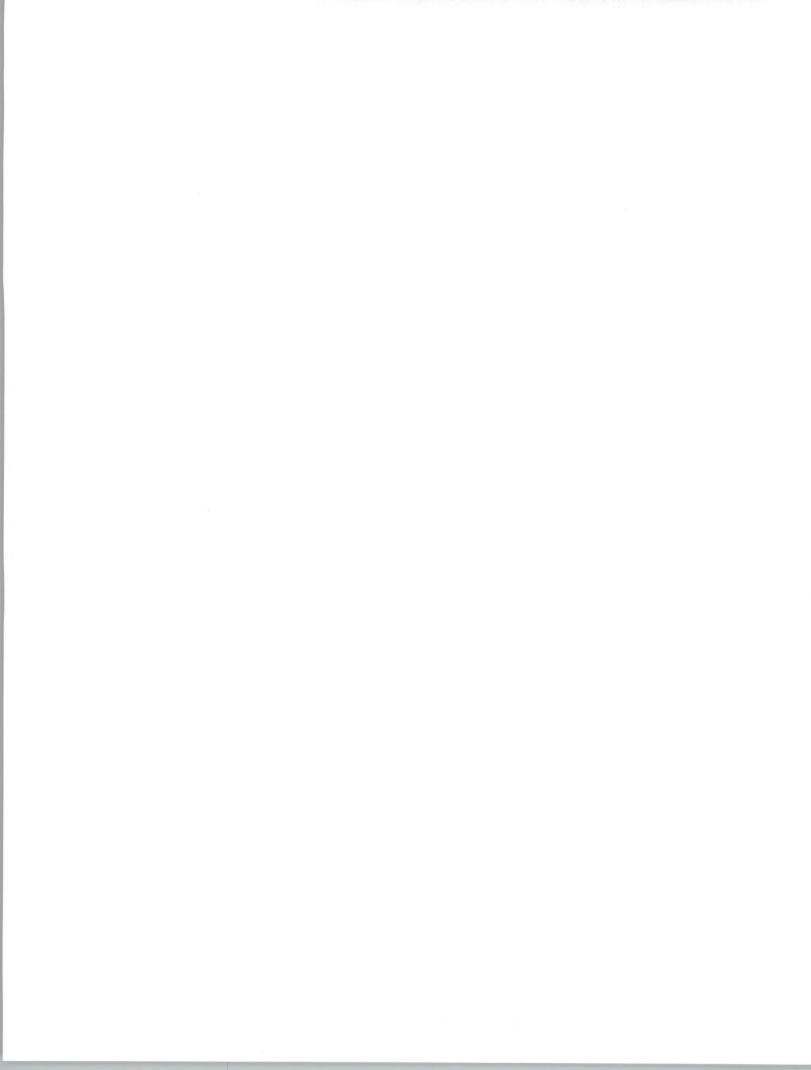
Vendor recommendations are summarized in Exhibit VI-2.

EXHIBIT VI-2

Discrete 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

The 1992 revenues were very near the forecast in total. The recession did
linger, as expected, and the economy did impact growth rates. The mix of
revenues did change, and the mix reflects the sudden move to client/server
environments, especially in applications software.

The 1997 estimates have changed to reflect a move to "replacement"
applications software. The downsizing, client/server activities require an
open systems approach which is not available in older applications envi-
ronments. As change occurs, there will be some double expenditures in
the area of software maintenance charges. Implementations of new sys-
tems often take at least a year, and dual systems must run for that period.
Also, some applications may be saved from old systems and integrated
with new applications, i.e., financials might run on a mainframe while
operations might be in a client/server environment.

Near the end of the forecast period, we will begin to see object-oriented
design and more "openness" in applications software. This occurrence
should open up excellent opportunities for add-on niche products and
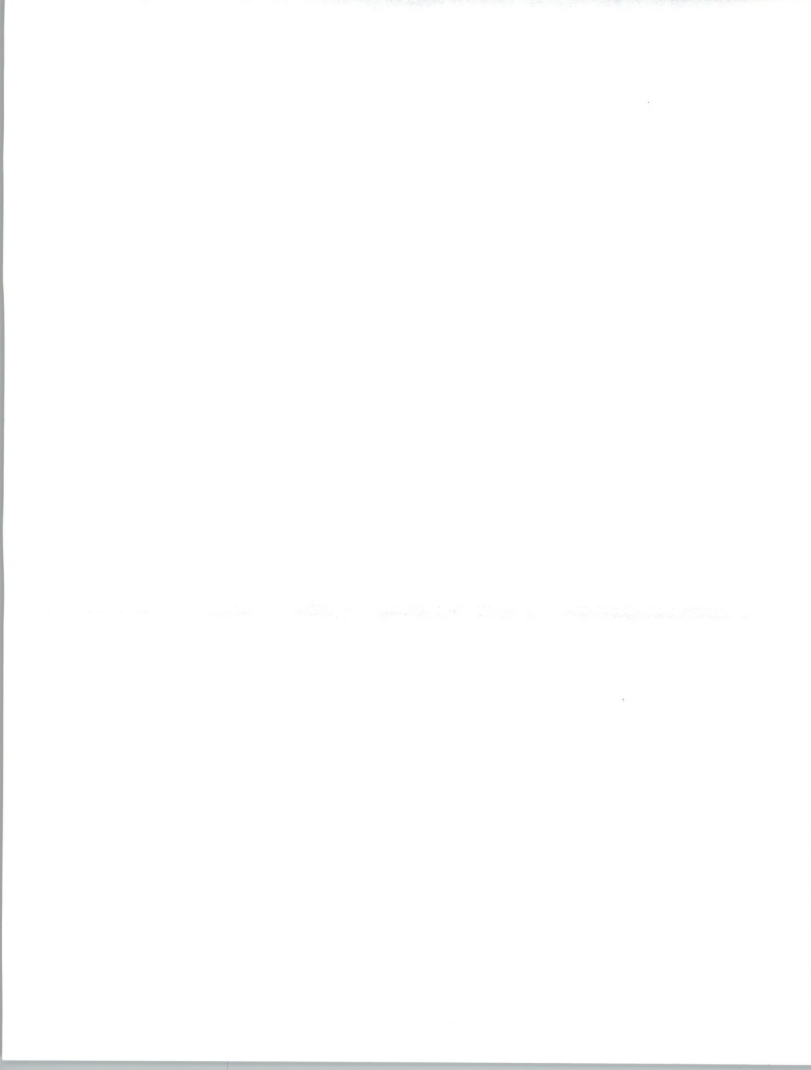specific professional services expertise.

EXHIBIT A-1

Discrete 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	13,085	12	14,632	16,450	18,594	21,152	24,211	27,950	14
Processing Services	870	3	896	923	951	979	1,009	1,039	3
- Transaction Processing	870	3	896	923	951	979	1,009	1,039	3
Turnkey Systems	2,940	11	3,269	3,640	4,062	4,544	5,096	5,728	12
- Equipment	1,300	6	1,380	1,463	1,551	1,644	1,742	1,847	6
- Software Products	1,140	13	1,289	1,457	1,647	1,864	2,109	2388	13
- Applications Software	990	14	1,130	1,288	1,469	1,674	1,909	2,176	14
- Systems Software	150	6	159	169	179	189	201	213	6
- Professional Services	500	20	600	720	864	1,037	1,244	1,493	20
Applications Software	2,285	18	2,695	3,209	3,864	4,703	5,789	7,201	22
- Mainframe	390	5	410	431	452	475	498	523	5
- Minicomputer	1,145	11	1,275	1,415	1,571	1,744	1,936	2,148	11
- Workstation/PC	750	35	1,010	1,364	1,841	2,485	3,355	4,529	35
Systems Operations	705	20	846	1,017	1,226	1,479	17,89	2,168	21
- Platform Operations	260	16	301	349	405	470	545	632	16
- Applications Operations	280	19	333	396	472	561	668	795	19
- Desktop Services	90	26	113	141	177	221	276	345	25
- Network Management	75	32	99	131	172	228	301	397	32
Systems Integration	1,364	19	1,620	1,934	2,321	2,785	3,325	3,972	20
- Equipment	800	19	952	1,142	1,382	1,673	2,007	2,409	20
- Software Products	99	16	115	134	157	183	213	249	17
- Applications Software	65	14	74	84	97	111	126	144	14
- Systems Software	34	21	41	50	60	72	86	105	21
- Professional Services	420	19	500	595	708	843	1,003	1193	19
- Other	45	18	53	63	74	87	103	121	18
Professional Services	4,815	8	5,178	5,571	5,983	6,434	6,929	7,508	8
- IS Consulting	1,190	12	1,333	1,493	1,687	1,906	2,154	2,434	13
- Education & Training	750	10	825	908	998	1,098	1,208	1,329	10
- Custom Software	2,875	5	3,020	3,171	3,298	3,430	3,567	3,745	4
Network Services	106	21	128	155	188	227	275	334	21
- Electronic Information Svcs.	52	19	62	74	88	104	124	148	19
- Network Applications	54	22	66	81	100	123	151	186	23
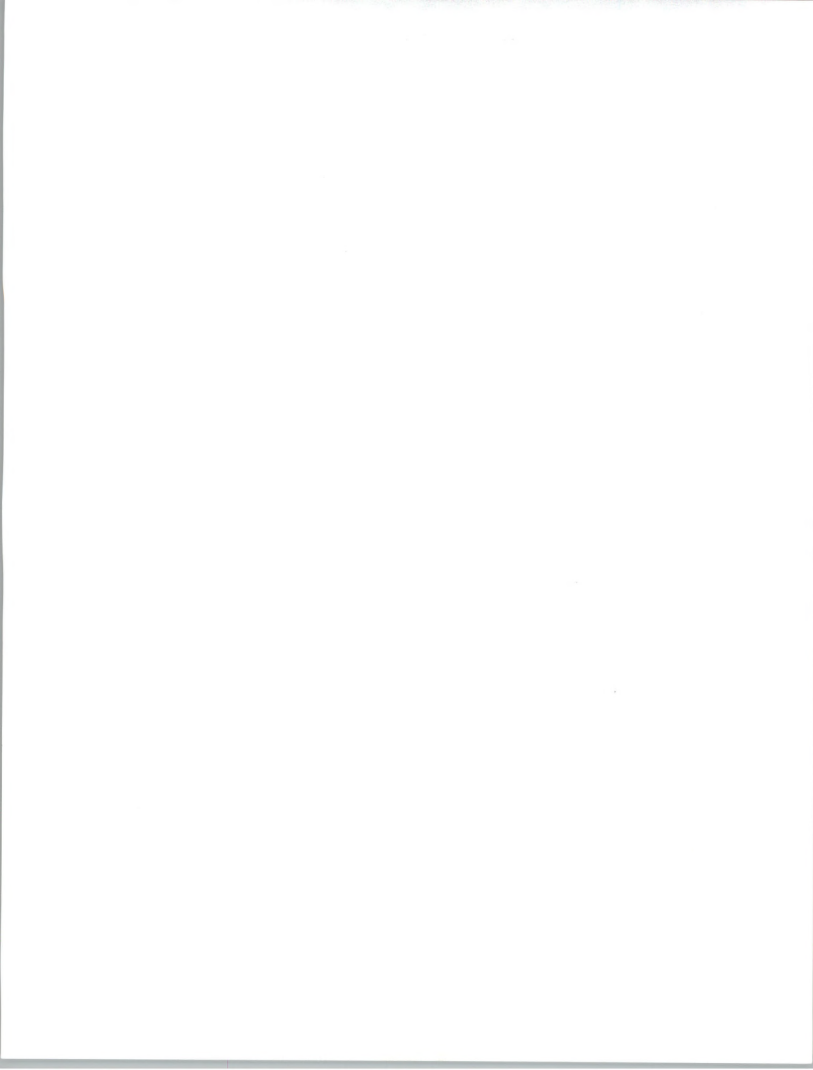
EXHIBIT A-2

Discrete 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	13,100	13,085	-15	-0	22,928	24,212	1,284	6	12	13
Processing Services	875	870	-5	-0	1,077	1,009	-68	-6	4	3
Turnkey Systems	3,097	2,940	-157	-5	4,975	5,096	121	2	10	12
Applications Software	2,224	2,285	61	3	4,380	5,789	1,409	32	14	20
Systems Operations	688	705	17	2	1,680	1,789	109	6	20	20
Systems Integration	1,346	1,364	18	1	3,536	3,325	-211	-6	21	20
Professional Services	4,766	4,815	49	1	7,000	6,929	-71	-1	8	8
Network Services	104	106	2	2	280	275	-5	-2	22	21

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