RESEARCH REPORT

US High Technology Manufacturing Sector IT Software & Services Market: 1997 - 2002

United States High Technology Manufacturing Sector IT Software & Services Market: 1997 - 2002

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Abstract

The High Technology Manufacturing industry has a strong need to use IT products and services effectively in order to be able to move into new markets with the 'right' products at the 'right' time.

Successful High–Tec Manufacturing sector firms achieve this by prioritizing excellence in execution over innovation. It is less important to be first into the market than to have the most appropriate products when entry is made.

Successful High Technology Manufacturing firms mirror this approach in implementing IT based solutions. They emphasize optimum execution over speed of execution.

Successful High Technology Manufacturing firms tend to spend proportionally less on IT than less successful firms. They achieve this by rigorous simplification of all internal and external processes. They also invest in partnership arrangements with IT product and services vendors in order to maintain state-of-the-art capability in key areas like supply chain management.

This report assesses the use of IT within the U.S. High Technology Manufacturing sector, particularly for IT Software & Services.

The report provides an analysis of total IT budgets for the U.S. High Technology Manufacturing sector. It provides forecasts for IT Software & Services expenditure through to the year 2002 and provides comparisons with other industry sectors.

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United States High Technology Manufacturing Sector IT Software & Services Market : 1997 - 2002

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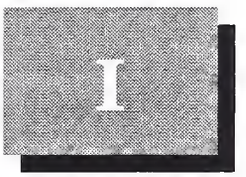

Introduction

This report is produced as part of INPUT's *U.S. Market Forecast Program* for the IT Software & Services industry.

This report is one of a series produced by INPUT to examine the relative importance and position of key industry sectors for the U.S. IT Software & Services business.

Companion reports in other INPUT Programs cover these industry sectors for Europe and from a worldwide perspective.

This chapter identifies the purpose and scope of this report, describes how the document is organized, and explains INPUT's research methodology.

A
Purpose of the Report

The purpose of this report is to provide an industry perspective on the High Technology Manufacturing sector in the United States for IT Software & Services vendors.

The report provides a quantitative analysis of the significance of the sector in relationship to the whole market and to other industry sectors for overall IT related expenditure especially expenditure on IT Software & Services.

The High Technology Manufacturing Sector addressed in this report is defined by INPUT as companies that fall within the following Standard Industrial Classification (SIC) codes:

- Computer equipment – 3571, 3572, 3575, and 3577.
- Communications equipment – 3661, 3663 and 3669.

- Electronic components and accessories – 3671, 3672, 3674, 3675, and 3676.

Appendix C contains a definition of the entire Discrete Manufacturing sector, within which High Technology Manufacturing is classified.

B
Scope of the Report

This report specifically focuses on the High Technology Manufacturing sector, as defined above, in the U.S., from the perspective of the IT Software & Services industry.

The analysis of this sector provided in this report, covers total IT expenditure in general and IT Software & Services user expenditure in particular.

These areas are described in the sub-sections below.

1. Total IT Expenditure

Respective sections in the report analyze and forecast the total IT budget, including both internal and external IT-related spending. This comprises:

- Equipment sales — expenditure on computer and data communications hardware products.
- Software products — all expenditure on systems software products and applications software product licenses including support services where these are included within the basic license fee.
- Information services — all expenditure on professional services, systems integration, outsourcing, processing services, network services, turnkey systems, systems software product support services and applications software product support services, and equipment services which comprises equipment maintenance and environmental services.
- Communications — all expenditure on IT-related data communications services.
- Facilities — IT budget expenditure on overheads such as space, heating, lighting, furniture, vehicles etc.

- Staff — direct in-house staff costs including any temporary contract labor.

2. IT Software & Services Categories

The complete list of categories included within INPUT's definitions is as follows:

- Professional services.
- Systems integration.
- Outsourcing.
- Processing services.
- Network services.
- Systems software products.
- Applications software products.
- Turnkey systems.
- Equipment services.

3. Industry Sectors

INPUT defines the following industry sectors according to the most recent revision of the Standard Industrial Classification (SIC) code system:

- Discrete manufacturing.
- Process manufacturing.
- Transportation services.
- Telecommunications.
- Utilities.
- Retail trade.
- Wholesale trade.

- Banking and finance.
- Insurance.
- Health services.
- Education.
- Business services.
- Federal Government.
- State and Local Government.
- Miscellaneous industries.

The definition of these sectors by SIC code can be found in Appendix C, Terms and Definitions.

Additionally, INPUT recognizes a separate set of Process or Cross-Industry sectors since they have general applicability across all industries.

These sectors involve multi-industry applications such as human resource systems and accounting systems.

These process-oriented sectors comprise:

- Accounting/Finance.
- Human resources.
- Education and training.
- Office systems.
- Engineering and scientific.
- Planning and analysis.
- Sales and marketing.

Further descriptions of these sectors are provided in the Terms and Definitions section included in this report as Appendix C.

C
Methodology

The data upon which this report is based was gathered as part of INPUT's ongoing market analysis program for the IT Software & Services business.

Trends, market sizes, and growth rates are based upon INPUT research, interview programs with users and buyers within the industry and the vendors serving these industries.

In addition extensive use was made of INPUT's corporate library. The resources in this library include on-line periodicals databases, subscriptions to a broad range of computer and general business periodicals, continually updated files on over 3000 IT Software & Services vendors, and U.S. Government industry statistics.

It must be noted that in the case of *financial data* some vendors are unwilling to provide detailed revenue data by product/services group or industry.

Also, vendors often use different categories of industries and industry segments, or view their services as falling into different product/service groups than those used by INPUT.

In these cases INPUT estimates revenues for these categories on a best-effort basis.

The values used in many of the exhibits contained in this report have been rounded for ease of reference.

D
Report Structure

The remainder of this report is structured in the following way:

Chapter II, *Executive Summary*, provides an overview of the principal analyses and conclusions developed in the main body of the report.

Chapter III, *High Technology Manufacturing Sector IT Environment*, discusses changes, market issues and activities in the U.S. High Technology Manufacturing sector that can affect the current and future use of IT Software & Services.

Chapter IV, *High Technology Manufacturing Sector IT Market*, contains an analysis of total IT budgets and IT Software & Services expenditures in

particular, within the U.S. High Technology Manufacturing sector. It provides forecasts for expenditure in these segments through to the year 2002 and provides comparisons to other industry sectors.

Chapter V, *Electronic Business Directions* is a discussion of the major driving forces causing organizations to redefine processes and reengineer their structures.

Appendix A provides a set of summary tables that form a supporting database for the market forecasts contained in this report.

Appendix B provides a reconciliation between the market assessments and forecasts shown in this report in comparison with those previously published by INPUT in 1996.

Appendix C provides a definition of the terms used in the analysis of the IT Software & Services market.

E
Related INPUT Research Programs and Reports

The following reports contain detailed analysis of each market sector, offering commentary and recommendations for vendors.

1.U.S. Reports

Desktop Services Opportunities for the U.S. - 1997

Evaluation of Business Continuity Services in the U.S.

IT Customer Services Market Analysis, U.S. 1997-2002

Evaluation of Digital Money Products in U.S. Banking

Impact of Digital Money on Banking, 1997

Evaluation of Federal Program Budgets, 1998

Federal Financial Management Systems Market 1996

Federal Imaging Market 1996-2001

Federal Information Systems and Services Market 1996-2001

Federal Information Systems and Services Market 1997-2002

Federal Telecommunications Market 1996-2001

Impact of Procurement Reform on Federal Government

Outlook for the Federal Professional Services Market 1996-2001

Evaluation of SAP Service Providers in the U.S., 1997

Evaluation of Firewall Solutions, U.S., 1997

Evaluation of Intranet Development Opportunities - U.S.

Outsourcing Vendor Performance Analysis - U.S.

Year 2000 Services Opportunities

2. European Reports

a. Europe Wide Reports

Desktop Services Opportunities - Europe

Evaluation of Business Continuity Services in Europe

Professional Services Market Forecast, Europe, 1997-2002

SAP Services - European User Perspectives

Evaluation of Internet Firewall Solutions, Europe

Evaluation of Intranet Development Opportunities - Europe

Customer Care and Billing Solutions within Telecommunications Providers in Europe, 1996-2000

Operational Services Market Forecast, Europe 1997-2002

Outsourcing Vendor Performance Analysis - Europe

b. French Reports

Evaluation des Opportunites de Services Micros et LANs France, 1997

Evaluation of Business Continuity Services in France

Evaluation of SAP Services Providers in France

Evaluation of Internet Firewall Solutions, France

Opportunites de Services autour d'Intranet, 1996-2001

Les Services D'Exploitation de Centres D'Appels, France

Outsourcing Vendor Performance Analysis - France

c. German Reports

Evaluation of Business Continuity Services in Germany

Outsourcing Vendor Performance Analysis – Germany

d. United Kingdom Reports

Desktop Services Opportunities – U.K.

Evaluation of Business Continuity Services in the U.K.

Future of Network Management Support in the U.K.

Evaluation of SAP Service Providers – U.K.

Evaluation of Intranet Development Opportunities – U.K.

Outsourcing Vendor Performance Analysis for the U.K.

3. Worldwide Profiles

Worldwide Market Profile, 1997-2002

Regional Market Profiles, 1997 - 2002

North America
Latin America
Asia Pacific
Western Europe
Central & Eastern Europe
Middle East / Africa

Country Market Profiles, 1997 - 2002

United States
Canada
Mexico

Australia
China
India
Japan
South Korea
Taiwan
Hong Kong
New Zealand
Singapore

Israel
South Africa

Argentina
Brazil
Venezuela

France
Germany
Italy
United Kingdom

Russia

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II

Executive Summary

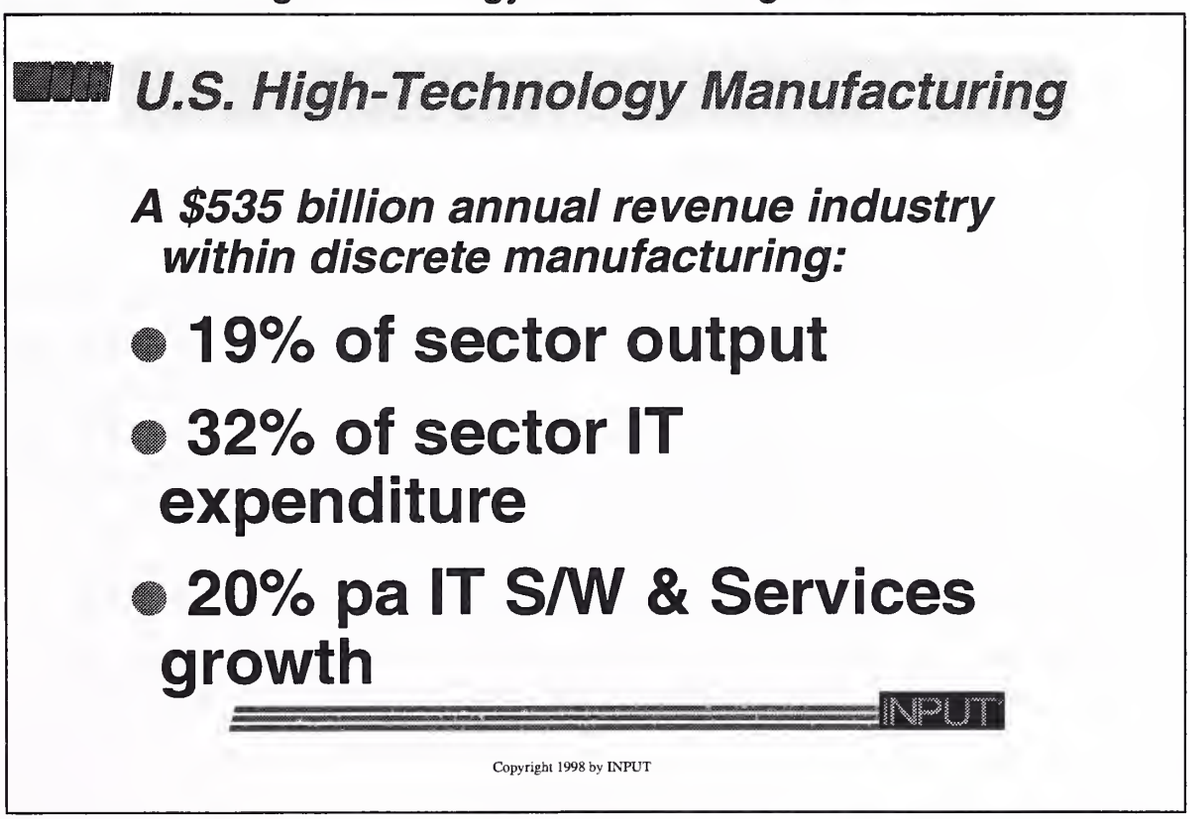
A
High Technology Manufacturers Emphasize Execution over Innovation

The U.S. High Technology Manufacturing sector comprises firms producing computer equipment, communications equipment and electronic components and accessories.

As an industry sector it represents nearly one fifth of the entire Discrete Manufacturing sector, see Exhibit II-1

Exhibit II-1

High Technology Manufacturing IT Market



Source: INPUT

Overall the sector is a high spender on IT, accounting for nearly one third of all IT expenditure within the Discrete Manufacturing sector.

In terms of growth for IT Software & Services the High–Tec Manufacturing sector is only just below the fastest growing sector, Telecommunications, with annual growth predicted at just under 20% per annum (19.5% to the Telecommunications sector's 20.4%).

The High Technology Manufacturing industry not only provides the products, electronic components, computer and communications equipment, that are the platforms for the transformation of modern business but is also under the spotlight to use them effectively.

Not surprisingly, the High Technology Manufacturing sector spends an above industry average proportion of its total output on IT, 7.5% against the U.S. industry average of 3.9%.

Perhaps surprisingly, the top performers in the industry appear to spend less proportionally on IT (up to one quarter less in some cases) in comparison to less successful firms.

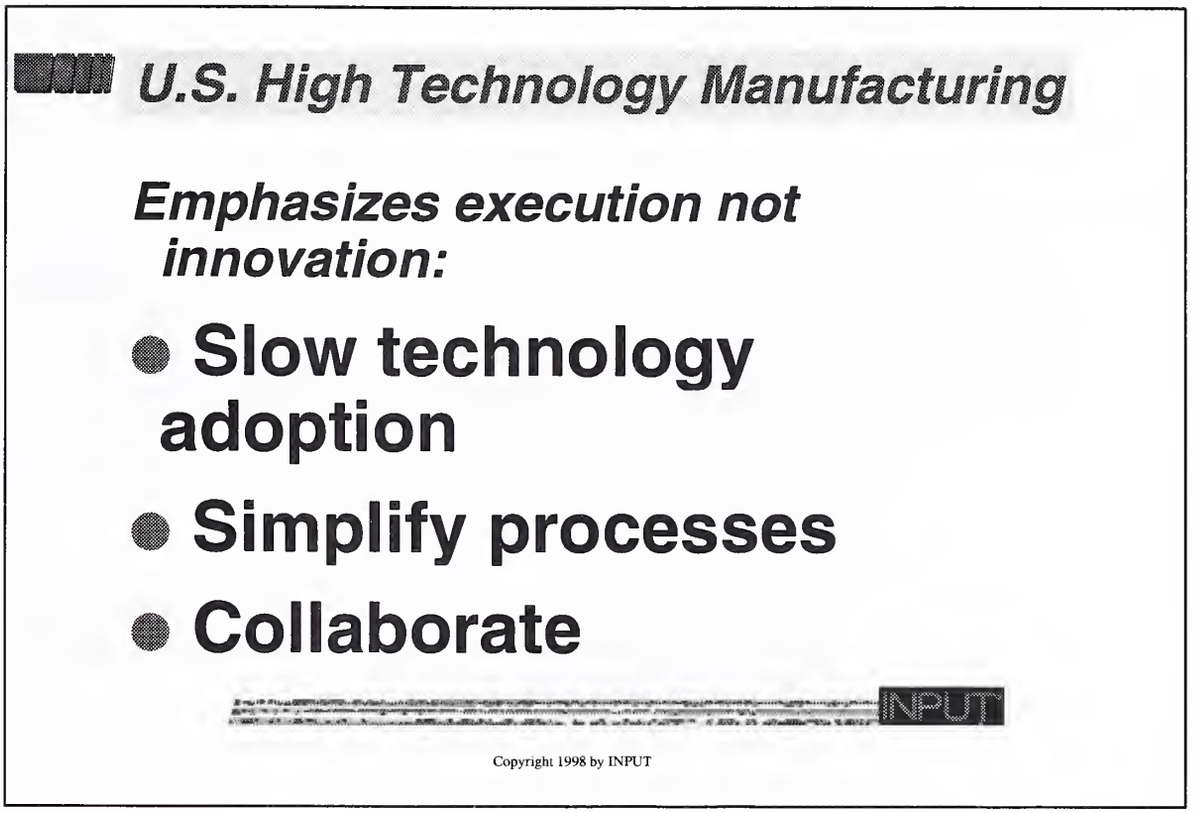
Top performers in High Technology Manufacturing industry place special emphasis on the effective use of IT systems rather than just the extent of the application of IT.

There are three key elements in this approach to IT that mirror an overall management philosophy which emphasizes *execution* over *innovation*, reference Exhibit II-2:

- In the market, top performing High Technology Manufacturing firms have to be ready to move quickly. But it is less important for them to be *first* than to be *right* when they do, *right* in terms of both function and functionality. Prioritizing excellence in execution over innovation is a philosophy that is also applied to the implementation of IT and factory automation.

Exhibit II-2

High Technology Manufacturing Industry Best Practice



Source: INPUT

- The simplification of operational processes is another vital part of the management philosophy of top performing High Technology Manufacturing firms. Three process areas are critical for High Technology Manufacturing firms, product development, customer relationship management, and supply chain management. Simpler business processes also lead to simpler IT and factory automation solutions at lower cost.

- Collaboration is also a major element of a top performing High Technology Manufacturing firm's management approach. This recognizes the impossibility of maintaining state-of-the-art capability alone in every single area of a firm's activities. Two areas of particular importance covered in this report are collaboration with IT vendors for Enterprise Application Solutions and Internet based Electronic Commerce.

B
Technology Adoption Slowed

It may seem paradoxical that in a world of rapid technology development and time-based competition that top performing High Technology Manufacturing firms seek to deliberately slow down the pace of IT adoption.

However, this approach pays off if it results in greater effectiveness, both in terms of operations and the return on capital invested.

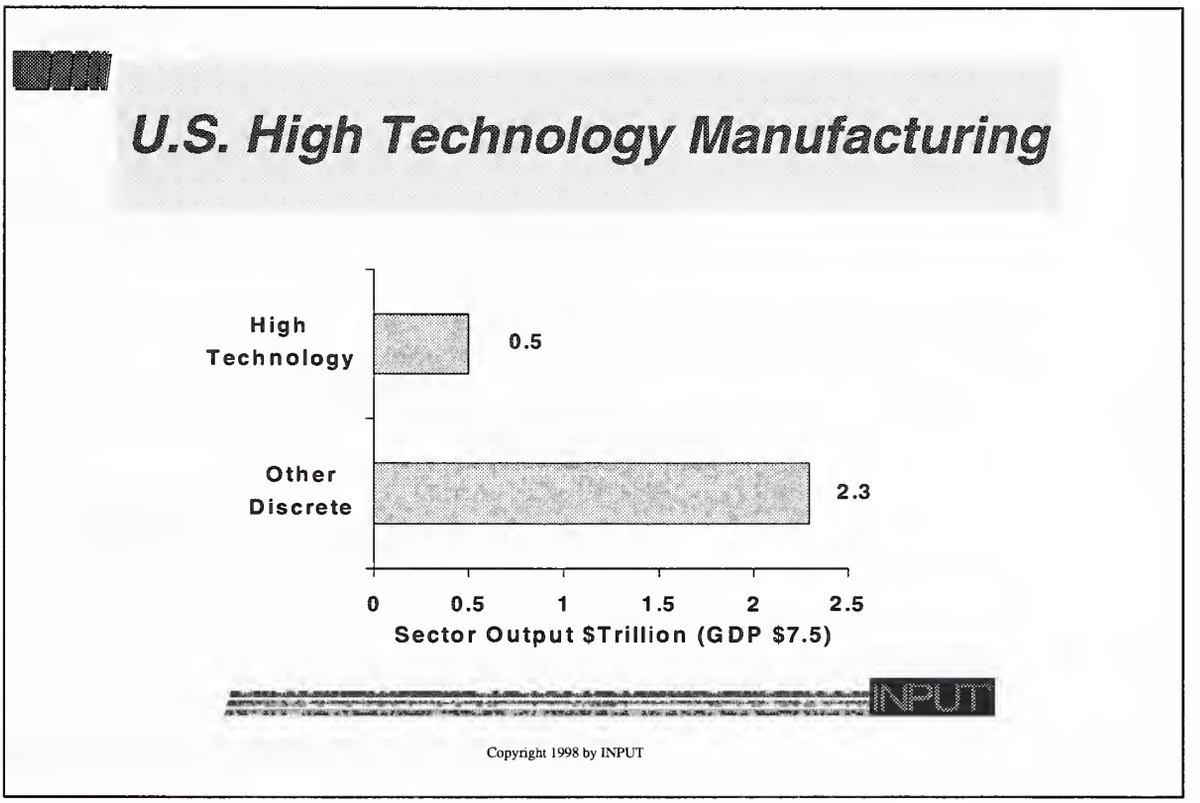
Consequently the High Technology Manufacturing sector overall, although a relatively big spender on IT ($40.1 billion in the U.S. in 1997 representing 7.5% of industry output) comes well below sectors such as Telecommunications (17.5%), Insurance (12.5%), and Banking and Finance (11.2%).

The remainder of this section of the Executive Summary reviews the overall size of the U.S. High Technology Manufacturing sector, and its expenditure on IT and IT Software & Services.

The High Technology Manufacturing sector represents just under 20% of the total Discrete Manufacturing sector, itself the largest individual sector grouped by INPUT in its industry sector analysis, see Exhibit II-3.

Exhibit II-3

High Technology Manufacturing Sector Output



Source: INPUT

Total Discrete Manufacturing activity in the U.S. in 1997 amounted to just under 16% of all economic output for all industry sectors.

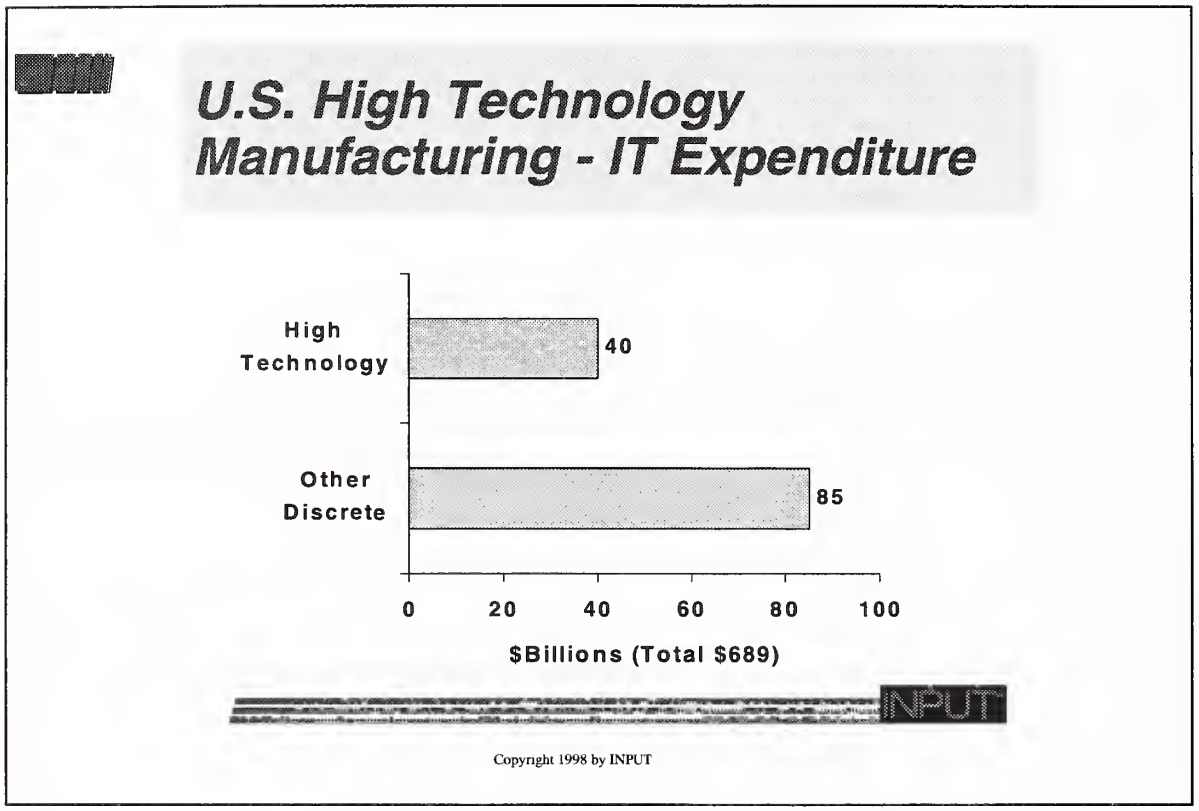
For comparison the Retail sector is the largest U.S. industry sector ($2.9 Trillion), followed by Process Manufacturing ($1.9 Trillion) and Business Services ($1.85 Trillion)

Measured against GDP, the total Discrete Manufacturing sector accounted for just over 37% of the U.S. economy, the High Technology Manufacturing sector about 7%. This is about twice the size in relative terms of the European High Technology Manufacturing sector.

The total IT related expenditure in the High Technology Manufacturing sector in the U.S. in 1997 accounted for 5.8% of the total for all industries, see Exhibit II-4.

Exhibit II-4

High Technology Manufacturing Industry IT Expenditure



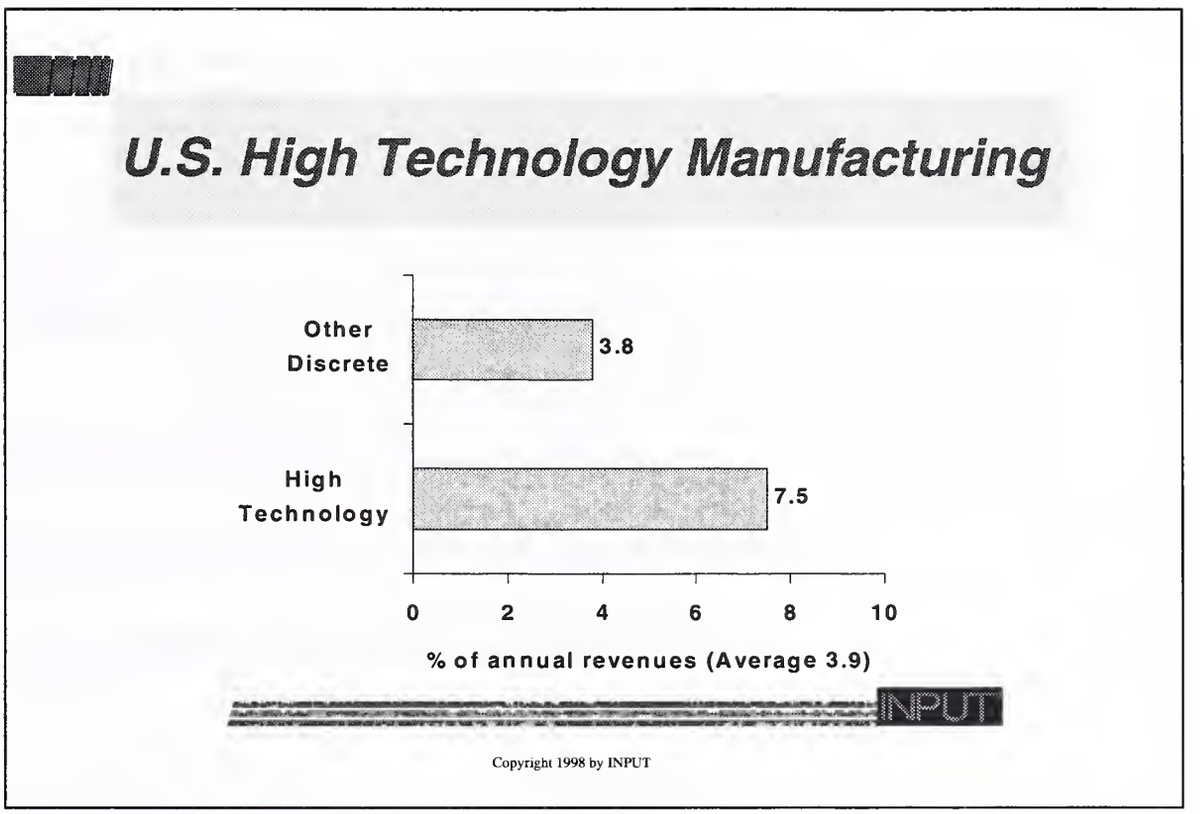
Source: INPUT

However, as an industry sector it ranked above average for the proportion of total revenues spent on IT (7.5% against an U.S. all industry average of 3.9%.).

In contrast other Discrete Manufacturing firms only averaged 3.8% of annual revenues devoted to IT, a figure just below the all sector average, see Exhibit II-5.

Exhibit II-5

High Technology Manufacturing Industry IT Expenditure Ratio



Source: INPUT

High Technology Manufacturing has one of the highest percentages of IT expenditure of annual revenues of any individual industry sector.

Only three sectors devote a higher proportion of annual revenues or expenses to IT, Telecommunications (17.5%), Insurance (12.5%), and Banking and Finance (11.2%).

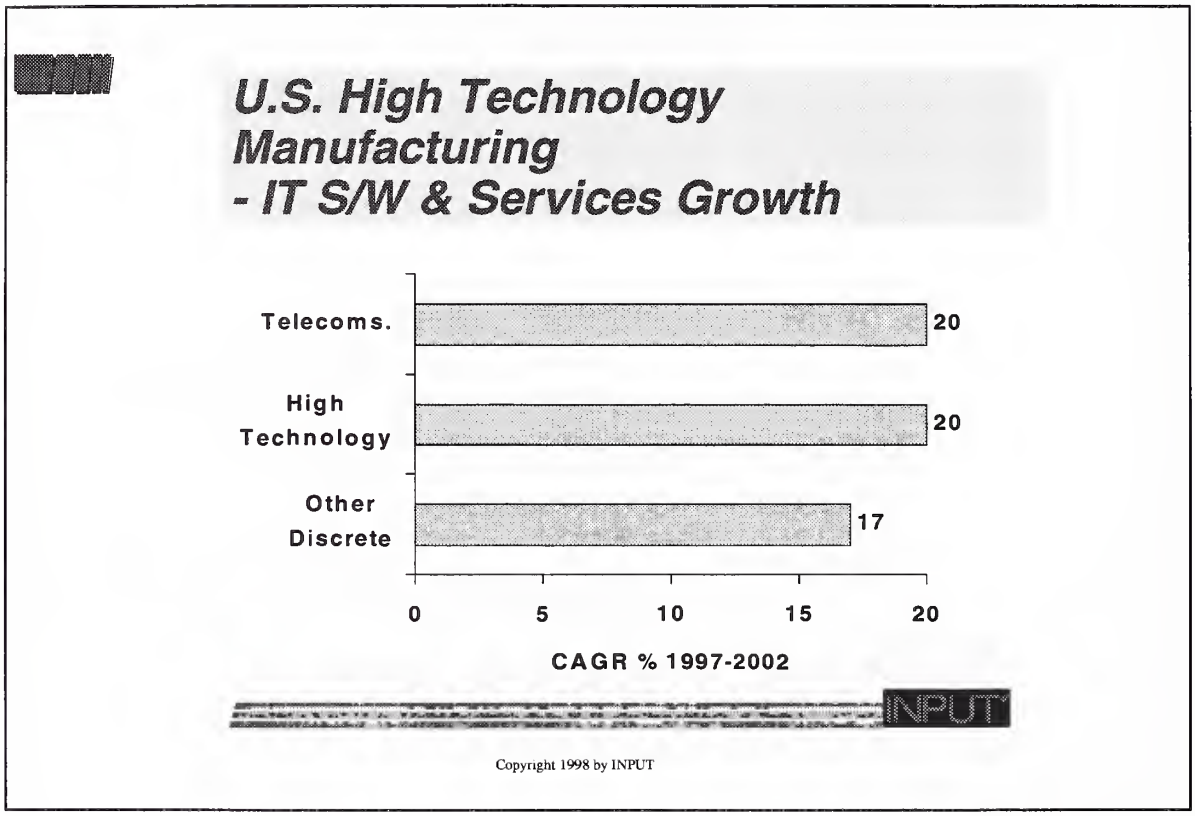
Of course as has already been mentioned there exist differences within the High Technology sector with regard to the proportion of total output spent on IT.

However, although the top performers spend proportionally less than others in the industry the lower performers spend an above industry average amount.

The U.S. High Technology Manufacturing industry sector ranked as the second fastest growing industry sector in terms of expected spending on IT Software & Services for the period 1997 to 2002, see Exhibit II-6.

Exhibit II-6

High Technology Manufacturing Industry IT Software & Services Growth



Source: INPUT

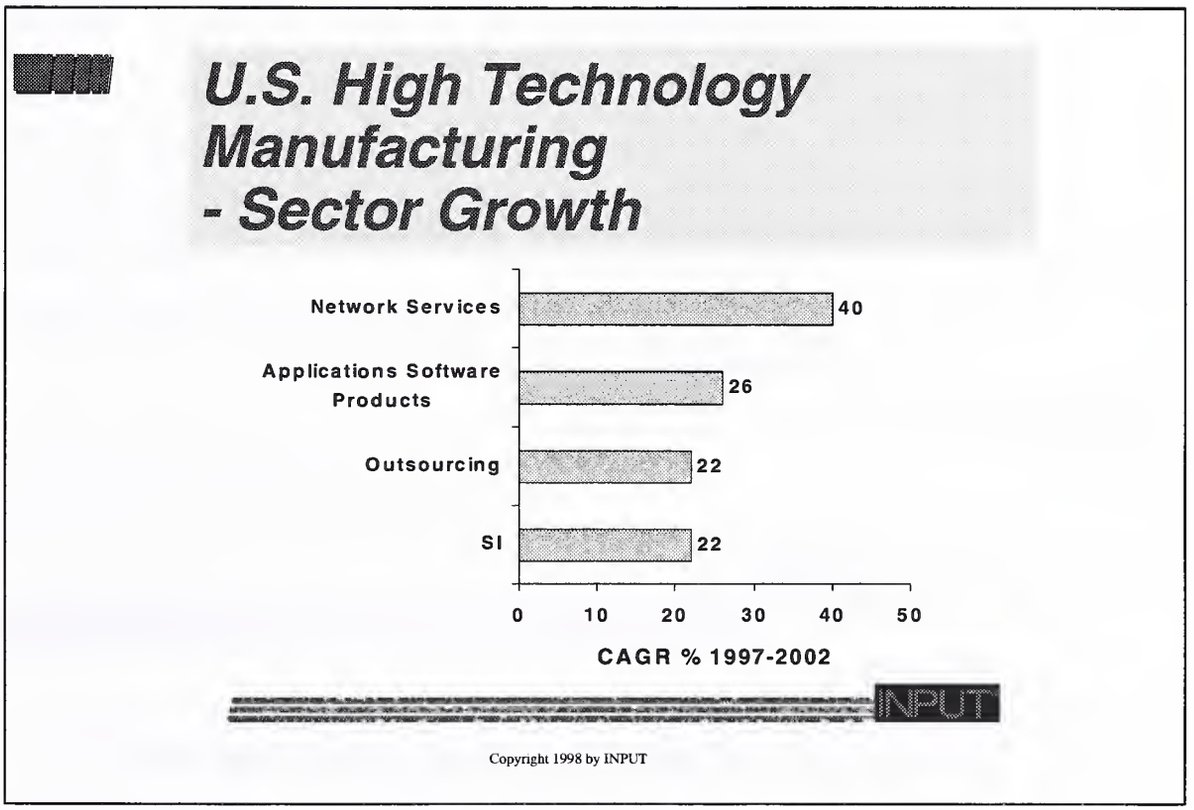
The CAGR for the total of all U.S. industry sectors is forecast at 16%.

Exhibit II-7 shows the three fastest forecast growth sectors within the IT Software & Services market in the High Technology Manufacturing sector.

In contrast Professional Services and Turnkey Systems will represent the weakest growth in the sector, both only growing at a forecast CAGR of around 20%.

Exhibit II-7

High Technology Manufacturing Industry - IT Services Sector Growth



Source: INPUT

Network Services are expected to show strong growth in this sector as High Technology Manufacturers seek Internet based Electronic Commerce solutions and continue to invest in sophisticated network support for supply chain management.

Applications Software Products growth pays testimony to the continuing demand for Enterprise Applications Solutions ERP products in the High Technology Manufacturing sector.

Outsourcing and Systems Integration sector growth show the continuing tendency for High Technology Manufacturing firms to seek partnerships and collaboration in order to meet their IT goals.

It is this collaborative approach, necessary to stay abreast of state-of-the-art developments in a fast moving industry that typifies the management approach of High Technology Manufacturing firms.

C
Process Simplification

The simplification of operational processes is a major feature of the management approach of top performing High Technology Manufacturing firms.

Fundamentally this is because High Technology Manufacturing firms strive for flexibility in their operations, and the vital human control that is still so necessary can operate more effectively the simpler the processes.

Three process areas are of particular importance to High Technology Manufacturing firms, see Exhibit II-8.

Exhibit II-8

The Three Key Industry Processes

Source: INPUT

The product development process, as already implied, emphasizes execution over innovation.

It is not so important to be the first into the market, it is very important to have a fully *functioning* product with the *functionality* that most closely matches market demand when that market is entered.

Flexibility in the product development process is key to meeting these aims. For example, having the flexibility to delay the *freeze point* for the product specification for as long as possible will help match fast changing buyer preferences.

The customer relationship management process is also vital to this objective.

Superior knowledge of customer needs is key to producing the *right* product for the *right* market.

Top performing High Technology Manufacturing firms devote significant effort to conducting direct discussions with customers rather than relying on traditional, but complex, methods managed by a separate marketing department, for obtaining market information and buyer data.

The supply chain is one of the most critical processes for High Technology Manufacturing firms.

Top performers seem to have moved a long way in the direction of outsourcing as many facets of this process as possible in order to achieve operating flexibility through simplicity.

Not only do successful firms employ more comprehensive IT support for this function than their less successful competitors but they also place greater reliance on using third parties in the process.

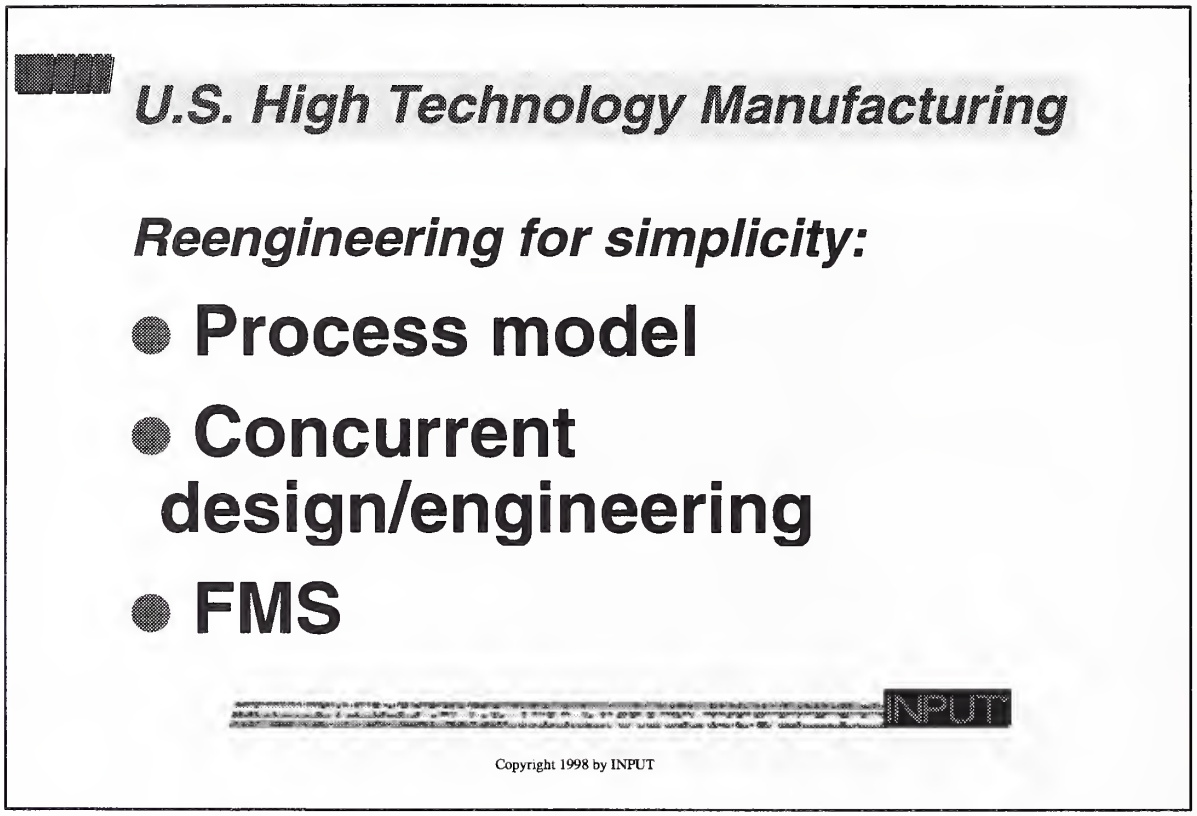
High Technology Manufacturing firms will seek suppliers to own and manage inventories and find other partners to handle transport logistics.

Best practice firms also tend to outsource the whole process of information management connected with controlling the supply chain.

Clearly the actual physical production process is at the heart of High Technology Manufacturing firms. Reengineering these processes for operational simplicity, and leveraging IT and factory automation technology, remain the key challenges for manufacturing firms, reference Exhibit II-9.

Exhibit II-9

High Technology Manufacturing Automation



Source: INPUT

Computer controlled automation is increasingly being used to coordinate every aspect of the manufacturing process, from product concept and creative design, through engineering, processing and assembly.

The shift to the process model away from the old command and control hierarchical organization, which dominated all manufacturing in the past, has been one of the major focal points for reengineering initiatives.

IT, particularly data communications technology, is the essential enabling mechanism for creating the vital linkages between the engineering of the product and the reengineering of the company organization.

Electronic Manufacturing is emerging from these reengineering initiatives as the benefits of designing the production process from the beginning are being realized.

Designing the whole business process form the beginning provides the opportunity for achieving optimum *product* engineering and optimum *production* engineering.

IT enabled 'concurrent design/engineering' has been one of the major objectives of many manufacturing firms for some time.

IT has been developed to the stage where it is able to support concurrency and this has assisted the breakdown of the traditional departmental and hierarchical organization structure.

In these operational systems the process that transforms the factory data into information, to be used by every single person involved in manufacturing the product, becomes an even more important process than the physical production itself.

Best practice manufacturing firms have also to constantly bear in mind their ultimate goal of maintaining operational flexibility. This goal is enshrined in the search for FMS, Flexible Manufacturing Systems.

IT and factory automation support for manufacturing processes is now promising to enable truly flexible manufacturing systems to be developed that really harness worker intelligence for adaptation and improvement.

This provides a very different solution from the one in which the whole system is embedded in computer software that actually limits human understanding of even some abstracted view of the whole process.

Unlike the potential of human beings to be flexible and adaptable to change, software is actually very difficult and expensive to change. In many cases this has led to manufacturing systems becoming very rigid in their operation which in the extreme has led to catastrophic failure, notably where robots have been involved.

D
Collaboration with IT Services Firms

Collaboration is a major element of a top performing High Technology Manufacturing firm's management approach.

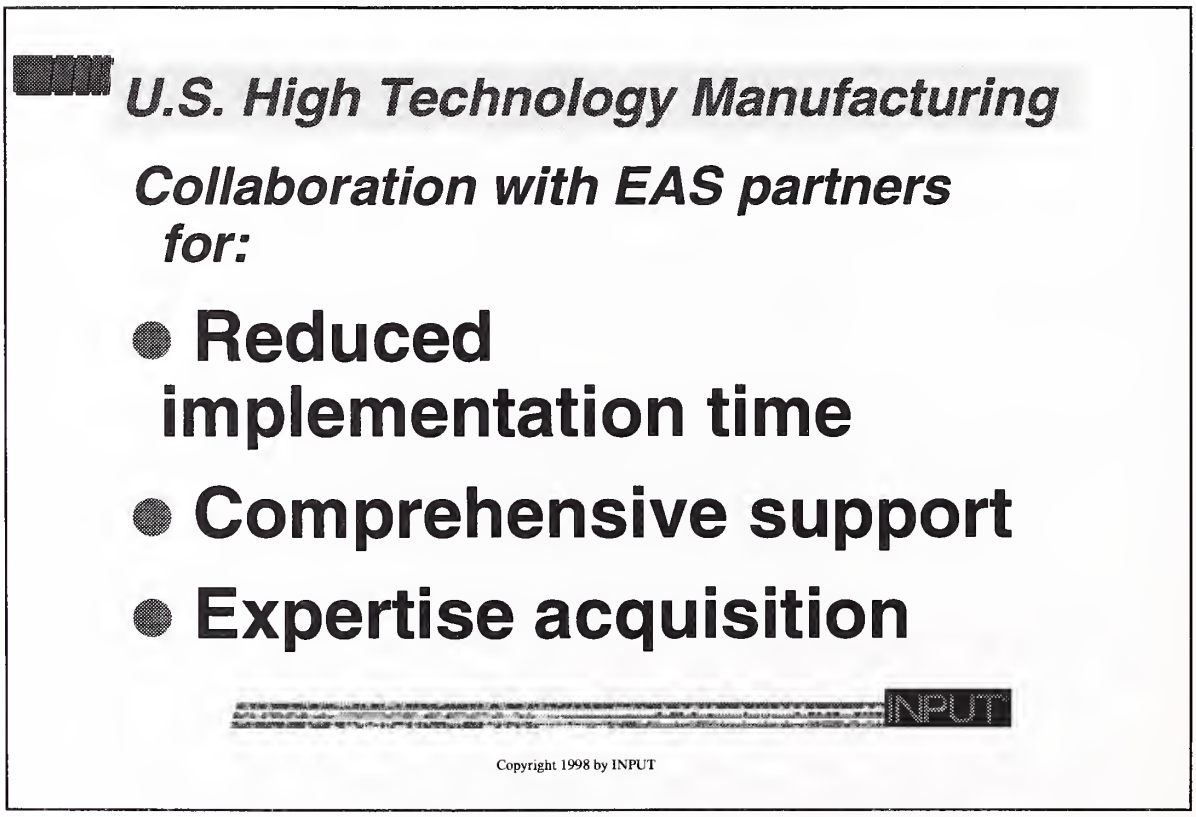
Collaboration recognizes the impossibility of maintaining state-of-the-art capability single handedly in every single aspect of a firm's activities within a rapidly developing and dynamic industry environment.

We have already referenced the importance to High Technology Manufacturing firms of involving third parties in collaboration with the management of the supply chain.

Two further important and related areas of collaboration are discussed here, firstly in the area of Enterprise Applications Solutions (reference Exhibit II-10) and secondly in the area of Internet Commerce.

Exhibit II-10

High Technology Manufacturing Industry Collaboration



Source: INPUT

The development of Enterprise Applications Solutions (EAS) implies the movement towards application product suites that integrate an increasing range of functionality.

The products of firms like SAP, Baan and Oracle Applications, typically referred to as Enterprise Resource Planning (ERP) products, are all included in this category.

The range of functionality currently offered by these products is likely to continue to develop and to acquire industry specific modules.

The benefits of using these systems are formidable in today's environment, the most frequently cited being:

- Improved functionality.
- Integration of diverse systems.
- Reengineering company processes and business activities.

However, the complexities involved in implementing them have led to the development of a very extensive after market in which major consultancies and professional services firms have developed a significant service line of business.

Consequently High Technology Manufacturing firms have built significant collaborative relationships with both the product and the services vendors serving this market.

The challenge for broad range EAS product vendors will be to offer genuine industry applications specialization as smaller more focused product vendors and to maintain the necessary client relationships that sheer size often precludes.

The challenge for the smaller more 'specific business knowledge' based EAS product vendors will be to leverage links with the majors for core functionality and generic skills like Intranet integration.

Services firms too will need to strike a careful balance between the need for 'specific business knowledge' and the defocusing tendencies of large market presence and rapid growth.

Internet Commerce (IC), the second area of collaboration to be discussed here, involves the use of the Internet for 'value' transactions and Electronic Commerce services, see Exhibit II-11.

Exhibit II-11

Internet Commerce Benefits

Source: INPUT

Vendors, manufacturers, distributors and suppliers are looking to Internet Commerce to help them create new revenue streams and retain current customers.

Internet Commerce is seen by High Technology Manufacturing firms as essential to achieve at least competitive parity and hopefully competitive advantage through the benefits listed in Exhibit II-11.

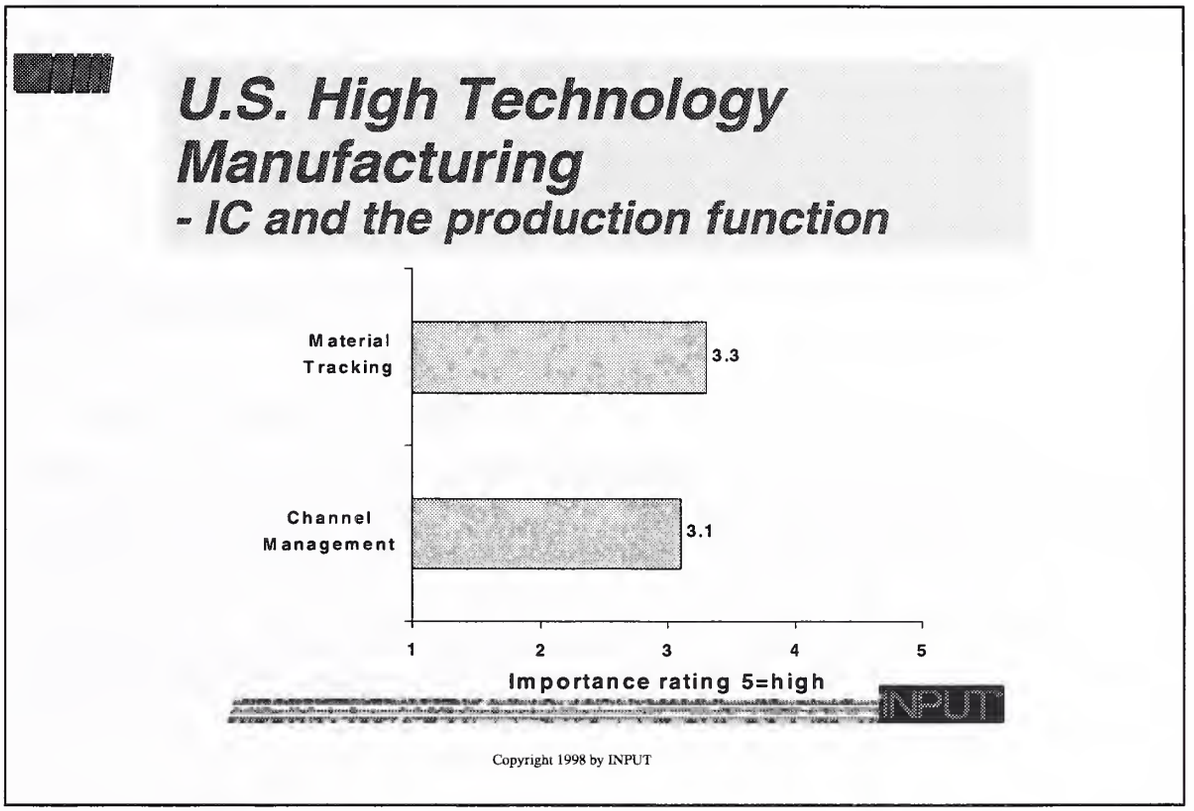
Internet Commerce is seen as a necessary part of doing business in the future, of becoming a business that is 'easy to do business with'.

The importance of this area of business development is propelling manufacturing firms to build partnerships with organizations that can help them achieve a strong Internet Commerce position as quickly as possible.

A recent survey by INPUT has shown that there are two important areas of Internet Commerce concerning managers involved in the production process, see Exhibit II-12.

Exhibit II-12

IC and the Production Function



Source: INPUT

Despite all of the benefits extolled for the Internet the survey showed that users in the manufacturing sector overall did not perceive it to be very important for their manufacturing processes.

Ratings for other factors beyond those shown in Exhibit II-12 included Routing/Scheduling (3.0), Distribution (3.0), and Inventory Management (3.0).

Thus whilst the Internet can be expected to facilitate most production processes in time, it is still not perceived generally within the manufacturing sector as important a factor as with Customer Services, Marketing and Sales.

The Internet is becoming both a key area of collaboration and a key enabler of collaboration. Internet Commerce will become just as important for the purchasing side as the distribution side of a firm's business.

Top performing High Technology Manufacturing firms will be increasing their collaborative efforts with Internet Commerce specialists. Intel's collaboration with SAP being an example of the further developments we are likely to see in this area.

III

High Technology Manufacturing Sector IT Environment

A
High Technology Manufacturing Sector Overview

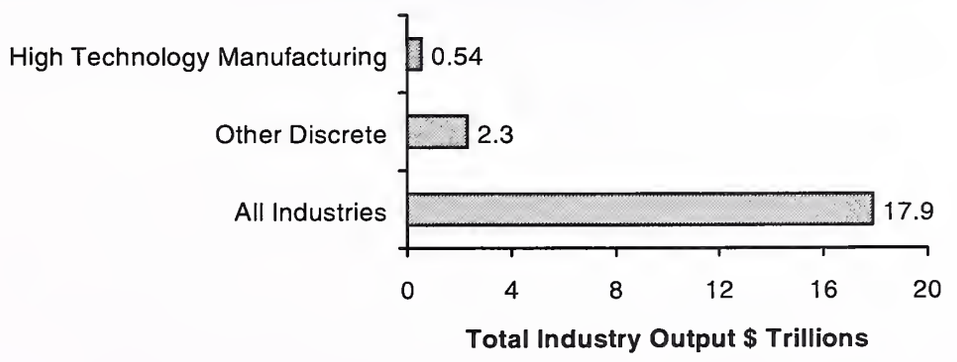
1. Macroeconomic Context

Globally the High Technology Manufacturing sector generates output estimated to total almost $1.4 trillion annually. The U.S. High Technology Manufacturing sector accounts for around 40% of this world total.

The High Technology Manufacturing sector accounts for 3% of the total output of the U.S. economy as indicated in Exhibit III-1.

Exhibit III-1

The High Technology Manufacturing Sector and Total U.S. Output - 1997



Source: INPUT

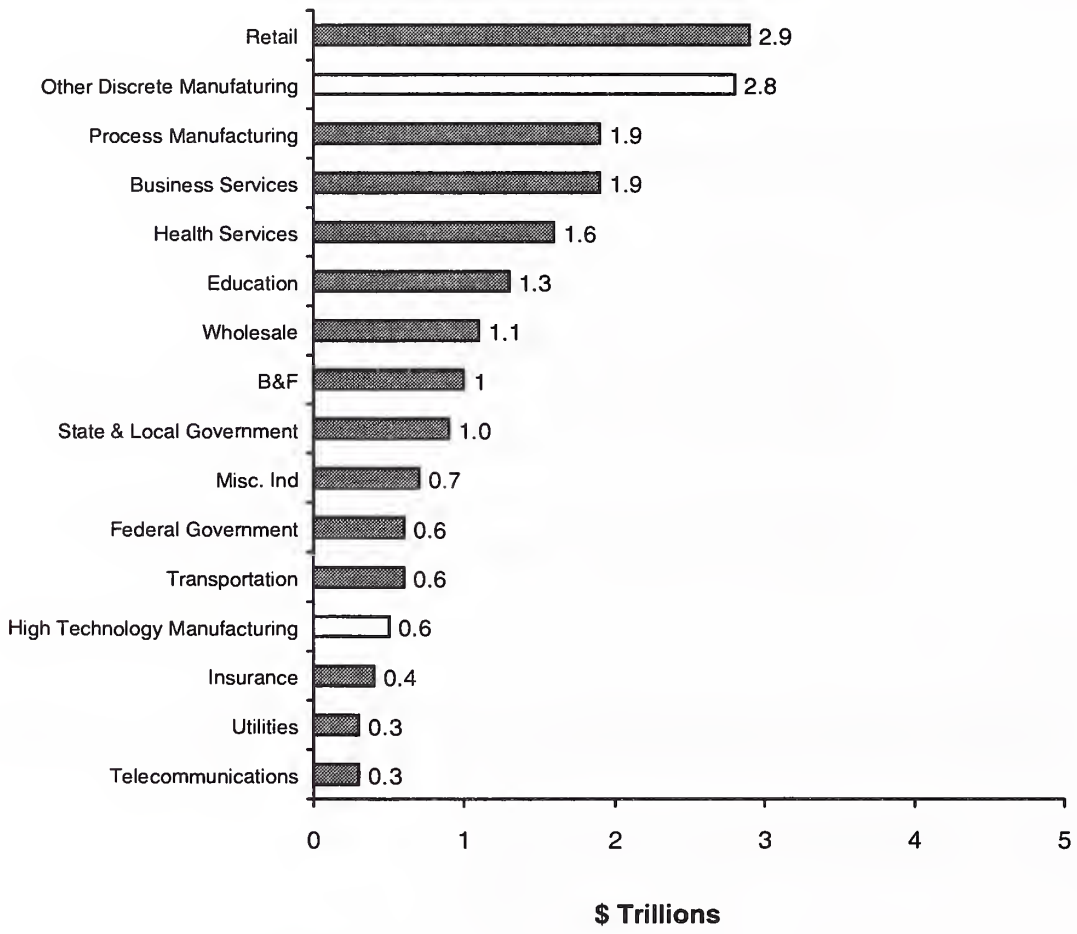
The U.S. High Technology Manufacturing sector is one of the smallest industry sectors measured by output but is significantly larger than the

European sector (half as big again in dollar terms) and larger than that of the Rest of World (dominated by Japan and other Asian economies).

A comparison of the relative size of the total output for each U.S. industry sector is shown in Exhibit III-2.

Exhibit III-2

Total Estimated Output by Industry Sector – U.S., 1997



Source: INPUT

The industry sectors shown in Exhibit II-2 are defined using the industry classification set out by INPUT in detail in Appendix C for the purposes of this report.

The analysis above measures the total output of each industry sector without regard for the inputs and outputs between sectors. Consequently

this analysis is done on a completely different basis from that used to calculate GDP.

Total industry output measures the total value of goods and services produced by each industry without eliminating intra-industry and inter-industry trading.

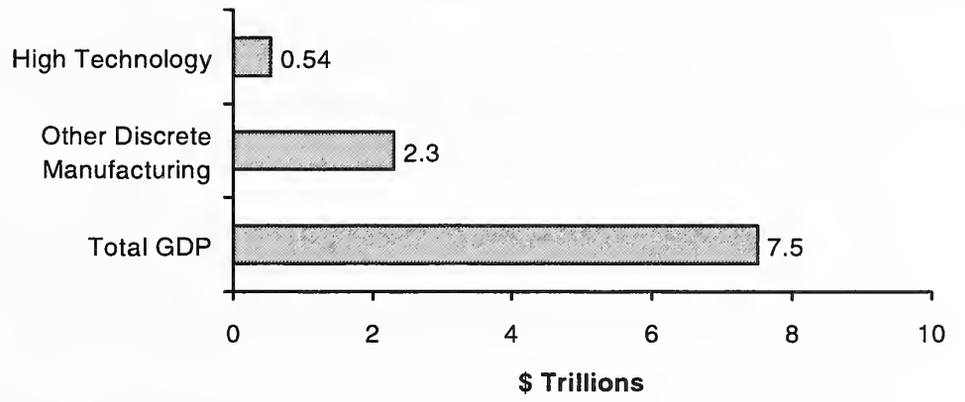
GDP estimates are specifically designed to remove these elements from the calculation.

The High Technology Manufacturing industry sector measured as a proportion of total U.S. GDP amounts to about 7%.

A comparison between the relative size of GDP and the measurement of total output for both the High Technology and all other Discrete Manufacturing sectors is shown in Exhibit III-3.

Exhibit III-3

GDP and Total High Technology Manufacturing Sector Output – U.S., 1997



Source: INPUT

INPUT uses the total economic output approach in this report, as it is a more meaningful way to conduct a subsequent analysis of the total significance of IT expenditure to the sector.

The metric that is important to industry executives and managers in respect of total industry output is the proportion of IT expenditure to the organizations total revenues or expenses.

The overall proportion of IT expenditure for a sector related to its total output is the benchmark for IT expenditure at the individual firm level. This is discussed in the next chapter.

2. Key Challenges for the High Technology Manufacturing Sector

Major challenges facing the High Tec Manufacturing sector include:

- Falling technology costs.
- Increasing operational expenses.
- Open standards and the commoditization of components.
- Global competition.
- Ever more demanding customers.

In consequence the High Technology Manufacturing sector has become fiercely competitive with dominant positions being carved out by vendors who have been able to establish market presence through brand leadership, differentiated product lines and superior distribution.

Intel is one notable example of a company that has created such a leadership role. Hewlett-Packard in printers and Toshiba in portable computers are other examples.

The history of the High Technology Manufacturing sector has been characterized by a continual cycle of innovation challenging industry participants to rapidly evolve and adapt to new challenges.

Volatility of the sector is evidenced by the observation that the industry no longer talks about the product life cycle but the company life cycle!

There are, however, notable differences in management practice between the top industry performers and the rest of the industry.

The approaches taken by these top performers illustrate some interesting insights in respect of High Technology Manufacturing management best practice.

These differences can be classified into three main categories:

- Attitudes towards strategic planning.
- Approaches to the achievement of competitive advantage.
- Approaches to the adoption of new technology.

a. Strategic Planning

At one time it was possible for new market niches in the High Technology Manufacturing sector to be exploited by new entrants with corresponding high margins for their products. For example Tandem in fault tolerant systems and Sun Microsystems in UNIX workstations.

Today competitive conditions determine that High Technology Manufacturing firms need to establish buyer awareness and credibility in newly created markets much more quickly. This puts significant time pressure on firms for the establishment of market position and brand recognition.

These factors make the formulation of medium and long-term strategy extremely problematic.

Overall High Technology Manufacturing firms are finding it increasingly difficult in the current environment to:

- Predict technology directions.
- Judge possible competitive responses.
- Forecast customer reaction and use.

Consequently top performing High Technology Manufacturing firms need to plan for multiple outcomes for new product introductions and develop contingency plans to cover expected missteps.

Placing little emphasis on strategic plans does not exclude the need for having an overall unifying vision for the organization. It is this vision that provides the framework for operating divisions to work autonomously with market driven strategies.

b. Competitive Advantage

The dynamics of the High Technology Manufacturing environment seem to imply the need for adopting multiple approaches for the achievement of competitive advantage.

Successful High Technology Manufacturing firms seem to place special emphasis on three process areas for competitive advantage gains:

- Product development.
- The management of customer relationships.
- Supply chain management.

The *product development* process of top performing High–Tec Manufacturing sector firms emphasizes execution over innovation.

High Technology Manufacturing firms must not only be ready to move into new markets quickly, but must also be able to offer superior performance in every respect upon entry if they are to be successful.

For example it is less important to be first into some new area or market than it is to have the 'right' products with the right 'features' and the 'right' support infrastructure for them.

Flexibility in the product development process is important if the 'right' product is to be produced. For example having the flexibility to delay the design freeze point as long as possible to ensure that design changes subsequently are minimized and market acceptance is maximized.

Paradoxically best practice firms accommodate more schedule slippage and more specification changes than is the industry norm.

Customer relationship management represents an important focus for best practice High Technology Manufacturing firms.

Superior knowledge of customer needs is key to eventually getting the right products into the right markets.

Consequently successful firms devote significant effort to conducting direct discussions with customers rather than just rely on conventional channels of information from the marketing department.

If a company is confident that it has the 'right' products then it seems it needs fewer variants to be successful and this in turn leads to other benefits like higher profit margins from simpler manufacturing processes and lower inventory expenses.

The simplification process, instanced here, turns out to be another trait of best practice High Technology Manufacturing firms.

In fact striving for simplicity, in what is by any measure a highly complex business, is a consistent theme for all successful manufacturing firms.

Supply chain management is another key process area.

Not only do successful firms seem to employ more comprehensive IT support for this function than their less successful competitors but they also seem to place greater reliance on involving third parties in this process.

High Technology Manufacturing firms will seek suppliers to own and manage inventories and other partners to handle transport logistics.

Most significantly best practice firms tend to outsource the whole process of information management supporting the supply chain which is so vital to binding the whole system together.

This collaboration with firms involved in the supply chain process is indicative of another important characteristic of successful High Technology Manufacturing firms, an emphasis on collaboration over competition.

This collaborative tendency is a manifestation of the innate complexity and speed with which the High Technology sector is developing. No one organization can possibly expect to maintain superior knowledge or experience of every area in which it must be involved in order to run its business.

Consequently an effective collaboration strategy is the only approach which can be expected to maintain an organization at the leading edge of as many aspects of its business as possible.

Best practice High Technology Manufacturing firms also place special emphasis on having the right cost structure, since product costs average in excess of 70% of revenues.

In competing on cost the best practice firms engage the whole organization in an attempt to cut out expense, this is not an area left solely to the manufacturing function.

c. Adoption of New Technology

It would appear that the more successful firms in the sector spend proportionally less on IT and factory automation than their less successful competitors and are slower to adopt new systems and technologies.

This may seem paradoxical, in a world of time-based competition and rapid technology development, but best practice High Technology Manufacturing firms seek to deliberately slow things down.

However, they place emphasis on getting the most effective use of IT rather than just applying IT or factory automation systems to their plant operations and support infrastructure.

Best practice High Technology Manufacturing firms rely more on the simplification of processes to limit the need for IT and factory automation systems in the first place.

Simpler business processes lead to simpler IT and automation solutions.

Simpler business processes lead to greater operational flexibility because they allow for greater human intervention. People can provide the flexibility; IT all too often produces rigidities in operational procedures.

B
Background Trends and Economic Assumptions

1. High Technology Manufacturing Sector Automation

The information revolution sweeping over industry is affecting every aspect of the manufacturing process from concept and creative design, through engineering, processing and assembly. Computers are coordinating every aspect of these functions.

However, manufacturing industry experience, particularly in the High Technology sector shows that the application of IT and factory automation is a two edged sword. It can bring huge productivity breakthroughs, but it can also lead to inefficient rigidities in manufacturing systems and occasionally catastrophic failures.

Rigidities in manufacturing systems are introduced by computerization where they limit the capability for the human operators to adequately control the system in a flexible manner.

By their very nature manufacturing systems are inherently complex. Best practice suggests that every attempt must be made to simplify the basic processes in order to limit the extent to which IT needs to be used, but more importantly to enable human beings to still be able to control the system adequately.

At one time manufacturing organizations were fundamentally structured around an information transfer and control model.

IT has allowed manufacturing organizations to be reengineered around the production process in its entirety, around the whole value-chain.

Thus has been possible the shift from the classic hierarchical management structure to the manufacturing process model.

IT, particularly data communications technology, is the essential enabling mechanism for creating the vital linkages between the engineering of the product and the reengineering of the company.

Electronic Manufacturing is thus emerging from these changes as the benefits, of designing the whole business process from the beginning, are being realized.

Designing the business from the beginning provides the opportunity to achieve optimum *product* engineering and optimum *production* engineering.

Also of particular significance is the capability of computer driven networks to allow manufacturing firms to work much more easily with subcontractors and outsourcers, for example CAD designers.

IT enabled 'concurrent design/engineering' has been one of the major objectives of many manufacturing firms for some time. IT is now able to support concurrent design, which forces the breakdown of the traditional departmental organization structure already referred to.

Utilizing IT enabled 'concurrent design/engineering' systems enables the manufacturing function, the maintenance function and even customers in some instances, to be involved right through the entire process from design concept to build.

In these systems the transformation of the factory data flows into information for all these participants is becoming an even more important process than the actual manufacturing process itself.

The development of open standards like STEP are a vital part of these developments in that they allow systems from different sources to be linked together in just the same analogous way that open standards have transformed the client/server computing environment.

Best practice manufacturing firms have had to constantly bear in mind their ultimate goal of maintaining flexibility in these systems, FMS (Flexible Manufacturing Systems) are testimony to that.

Concurrent design/engineering seeks to model the craft approach to production when the entire process could be held in the mind of one person.

That is a very different model than the one in which the system is embedded in computer software which limits human understanding of even some abstracted view of the whole process.

Ironically perhaps, given the malleability of data and information, computer software is very difficult to change and adapt whereas computer equipment can be readily swapped and extended. IT support for manufacturing processes is now promising to enable truly Flexible Manufacturing Systems to be developed that harness worker intelligence for adaptation and improvement.

The enabling of human control for manufacturing rather than the adoption of rigid robotic automation models reflects the emergence of biology as the dominant scientific metaphor as we enter the 21st century.

2. Overall Economic Assumptions

The forecast for the High Technology Manufacturing sector IT Software & Services market contained in this report are based on a fundamentally positive economic scenario.

However concerns exist about the Far Eastern economic crisis and its possible knock-on effects for the global economy as a whole.

It should, however, be recognized that a far worse financial impact, than that assumed here, could yet impact the global economy. This is a continuing risk until the Japanese authorities have demonstrated that they have taken sufficient action to stabilize their economy.

Some economic uncertainties exist even for the buoyant U.S. economy.

Of particular relevance are:

- The possibility of a stock market 'correction' that would affect business confidence generally and thus could inhibit IT investment decisions.
- The deteriorating economic stability of the Far Eastern nations, most importantly Japan.
- The issue of the supposed "new economic paradigm" in which the advanced economies are expected to enjoy years of continued economic growth and low inflation as a result of the erosion of the traditional 'business cycle'.

The "new economic paradigm" is based on the theory that technology development and global competition have created a uniquely benign environment for economic growth to continue unhindered by the ups and downs of the normal business cycle.

Technology, particularly IT, it is argued, has improved productivity to such an extent that traditional economics no longer fully applies.

An example of this is computer based JIT systems that eliminate most inventories, one of the key causal factors in the mechanics of the business cycle.

At an overall economic level these arguments are hard to sustain and it would be a high-risk strategy to base forecasts on this scenario.

One of the major counter arguments is the lack of firm evidence to support significant measured productivity improvements in service industries, the most highly developed users of IT systems.

This productivity paradox, huge investments in IT to achieve productivity improvement but little evidence to support it at an industry level or at a macro economic level, is possibly explained by neo-classical economics.

The argument centers on the observation that IT equipment has had the peculiarity of falling rapidly in price even as its functionality has increased; as a result IT has been applied to less and less valuable tasks.

In formulating the forecasts contained in this report INPUT has basically assumed that overall economic growth will continue in the U.S. over the

forecast period according to currently predicted rates, without massive shocks imposed from other parts of the world, specifically the Far East.

Economic assumptions for the U.S. economy are summarized below.

Economic growth:
-Official growth target for 1997, 3.8% and 2% targeted for 1998.

Employment:
-50% of the U.S. population is presented within the working population.

Unemployment:
-5.4% level for 1996 declined to a slightly improved 5% in 1997 and is expected to increase slightly to 5.1% in 1998.

GDP Deflators are estimated at:

1996 – 2%
1997 – 2%
1998 – 2.2%.

C
Information Systems Environment

The High Technology Manufacturing sector in total accounted for just fewer than 6% of all IT related expenditures in the U.S. in 1997. As an industry it ranked above the U.S. average for the proportion of total industry revenues (industry output) spent on IT related activities.

The High Technology Manufacturing sector averaged 7.5% of annual revenues spent on IT in 1997 in the U.S. compared to the average across all industry sectors of 3.84%, and 3.76% for all other Discrete Manufacturing Sectors.

Chapter IV below provides a detailed analysis of IT related expenditure, and specifically of IT Software & Services expenditure within the sector. Chapter IV also provides comparisons with other industry sectors.

This sub-section comments on a very significant area for IT executives and managers in the High Technology Manufacturing sector, the general trend towards the use of integrated software application packages (Enterprise Application Solutions or EAS).

Also included is a review of buyer awareness of EAS vendors in the U.S.

1. Enterprise Applications Solutions

EAS will be one of the major focal points for IT management over the next few years as users and software product vendors seek the benefits of increasing application integration.

To date these developments have mostly been focussed around the rapid acceptance of Enterprise Resource Planning (ERP) solutions from such vendors as SAP, Baan, and Oracle Applications.

However, it should be recognized, that although these named vendors have been the subject of much high profile commentary that there are an extremely wide range of vendors operating in this space, typically offering specialized features optimized for particular industry sectors or categories of firms.

In the future INPUT expects to see the level of applications integration increase with leading vendors targeting specific industry sectors with additional functionality married to their core products.

The range of integrated functionality is extending across at least the following areas:

- Enterprise Resource Planning (ERP).
- Logistics and Supply Chain Management.
- Human Resources Management Systems.

Other areas of major functionality, e.g. Customer Care and Billing (CC&B) will be important for other sectors.

In the manufacturing sector another application integration effort is represented by Product Data Management (PDM) systems which are directed primarily at interfacing with the product development applications of CAPM, CAD/CAM etc.

Another tendency is the development of a higher level of software applications product for EAS within manufacturing, Manufacturing Execution Applications Solutions (MEAS).

MEAS would provide the linkage between the traditional MRP functionality within ERP systems and the actual control of the manufacturing process itself.

Some indication of the drivers behind the shift towards using integrated EAS is provided by the results from a recent survey conducted by INPUT of the Baan user community in the U.S.

The benefits sought by users from the applications products were primarily:

- Improved functionality.
- The integration of diverse systems.
- Reengineering of company processes.
- Reengineering of business activities.

Improved functionality included achieving Year 2000 compliance, and improving customer service and company productivity through the use of standardized systems and new capabilities.

The integration of diverse systems also offers the benefits of:

- Standardization.
- Reduce the number of stand-alone systems.
- Replace and modernize legacy systems.
- Expand system capabilities to multiple sites.

Reengineering company processes is expected to improve, smooth and standardize key client procedures, thus improving productivity as a result of faster error-free functionality and reduced costs.

Reengineering the company's business activities is expected to improve information flow, responsiveness to customers and customer service.

In implementing product solutions in this area vendors face a significant challenge to provide disparate users with appropriate services.

Consequently an extensive support and services business has grown up to provide these implementation services.

Research carried out by INPUT in both the SAP and Baan after markets indicates that leading services firms are striving for success through the following approaches:

- Reducing implementation times for ERP products.
- Offering fixed price contracts.
- Addressing the skill shortages with aggressive recruitment and training of consultants.
- Acquiring and developing expertise in IT products that interoperate with standard ERP packages, particularly with an emphasis on growth areas such as NT and SQL Server.
- Gain expertise and exposure to a wider range of ERP products and not necessarily remain tied to only one product vendor.
- Develop services offerings that match the needs of smaller businesses, notably the SMEs.

The challenge for broad range EAS product vendors will be to offer genuine industry applications specialization as smaller more focused product vendors and to maintain the necessary client relationships that sheer size often precludes.

The challenge for the smaller more 'specific business knowledge' based EAS product vendors will be to leverage links with the majors for core functionality and generic skills like Intranet integration.

Services firms too will need to strike a careful balance between the need for 'specific business knowledge' and the defocusing tendencies of large market presence and rapid growth.

2. Buyer Awareness of EAS Vendors in the Manufacturing Industry

The importance of the Enterprise Resource Planning application product area was referenced in the previous section.

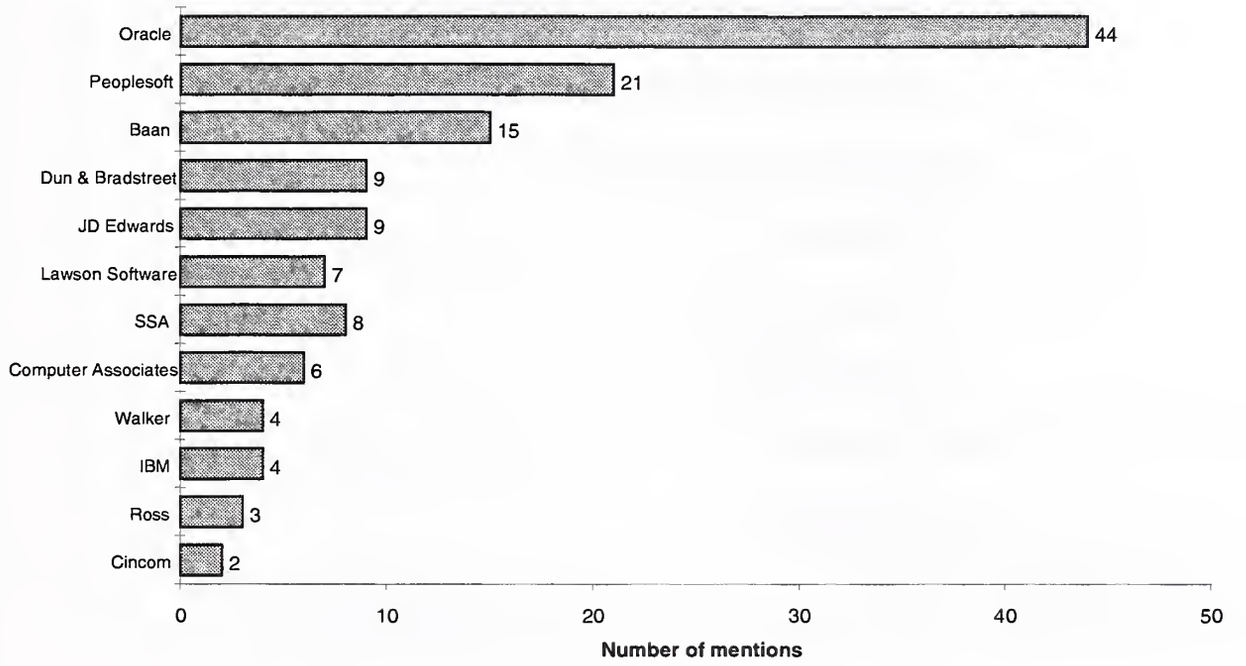
In this section survey results pertaining to comparative markets perceptions of the vendors operating in this field are provided for the whole Manufacturing sector.

The survey data from which this analysis is derived covered 78 users in North America. A separate series of reports covering both SAP products and Baan products are available for a more detailed analysis.

In Exhibit III-4 a comparison is shown of the relative importance to users of alternatives to SAP, the dominant ERP vendor in the U.S.

Exhibit III-4

Vendors Considered as Alternatives to SAP



Sample of 78 respondents

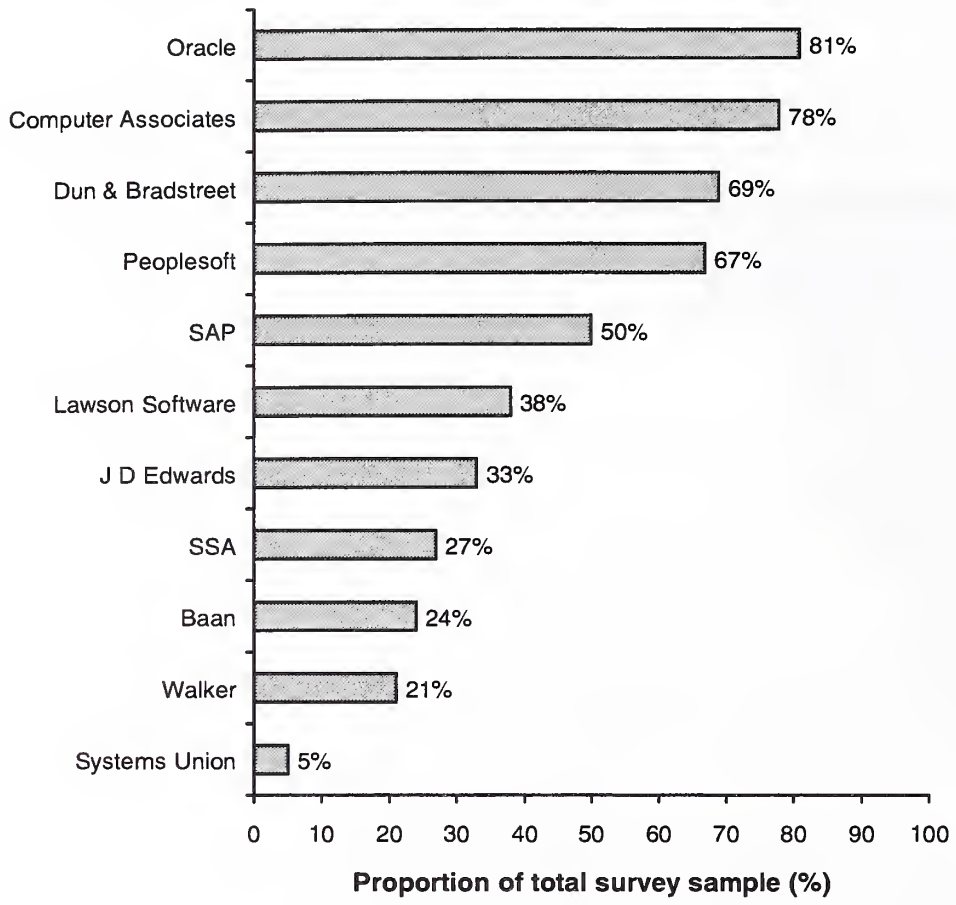
Source: INPUT

Oracle Applications, PeopleSoft and Baan stand out as the obvious rivals to SAP in Enterprise Applications Solutions bids.

Exhibit III-5 shows the percentage of the respondents rating each vendor used here as a measure of awareness.

Exhibit III-5

Prospective SAP Users' Awareness of ERP Vendors



Sample of 78 respondents

Source: INPUT

D

Internet Commerce in the Manufacturing Sector

Internet Commerce (IC) involves the use of the Internet or World Wide Web for "value" transactions and electronic commerce services.

IC addresses the needs of both business-to-business and business-to-consumer transactions.

IC extends the value chain beyond the corporate boundaries and encompasses the full supply chain / product life cycle / sales cycle.

It includes the use of Internet EDI, customer and product databases, electronic funds transfers, value-added networks, interactive voice-response customer service systems, sales and marketing on the Internet,

electronic catalogs, and basically anything simultaneously involving the Internet and business or commerce.

Vendors, manufacturers, distributors and suppliers are looking to Internet Commerce to help them create new revenue streams, open new markets and retain current clients.

They are specifically expecting to see the benefits of:

- Lowered operating costs.
- Competitive advantage or at least competitive parity.
- Global reach.
- Improved customer management.

All are looking to Internet Commerce as a necessary aspect of doing business in the future.

Manufacturers today are faced with more competitive pressures than ever. They are under unrelenting pressure to reduce costs, yet balance this with the need to remain responsive to customers and suppliers.

Now more than ever before, businesses are faced with the challenge of having to address the question – "am I a business that is easy to do business with?"

This pressure, combined with the significant growth in Internet Commerce has driven manufacturers to recognize the need to automate and coordinate the flow of information between front-end and back-office areas of the business.

Most savvy manufacturing firms are integrating their existing enterprise applications with Internet Commerce transaction capabilities in order to:

- Fully leverage their current investment in existing business systems.
- Manage the flow of business transactions internally and externally across their customers and supply chain.
- Become more "customer centric".

- Become an organization that relates to its customers, suppliers, and partners via electronic means.

Integrating Internet Commerce transactions with the enterprise allows businesses to expand operating efficiencies beyond the corporate walls.

Organizations are now expecting this integration to not only help them "extend the enterprise", but to be the "price of entry" – the strategic weapon in the arsenal of those enterprises seeking to gain a competitive advantage in a global economy that demands efficiency and rapid adjustment to market changes.

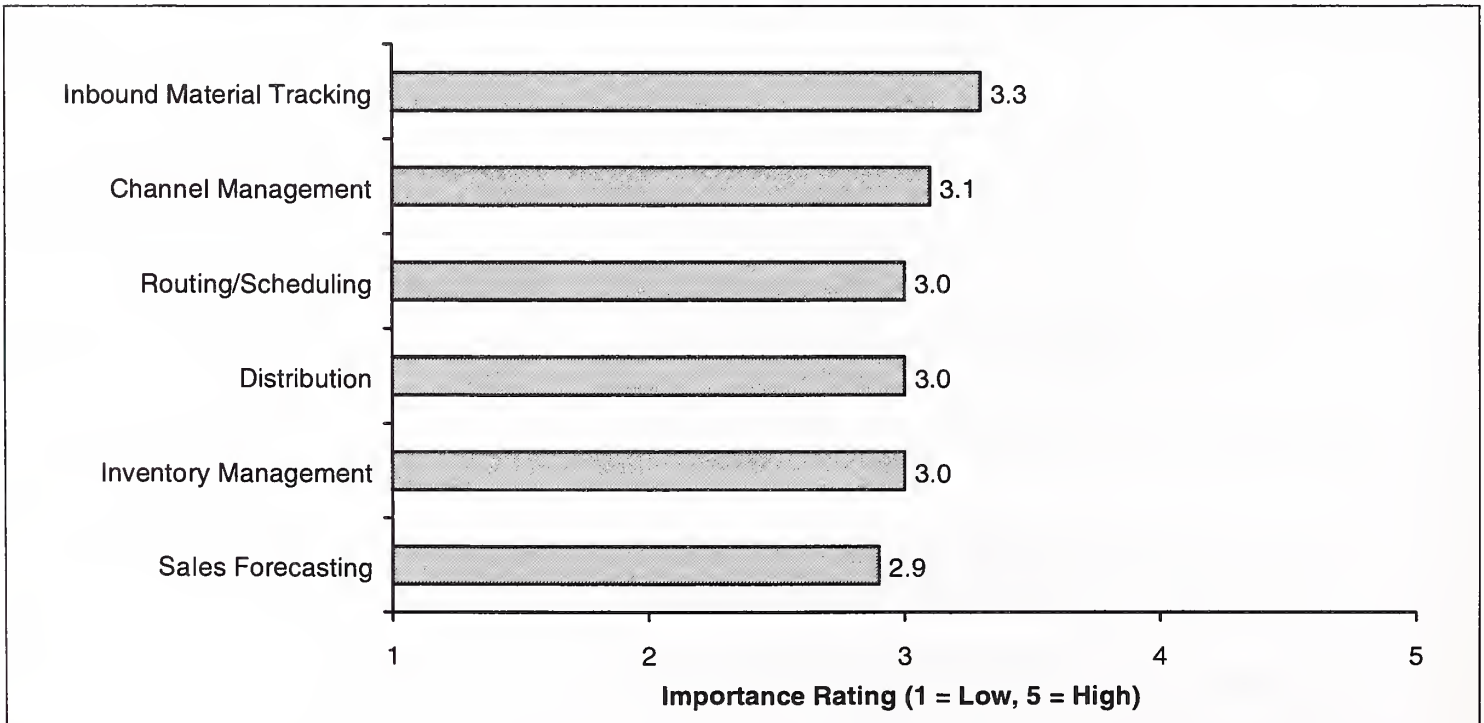
The key question is what business functions are being seen as important or necessary to integrate with Internet Commerce capabilities.

The Manufacturing sector is not unlike other industries – Internet Commerce is seen as having the greatest impact in Sales, Marketing, Purchasing and Customer Service for both users that have already implemented, as well as those planning to implement.

Exhibit III-7 shows the importance users attach to the impact (degree of importance) of the integration of IC to the business function.

Exhibit III-6

Importance of Internet Commerce to Manufacturing Related Activities



Sample: 50

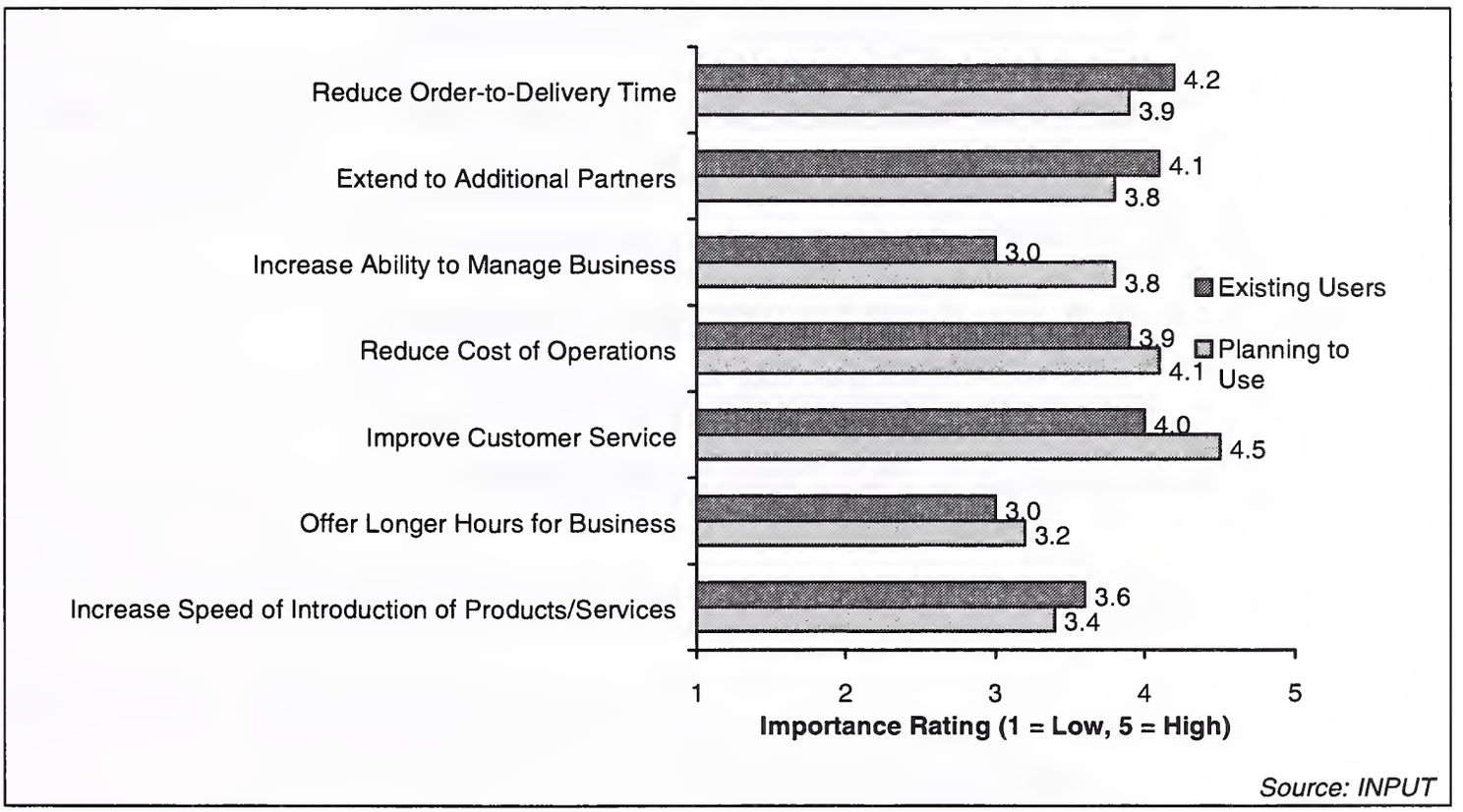
Source: INPUT

Interestingly none of these ratings is very high. Only two score above the 3 level and there is little differentiation with many other factors. For example other factors, like scheduling, were rated just below three.

Exhibit III-8 identifies the importance of expected benefits associated with integrating Internet Commerce.

Exhibit III-7

Objectives / Benefits Expected with Integration



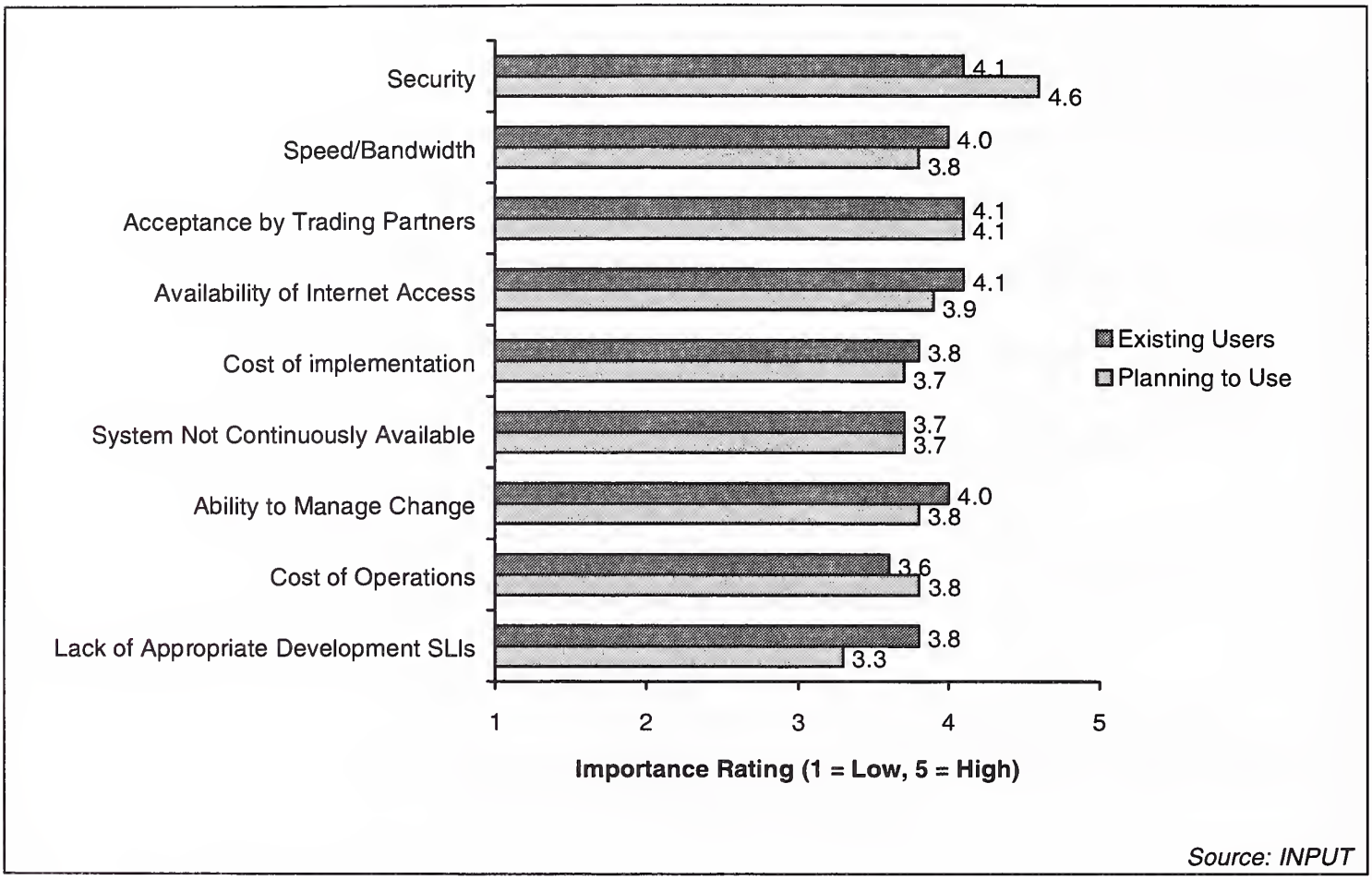
A key Business-to-Business objective for the manufacturing sector is the automation and streamlining of processes, such as purchasing, production, and delivery.

As can be seen in Exhibit III-8, reducing order to delivery times was identified as the most important benefit of Internet Commerce for manufacturing companies.

The issues and areas of concern that users have related to Internet Commerce are shown in Exhibit III-9.

Exhibit III-8

Internet Commerce Concerns



Source: INPUT

Security was identified as one of the main impediments to investing in Internet Commerce infrastructures for manufacturing companies.

Security and the other issues identified must be incorporated into the planning process, and potential vendors should be asked to explain how their solutions overcome these concerns.

IV

High Technology Manufacturing Sector IT Market

A

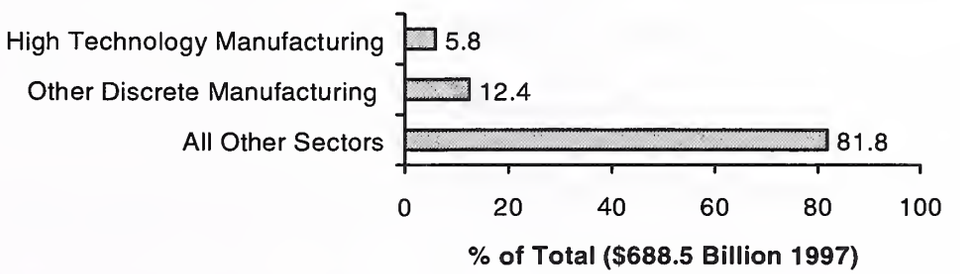
Total IT Budget for the High Technology Manufacturing Sector

The High Technology Manufacturing sector accounts for about 32% of all IT related expenditure in the U.S. Discrete Manufacturing sector.

Exhibit IV–1 shows the proportion of High Technology Manufacturing sector expenditure compared to the total amount spent by U.S. organizations on IT related items.

Exhibit IV-1

High Technology Manufacturing Sector IT Related Expenditure - U.S.



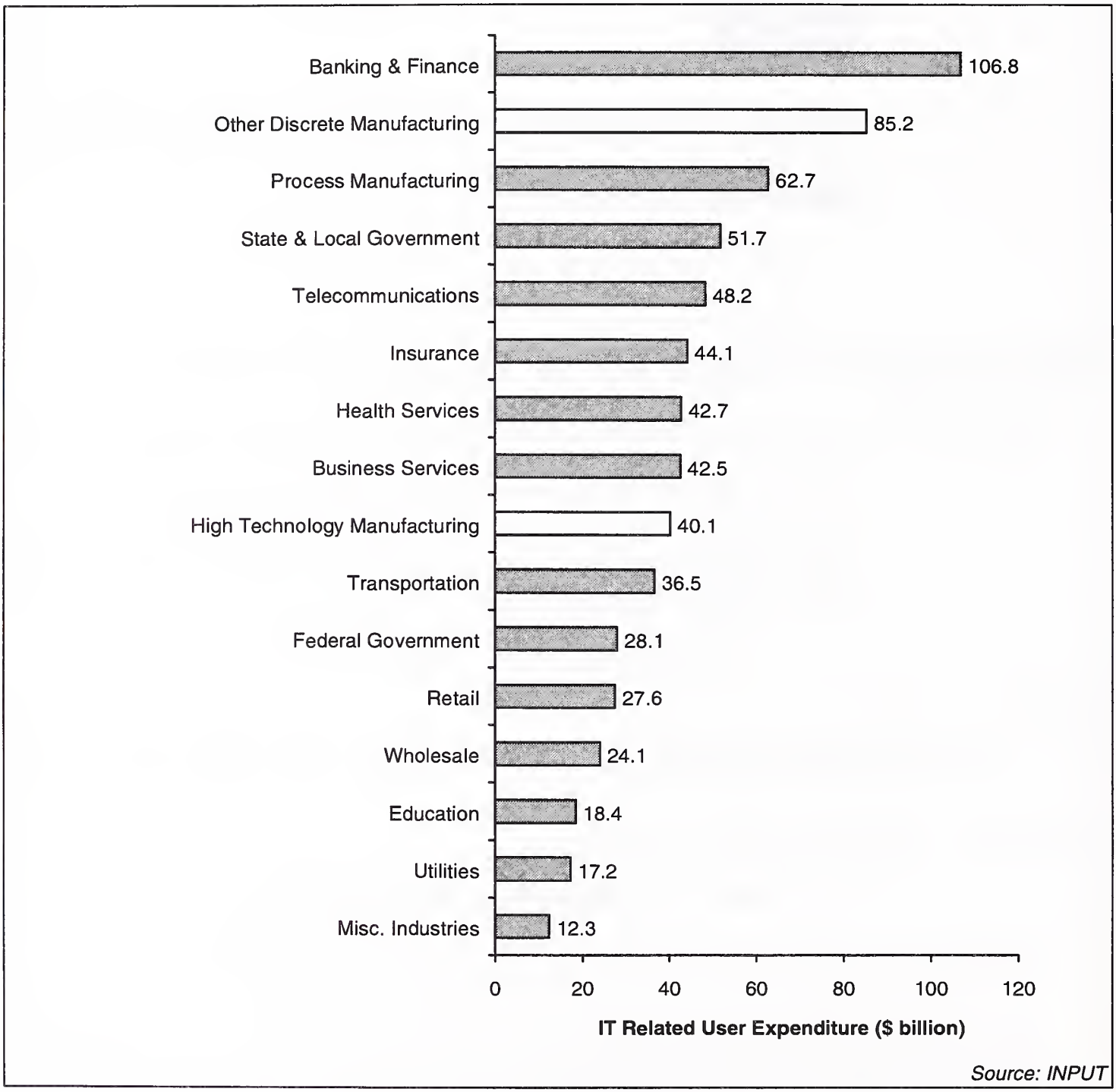
Source: INPUT

In comparison with other industry sectors the total Discrete Manufacturing sector (High Technology and Other) would rank as the largest individual industry sector overall as is shown in Exhibit IV-2.

The High Technology Manufacturing sector alone is somewhat larger than the Transportation sector for IT expenditure.

Exhibit IV-2

Industry Sector Comparison – U.S., 1997



Source: INPUT

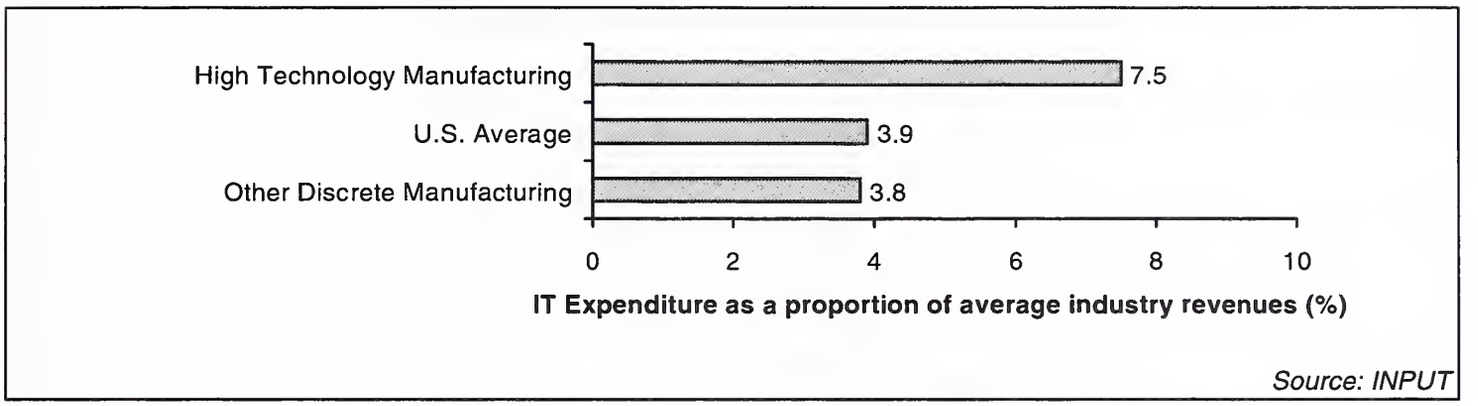
A fuller comparison of the High Technology Manufacturing sector with other industry sectors is provided in Section C of this Chapter below.

As a proportion of total industry output (the average for the individual organizations in the sector) the High Technology Manufacturing sector spent 7.5% of its revenues on IT in 1997.

Exhibit IV-3 shows the comparison for this metric with the average for all U.S. organizations; Exhibit IV-4 shows a comparison with other major industry sectors.

Exhibit IV-3

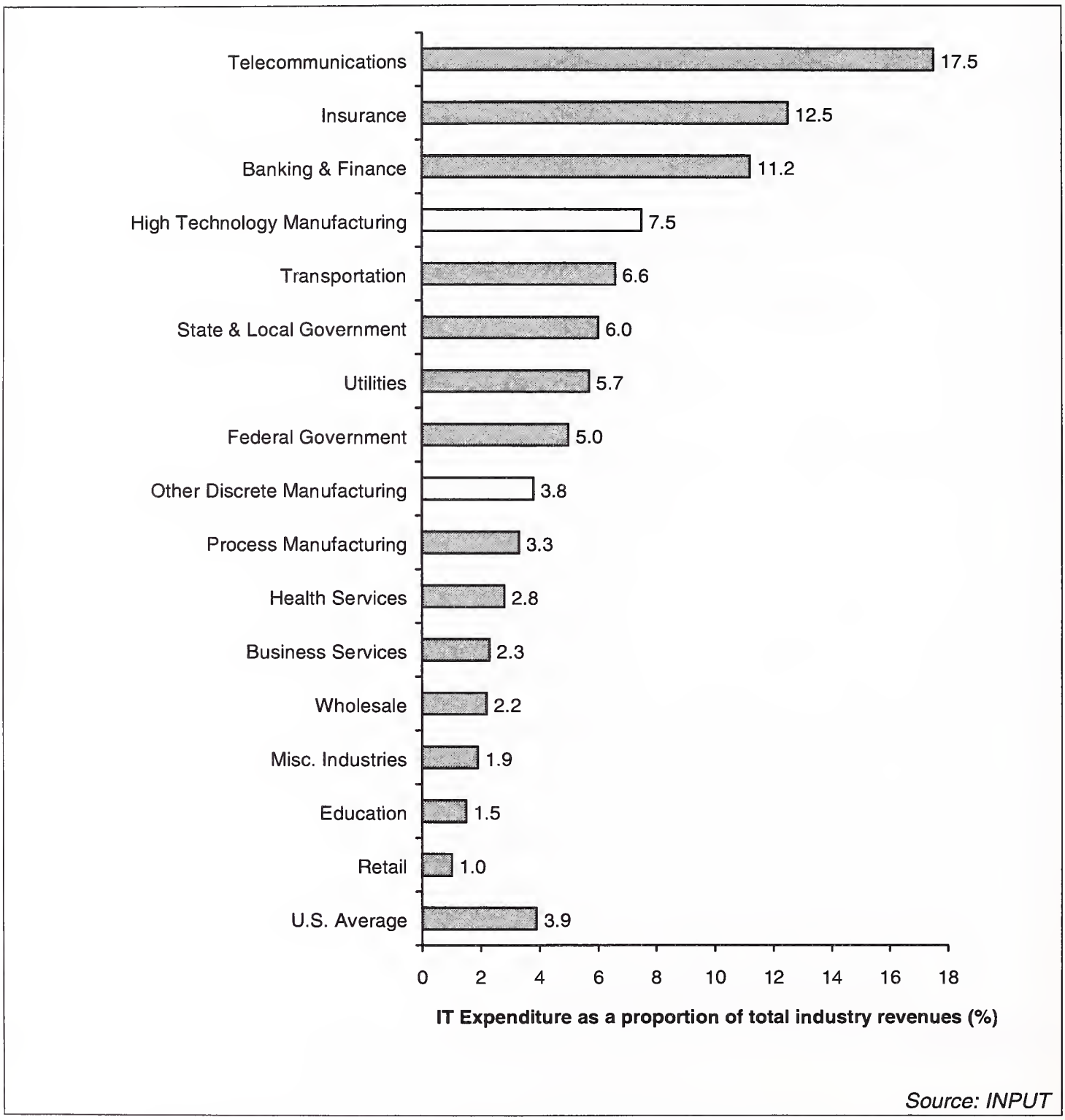
High Technology Manufacturing Sector IT Expenditure Comparison



Source: INPUT

Exhibit IV-4

Industry Sector Comparison – IT Expenditure U.S., 1997



Source: INPUT

INPUT analyzes total IT related expenditure into six principal categories. Exhibit IV-5 shows the analysis of total IT expenditure for the High Technology Manufacturing sector in the U.S.

These six categories are:

- Equipment sales — expenditure on computer and data communications hardware products.
- Personnel— expenditure on permanent in-house staff excluding all externally provided people and contractors.
- Software products — all expenditure on systems software products and applications software product licenses including support services where these are included within the basic license fee.
- IT services — all expenditure on professional services, systems integration, outsourcing, processing services, network services, turnkey systems and systems software product support services and applications software product support services but excluding the provision of any products whether hardware or software. (NB. This is a narrower definition of services than used by INPUT for its full assessment of IT Software & Services markets as provided in Section B of this Chapter below.)
- Communications — all expenditure on IT-related data communications services.
- Facilities — IT budget expenditure on overheads such as space, heating, lighting, furniture, vehicles etc.

Exhibit IV-5

High Technology Manufacturing Sector – IT Budget Analysis - 1997

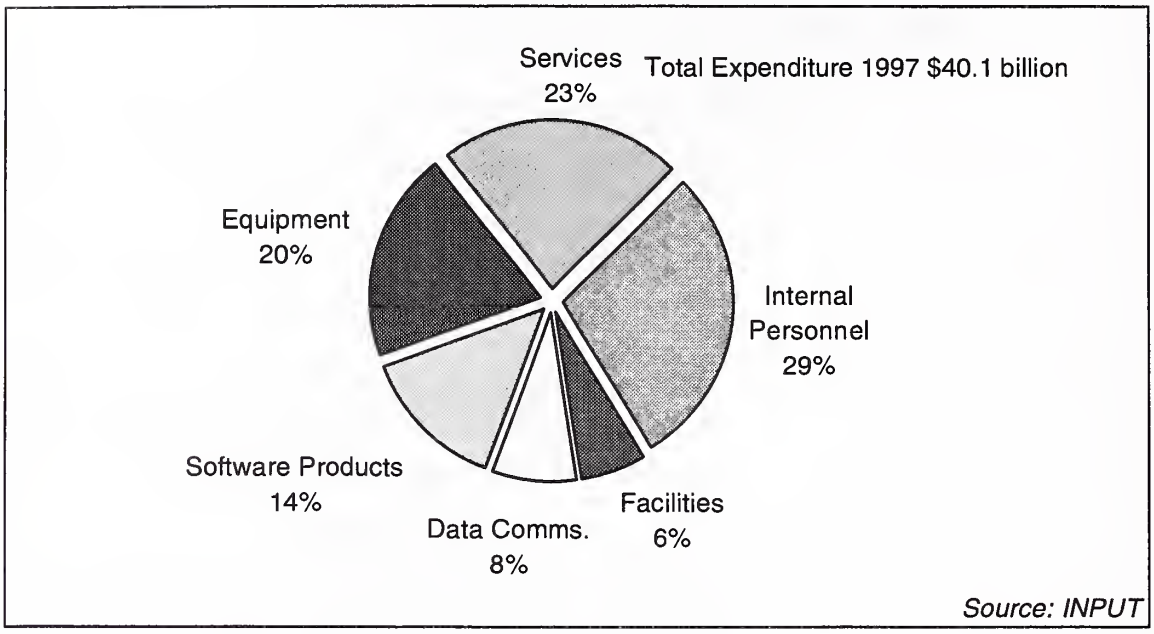


Exhibit IV-6 shows the same analysis (as in Exhibit IV-5) but for the whole U.S. market.

Exhibit IV-6

U.S. – IT Budget Analysis - 1997

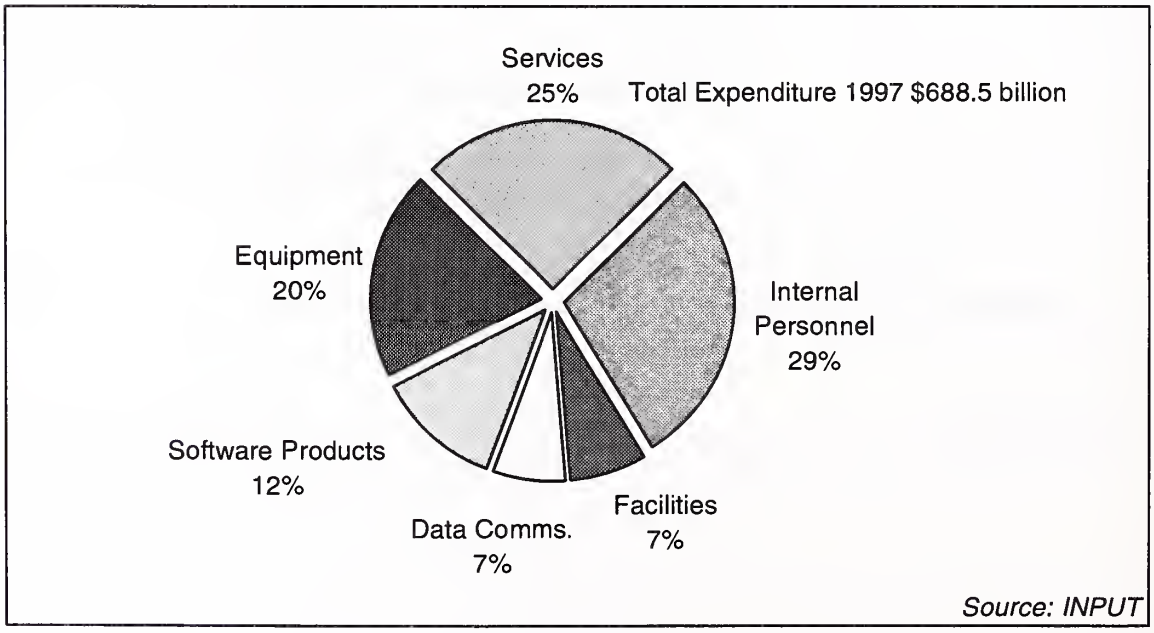
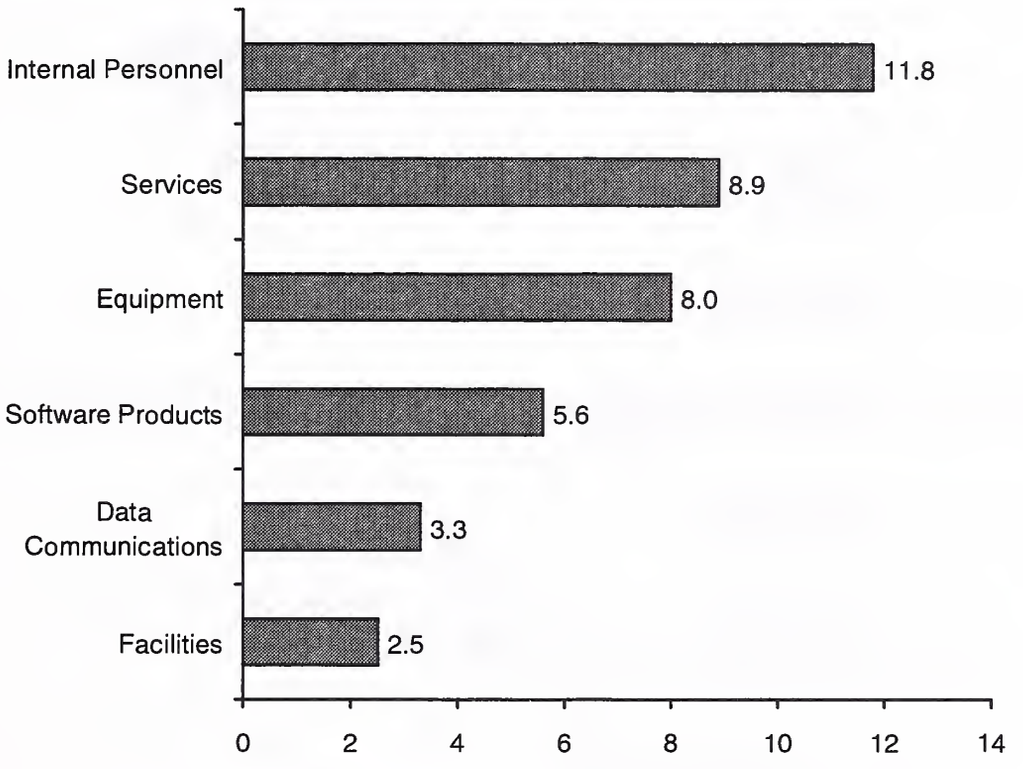
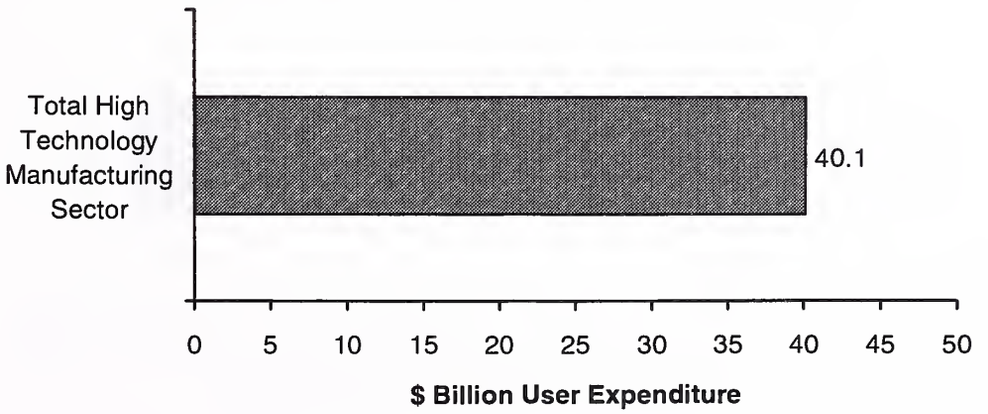


Exhibit IV-7 shows the relative size of each of the six principal segments of IT related expenditure for the High Technology Manufacturing sector.

Exhibit IV-7

IT Related User Expenditures – U.S. High Technology Manufacturing Sector, 1997



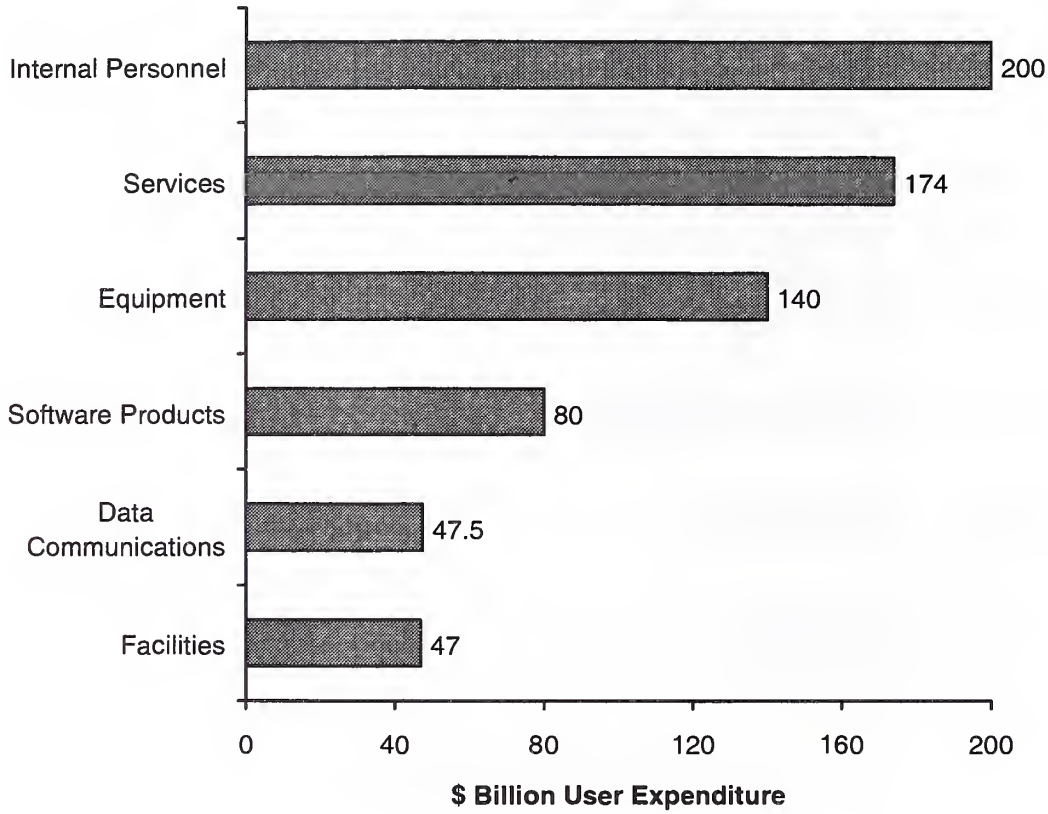


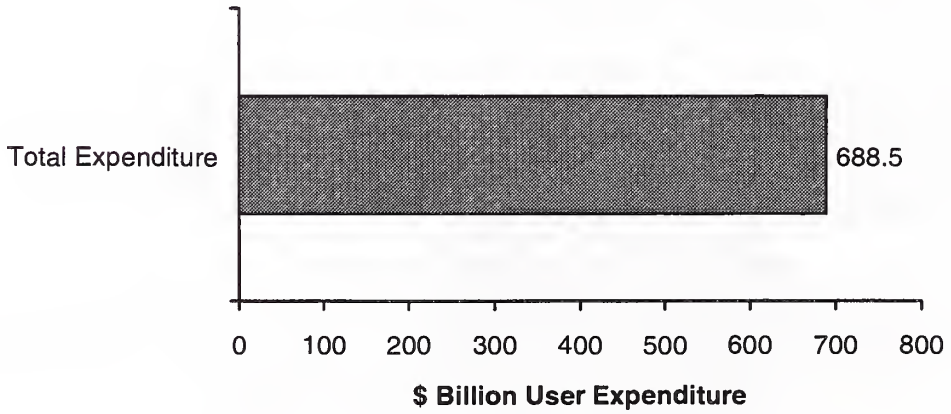
Source: INPUT

Exhibit IV-8 shows the comparative table for the whole of the U.S. market.

Exhibit IV-8

IT Related User Expenditures–U.S., 1997





Source: INPUT

B
IT Software & Services Market

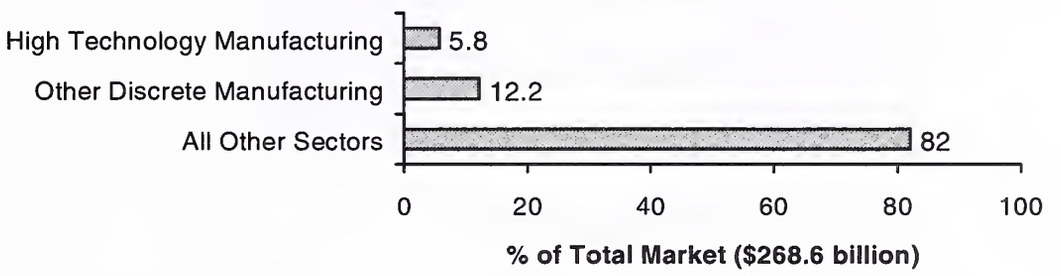
1. Total IT Software & Services Expenditure

a. High Technology Manufacturing Sector IT Software & Services Expenditure

Exhibit IV-9 shows the proportion of IT Software & Services expenditure within the High Technology Manufacturing sector in comparison to the total U.S. market.

Exhibit IV-9

High Technology Manufacturing Sector IT Software & Services Expenditure – U.S., 1997

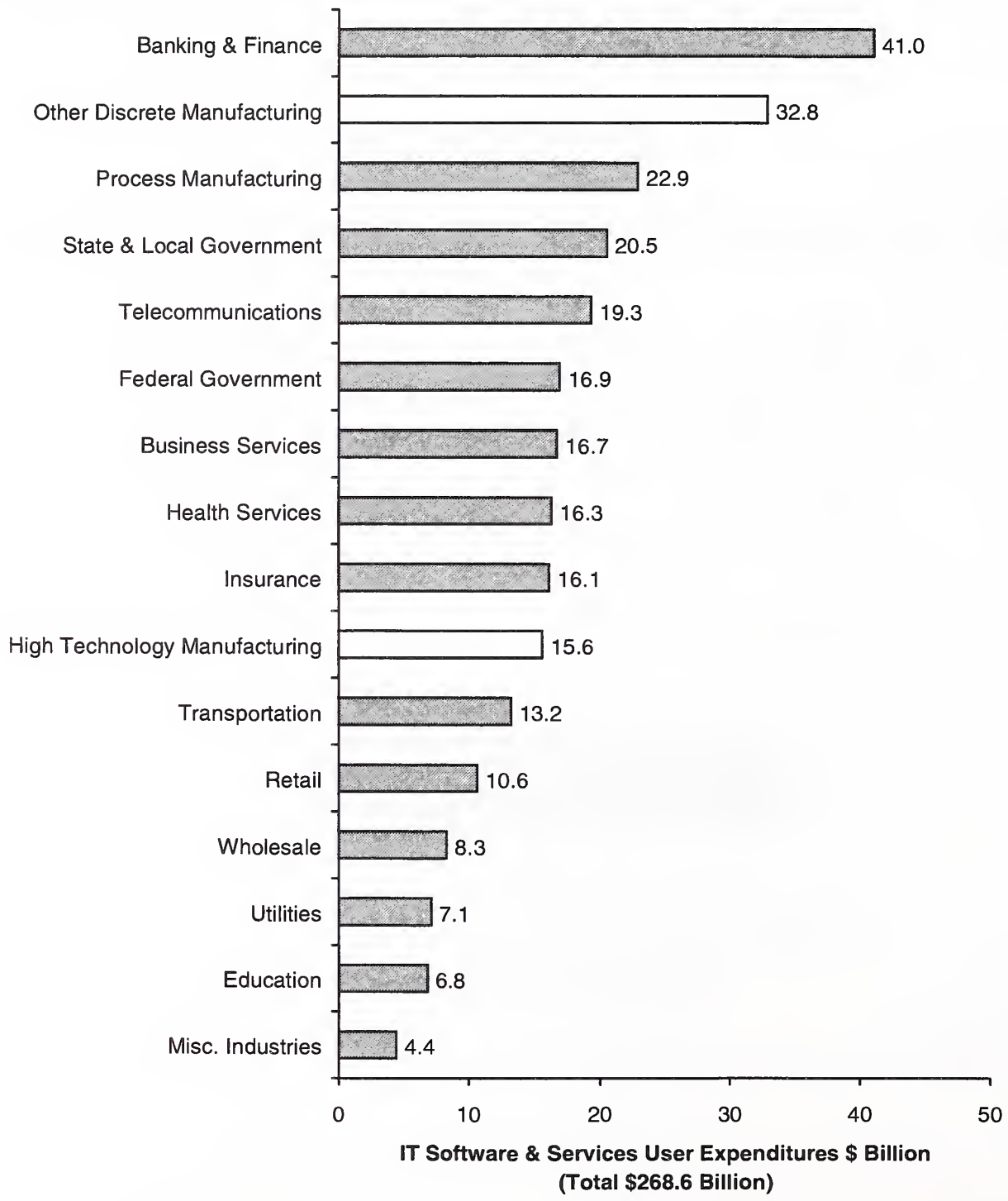


Source: INPUT

Exhibit IV-10 shows a comparison between the High Technology Manufacturing sector IT Software & Services market and other U.S. industry sectors.

Exhibit IV-10

Industry Sector Comparison – IT Software & Services – U.S., 1997

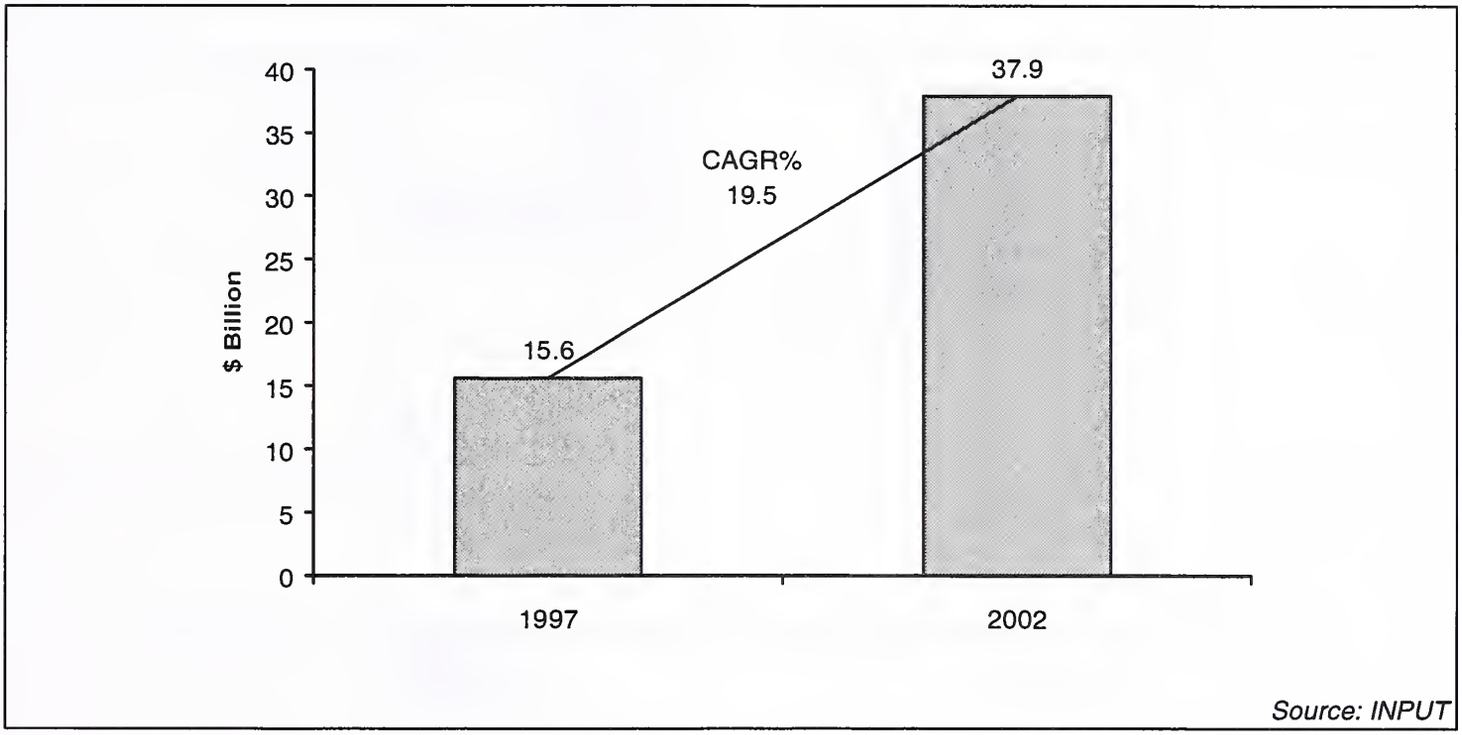


Source: INPUT

Growth expectations for the High Technology Manufacturing sector IT Software & Services market are shown in Exhibit IV-11 and in comparison with the total U.S. market for IT Software & Services in Exhibit IV-12.

Exhibit IV-11

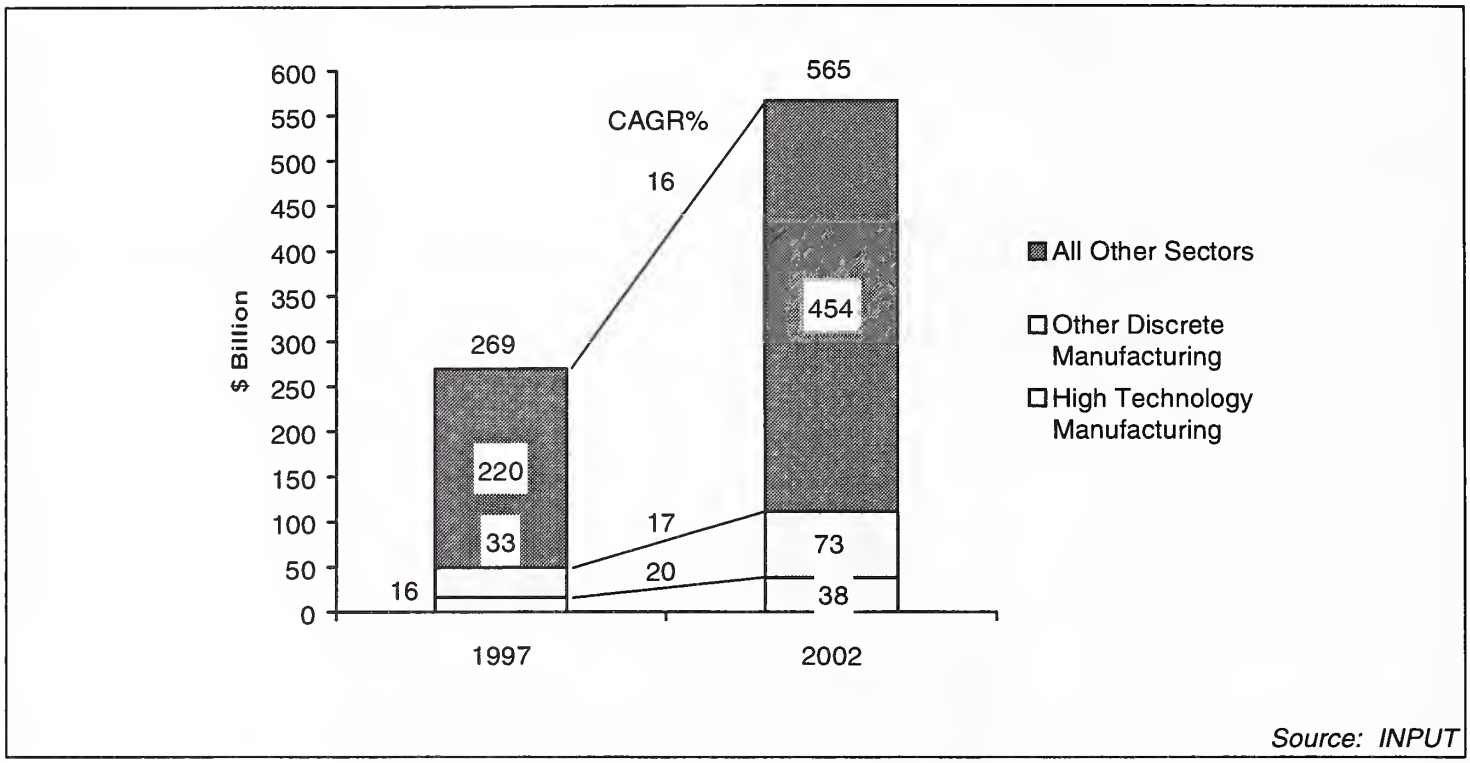
High Technology Manufacturing Sector IT Software & Services Market – U.S.



Source: INPUT

Exhibit IV-12

IT Software & Services Forecast- U.S.



Source: INPUT

b. Industry Sector Composition of IT Software & Services Markets

The total volume of expenditure for IT Software & Services in the High Technology Manufacturing sector, described above, is analyzed by INPUT into three separate categories:

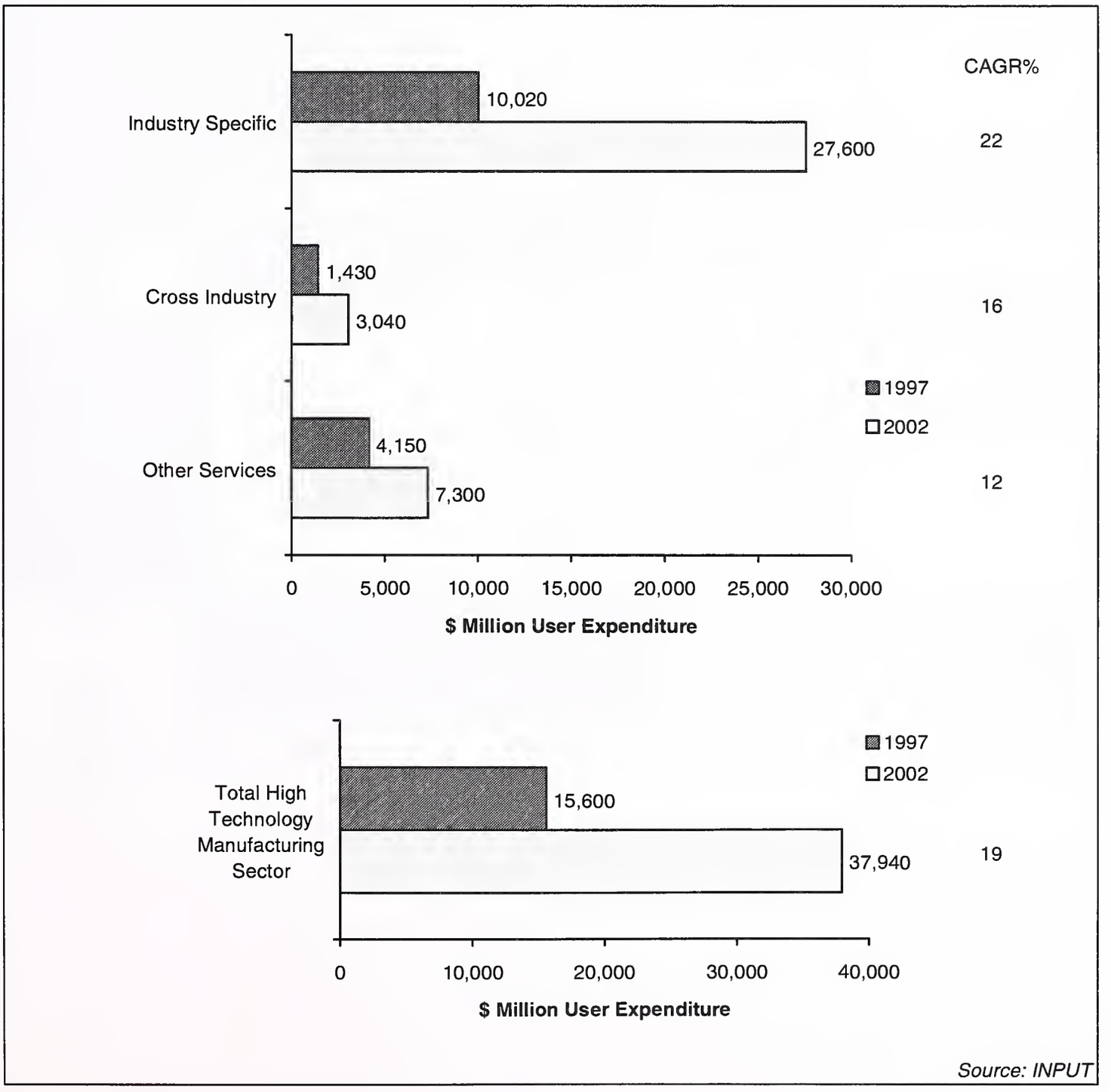
- Industry Specific expenditures – these are for services that are related specifically to the High Technology Manufacturing industry.
- Process or Cross-industry expenditures – these are for multi-industry applications such as human resource systems, accounting systems, etc.
- Other services expenditures – these are for general services that do not fall into the two categories described above. The two principal sectors classified in this 'other services' category are Systems Software Products and Equipment Services. The category also includes some types of expenditure in Processing services and Network Services.

The analysis of IT Software & Services expenditure within the High Technology Manufacturing sector according to this breakdown is shown in Exhibit IV-13.

Exhibit IV-14 provides a more detailed numerical tabulation of this analysis.

Exhibit IV-13

Total IT-Related User Expenditures– High Technology Manufacturing Sector U.S.



Source: INPUT

Exhibit IV-14

Analysis of IT Software & Services Expenditure – High Technology Manufacturing Sector U.S., 1997

Segment		User Expenditures $ Billion		
		Industry Specific	Cross Industry	Other Services
Professional Services	Total	3,250		
Systems Integration	Total	1,150		
	Software Products	85		
	Equipment	600		
	Other	465		
Outsourcing	Total	1,300		
Processing Services	Transactions	300	250	
	Other services			350
Network Services	Total	350		650
Applications Software Products	Total	2,000	1,100	
Turnkey Systems	Total	1,670	80	
	Software Products	720	35	
	Equipment	520	25	
	Other	430	20	
Systems Software Products	Total			1,600
Equipment Services	Total			1,550
Total		10,020	1,430	4,150

Source: INPUT

The relationship between the different classifications of expenditure can be readily seen from the two previous Exhibits (IV-13 and 14).

Exhibits IV-15 shows the breakdown of the total amount of equipment included within INPUT's IT Software & Services categories.

Exhibit IV-15

Equipment Expenditure – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Systems Integration	600
Turnkey Systems – Industry Specific	520
Turnkey Systems – Cross Industry	25
High Technology Manufacturing Sector TOTAL	1,145

Source: INPUT

Exhibit IV-16 shows the calculation of the total amount of Software Products that are included within INPUT's IT Software & Services categories.

Exhibit IV-16

Software Products Expenditure – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Systems Integration	85
Applications Software Products – Industry Specific	2,000
Applications Software Products – Cross Industry	1,100
Turnkey Systems – Industry Specific	720
Turnkey Systems – Cross Industry	35
Systems Software Products	1,600
High Technology Manufacturing Sector TOTAL	5,540

Source: INPUT

Exhibit IV-17 shows the summation of the three different components that combine to form INPUT's definition of the IT Software & Services market.

Exhibit IV-17

IT Software & Services Components – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Equipment	1,145
Software Products	5,540
IT Services	8,915
High Technology Manufacturing Sector TOTAL	15,600

Source: INPUT

Exhibit IV-18 shows the summation of the three different categories of services that comprise the total amount of expenditure on IT Software & Services within the High Technology Manufacturing sector in the U.S. .

Exhibit IV-18

Total IT Software & Services – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Industry Specific	10,020
Cross Industry	1,430
Other Services	4,150
High Technology Manufacturing Sector TOTAL	15,600

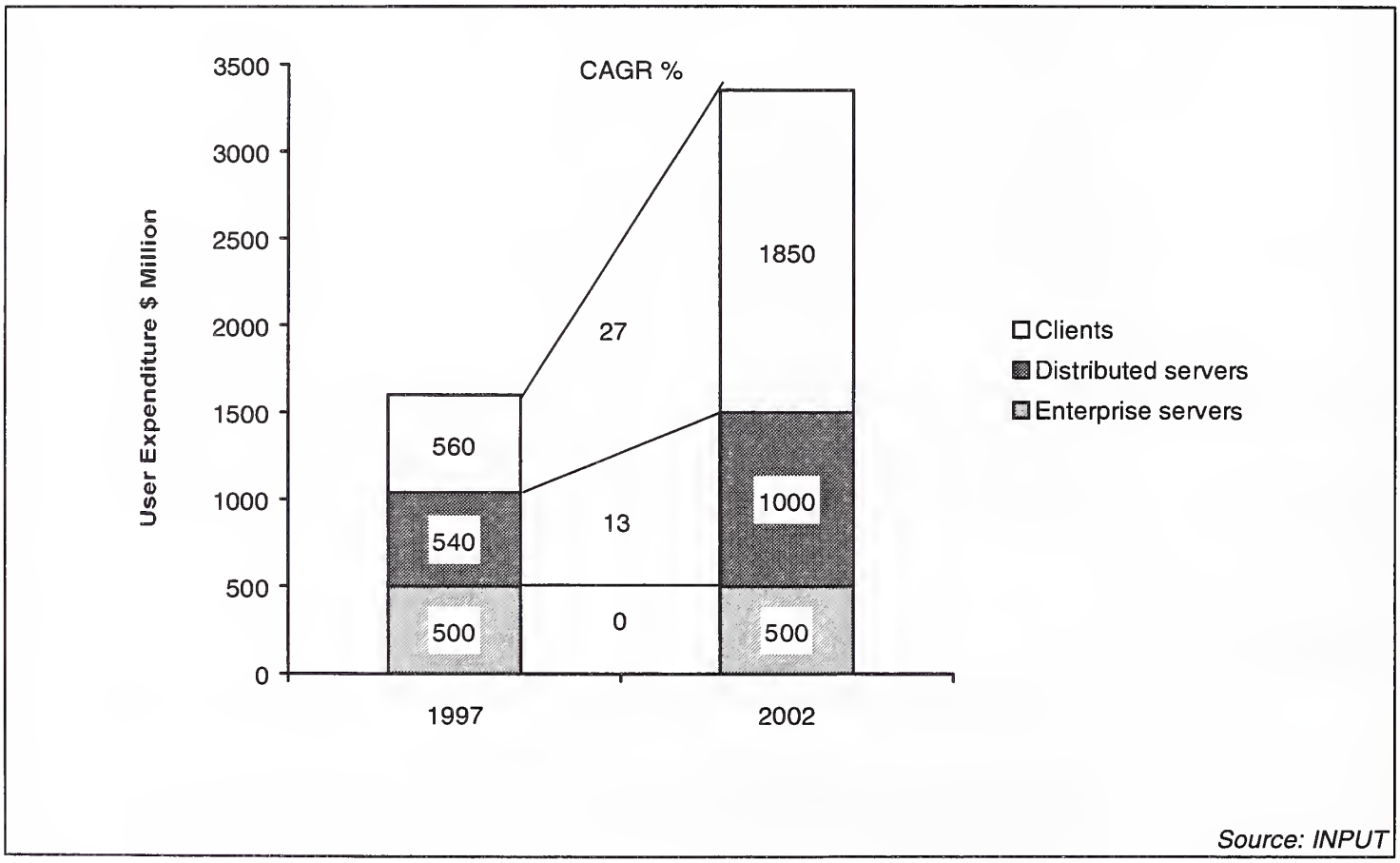
Source: INPUT

The two principal IT Software & Services categories that fall outside the Industry Specific classification are Systems Software Products and Equipment Services, they are briefly discussed below.

Exhibit IV-19 shows the forecast growth for Systems Software Products within the High Technology Manufacturing sector.

Exhibit IV-19

High Technology Manufacturing Sector - System Software Products Expenditure, U.S.



Source: INPUT

System Software Products enable the computer/communications system to perform basic machine-oriented or user interface functions.

INPUT defines the System Software Products sector as comprising four submodes:

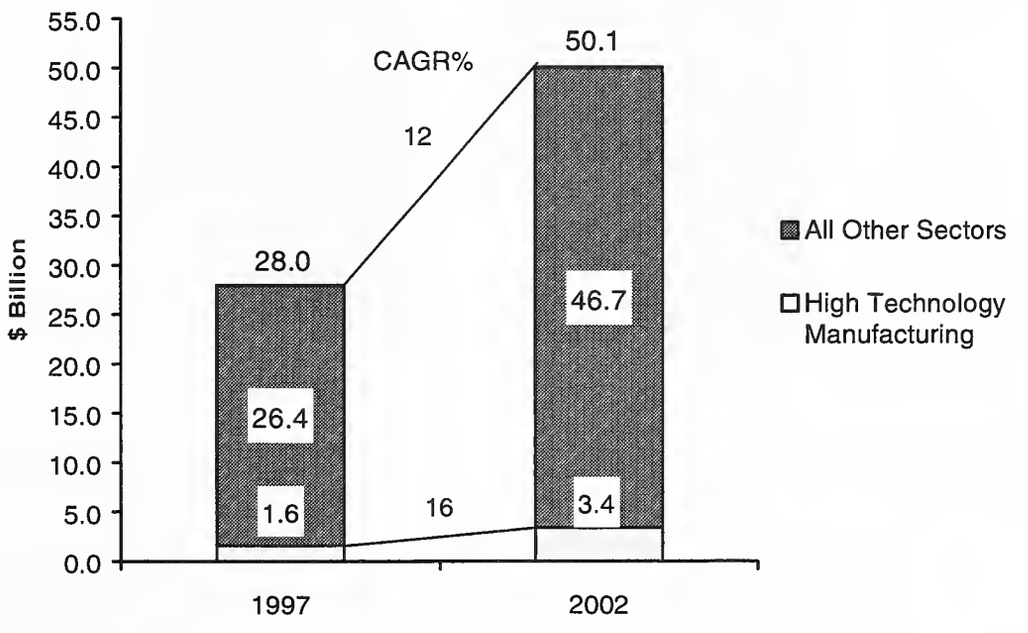
- Systems Control Products – the operating system, network control software etc.

- Operations management Tools – programs used by operational management, for example performance measurement and scheduling tools.
- Applications Development Tools – programming languages, database management systems and other development and productivity tools.
- Database Management Systems.

Exhibit IV-20 shows the comparison of the High Technology Manufacturing sector growth with that for the whole market in the U.S.

Exhibit IV-20

Systems Software Products Market Growth - U.S.

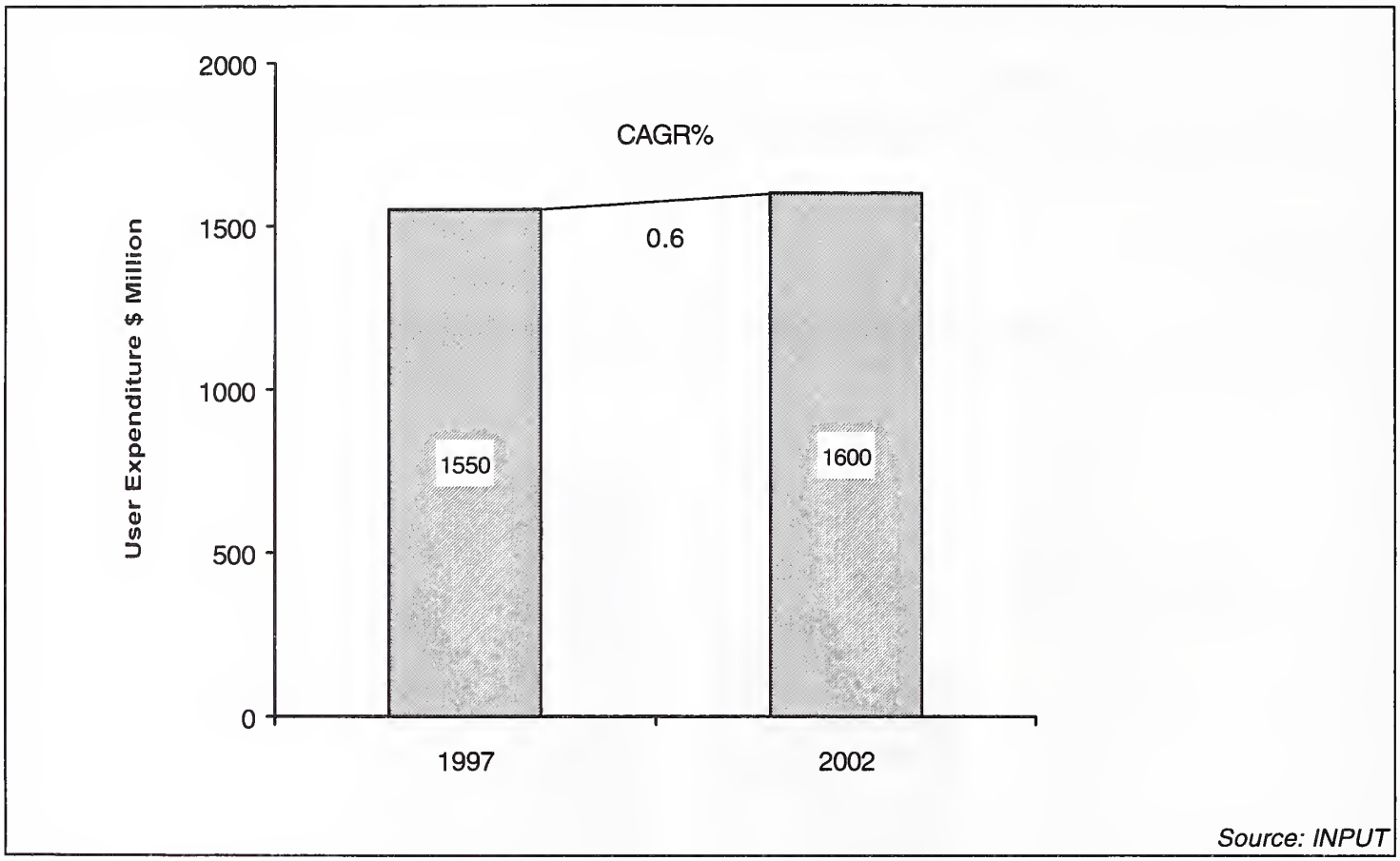


Source: INPUT

The Equipment Services expenditure that is generated within the High Technology Manufacturing Sector is analyzed in Exhibit IV-21 below.

Exhibit IV-21

High Technology Manufacturing Sector - Equipment Services Expenditure, U.S.



The Equipment Services category is comprised of two principal elements:

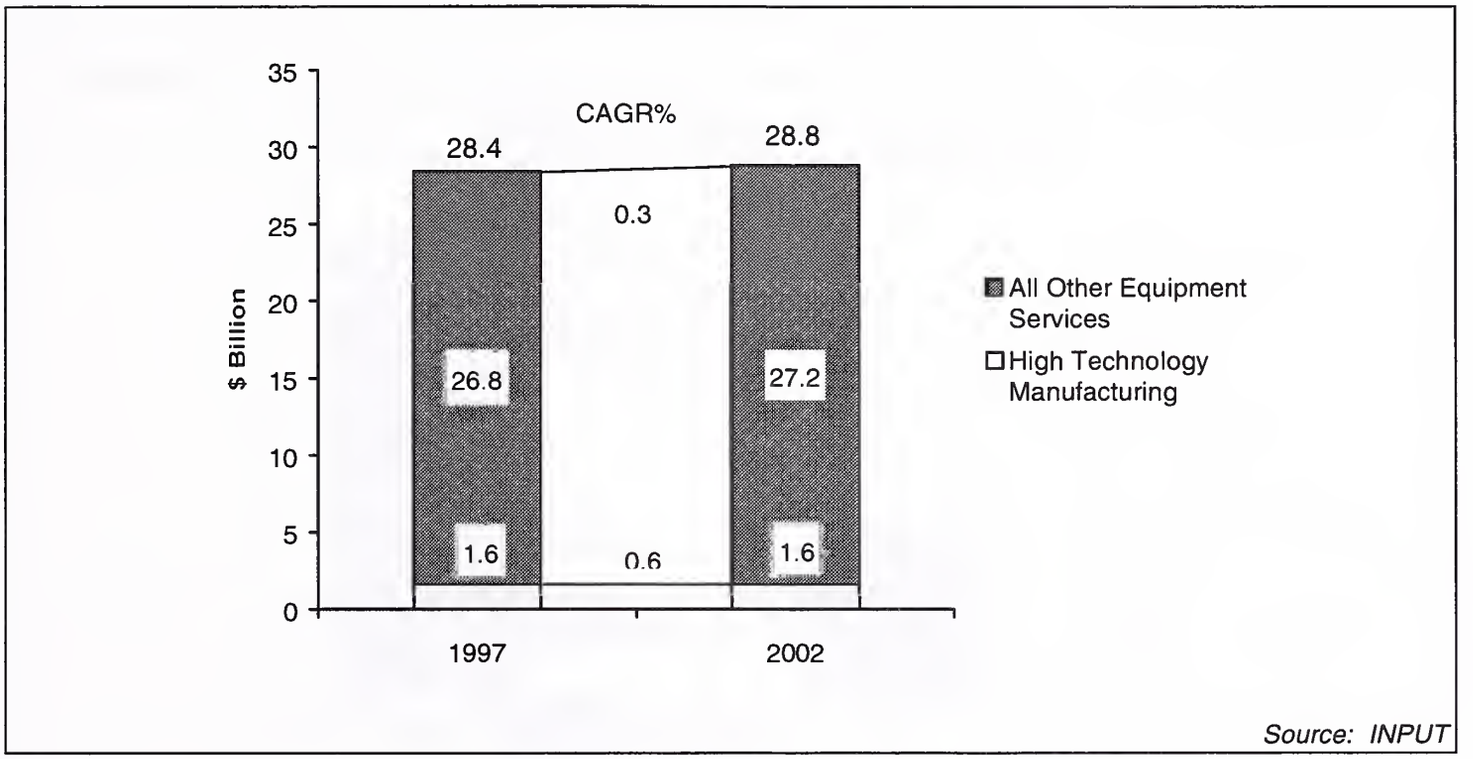
- Product Maintenance- services need to repair, diagnose and provide preventive maintenance both onsite and offsite for computer/communications systems including systems software products where these expenditures are not included within System Software Product License agreements.

- Environmental Services – planning and implementation services which affect the environments in which computer systems are operated. This category therefore covers; computer rooms, electrical power and HVAC systems, network attachments and associated building services.

Exhibit IV-22 shows the comparison of the High Technology Manufacturing sector growth with that for the whole market in the U.S.

Exhibit IV-22

Equipment Services Growth - U.S.



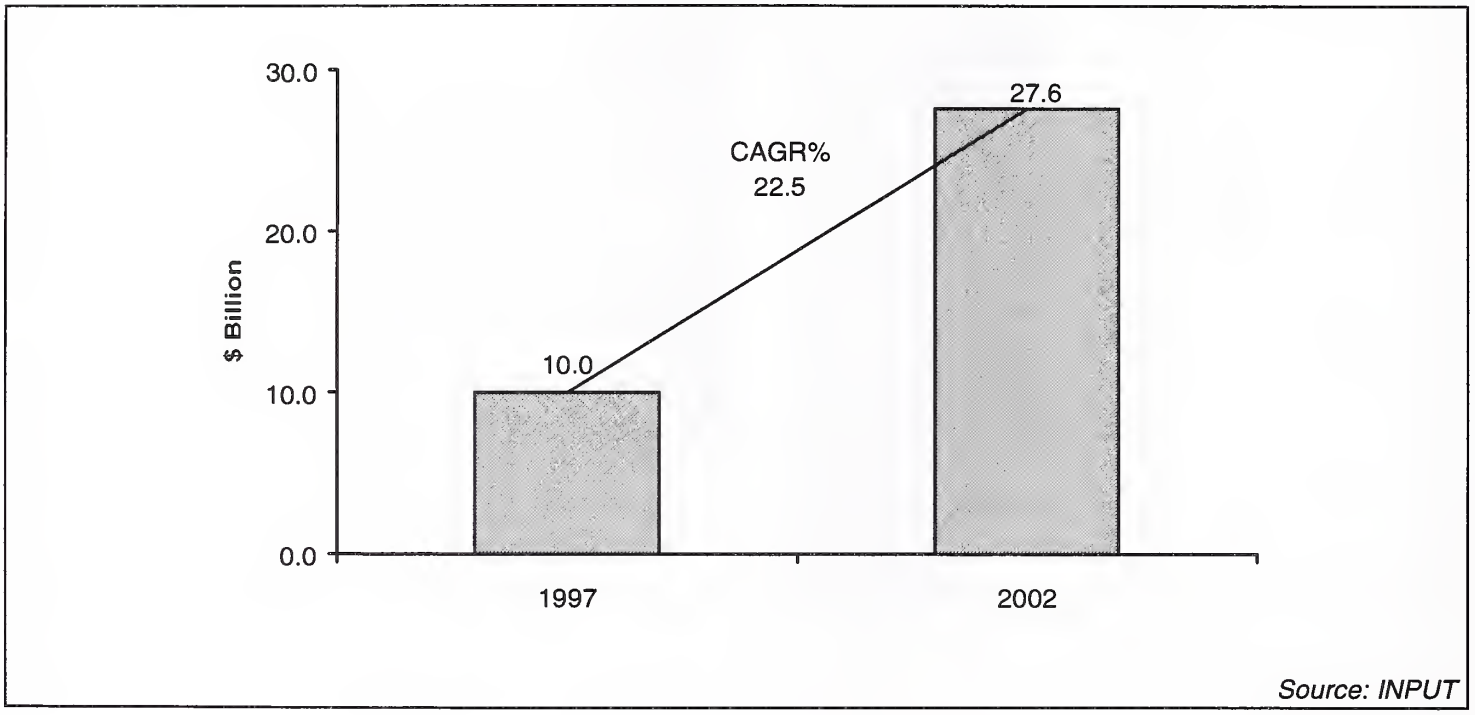
Source: INPUT

2. Industry Specific IT Software & Services Expenditure

This subsection focuses on the *Industry Specific* IT Software & Services market. Exhibit IV-23 shows the expected growth for all expenditure in this category for the High Technology Manufacturing sector in the U.S.

Exhibit IV-23

High Technology Manufacturing Sector Industry Specific IT Software & Services Market



Source: INPUT

Exhibit IV-24 provides analysis of this sector by the principal forms of service delivery.

Exhibit IV-24

Analysis by Service Category – High Technology Manufacturing Industry Specific Market, U.S.

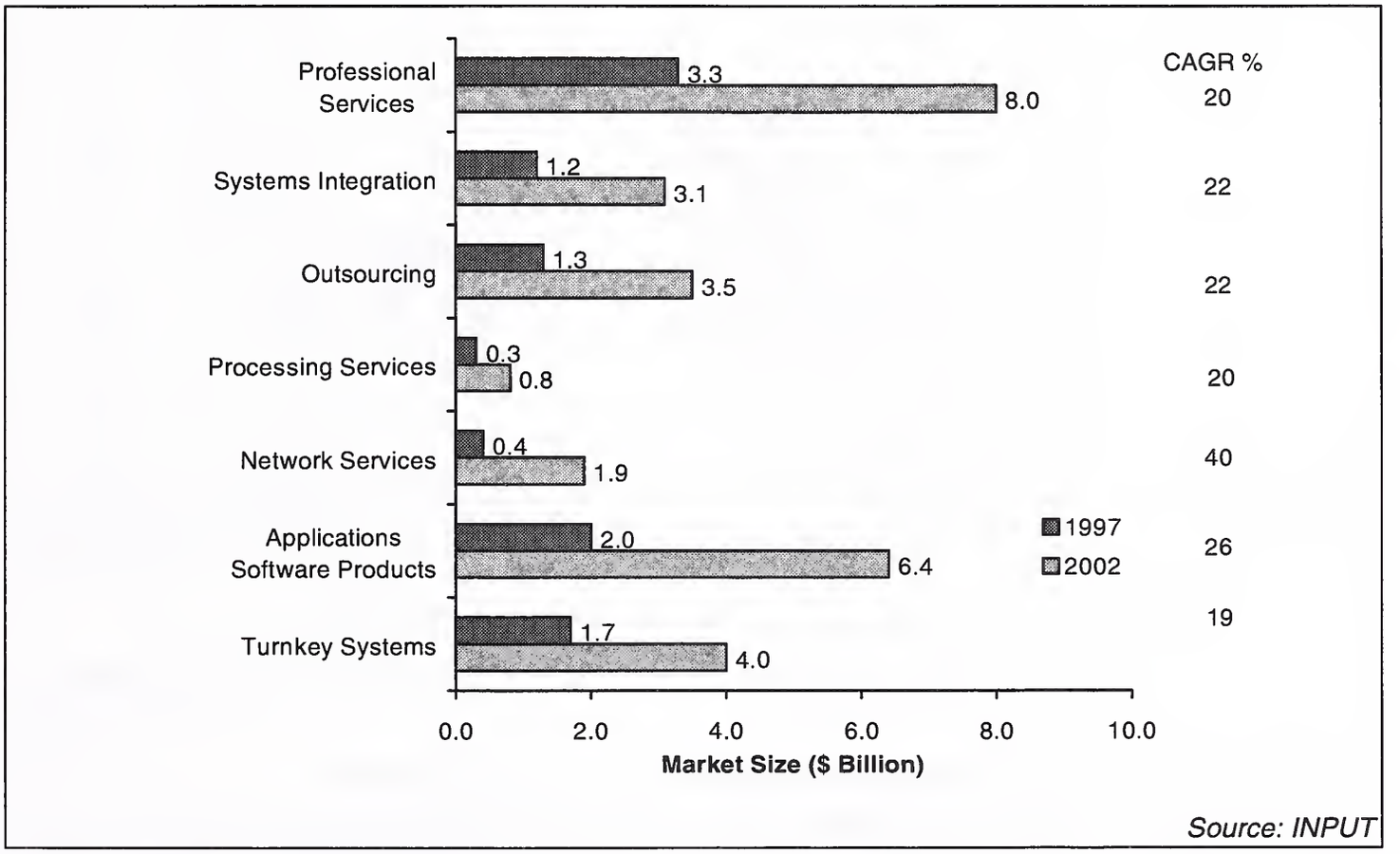


Exhibit IV-25 provides a tabular analysis showing the detailed data.

Exhibit IV-25

High Technology Manufacturing Industry Specific IT Software & Services Market, U.S. ($million)

Sector	1997	CAGR	2002
Professional Services	3,250	19.7%	8,000
Systems Integration	1,150	21.9%	3,100
Outsourcing	1,300	21.9%	3,500
Processing Services	300	20.0%	750
Network Services	350	39.5%	1,850
Applications Software Products	2,000	26.2%	6,400
Turnkey Systems	1,670	19.1%	4,000
Sector TOTAL	10,020	22.5%	27,600

Source: INPUT

Each of these principal service modes is described in more detail below.

a. Professional Services

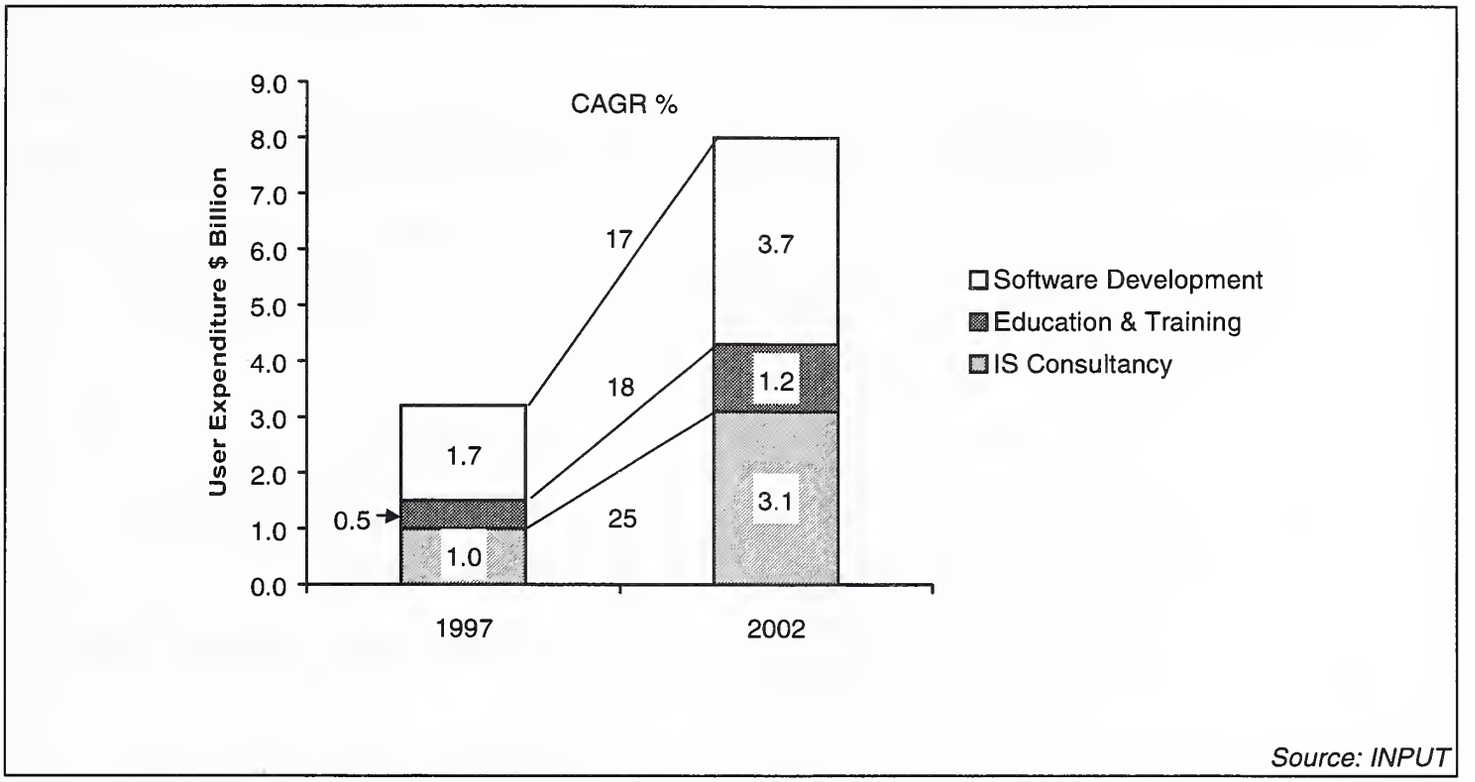
Exhibit II-26 shows the forecast for the High Technology Manufacturing sector Professional Services segment, the second largest individual services delivery mode in the sector.

The professional service category comprises three subcategories: consulting, education and training, and software development.

Software development is by far the dominant sector and will remain so over the forecast period even though it is predicted to grow more slowly than the other two subcategories.

Exhibit IV-26

High Technology Manufacturing Sector Professional Services Market - U.S.



Source: INPUT

Exhibit IV-27 provides the detailed forecast data in tabular form.

Exhibit IV-27

Professional Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
IS Consulting	1,720	16.6%	3,700
Education & Training	530	17.8%	1,200
Software Development	1,000	25.4%	3,100
TOTAL	3,250	19.7%	8,000

Source: INPUT

b. Systems Integration

Systems Integration is a vendor delivered service that provides a complete solution to an information systems requirement.

The vendor meets the client's needs through the custom selection and implementation of a variety of information systems products and services.

A Systems Integrator is responsible for the overall management of a systems integration contract and is the single point of contact and responsibility to the buyer for the delivery of the specified system function, on schedule and at the contracted price.

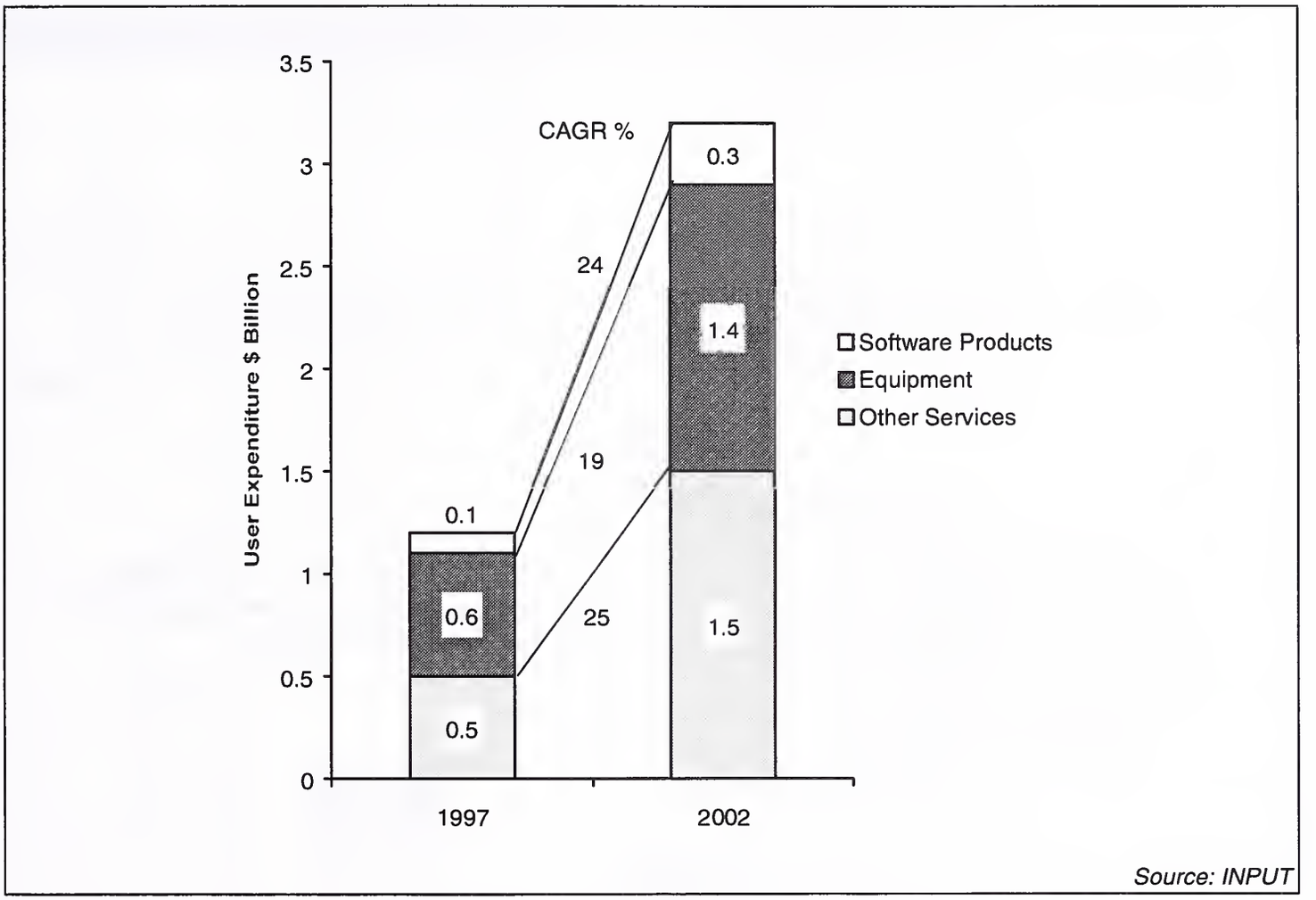
The principal components of a systems integration contract are:

- Equipment – the information processing and communications equipment required to build the systems solution.
- Software products – prepackaged applications and systems software products.
- IT-related professional services - the value added element that develops and implements the client solution.
- Other products and services – miscellaneous items such as engineering services, computer supplies and business support services.

Exhibit IV-28 shows the anticipated development of the Systems Integration market in the U.S.

Exhibit IV-28

High Technology Manufacturing Sector Systems Integration Market - U.S.



Source: INPUT

Exhibit IV-29 shows the detailed forecast data in tabular form.

Exhibit IV-29

Systems Integration – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Software Products	85	24.1%	250
Equipment	600	18.5%	1,400
Other Services	465	25.5%	1,450
High Technology Manufacturing Sector TOTAL	1,150	21.9%	3,100

Source: INPUT

c. Operational Services

INPUT has in the course of 1997 introduced the term *Operational Services* to distinguish and group together those services that provide continuous computer/network operations and/or support.

The Operational Services sector comprises:

- Outsourcing services.
- Processing services.
- Network services including Internet services.

Each of these subsectors is described below.

i. Outsourcing

Outsourcing is a long-term (greater than one year) relationship between a client and a vendor in which the client delegates all, or a major portion, of an operation or function to the vendor.

The operation or function may either be solely information systems outsourcing based, or include information systems outsourcing as a major component (at least 30%) of the operation.

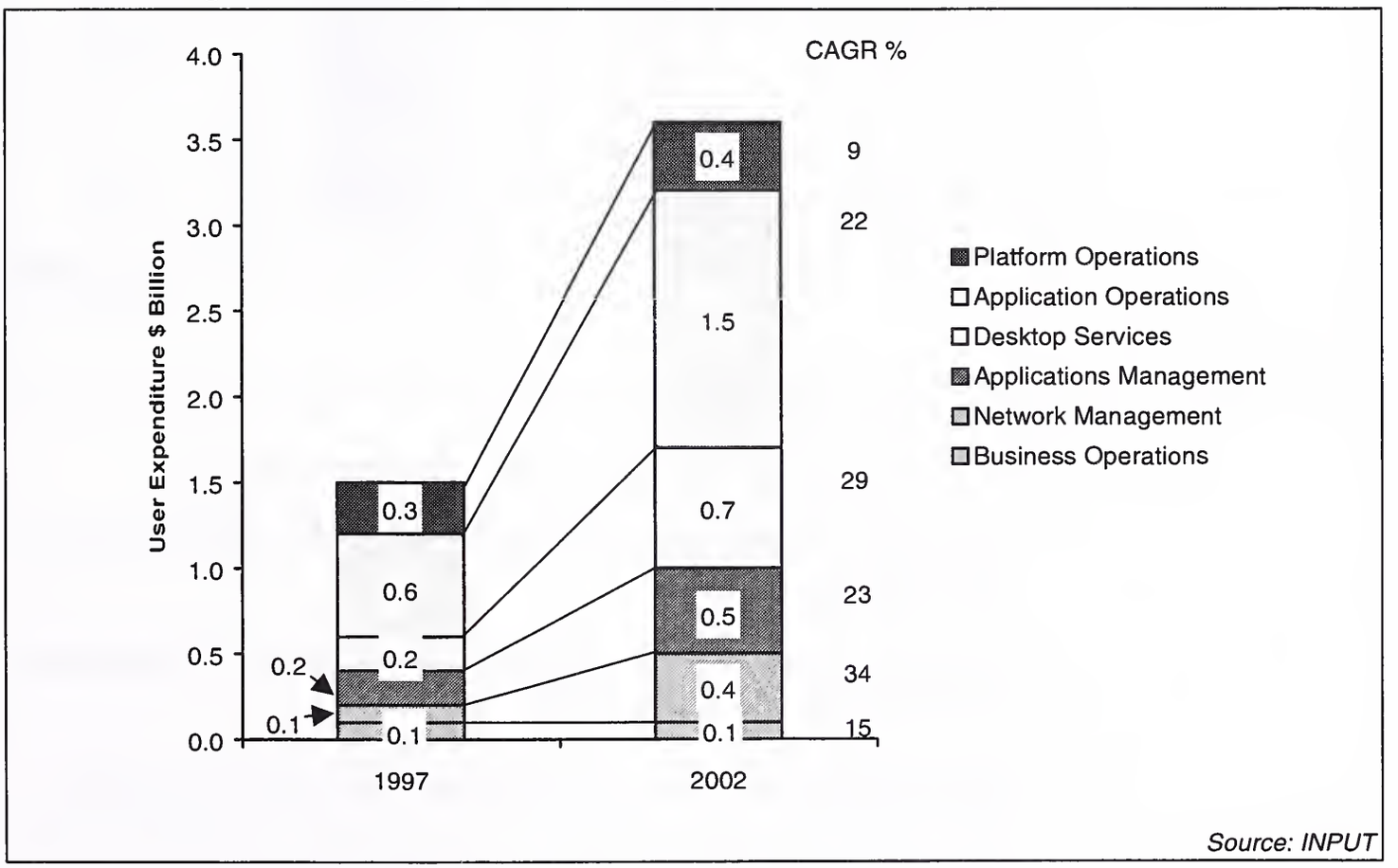
The critical components that define an outsourcing service are:

- Delegating an identifiable area of the operation to a vendor.
- Single-vendor responsibility for performing the delegated action.
- Intentional, long-term relationship between the client and the vendor.

Exhibit II-30 shows the growth forecast for the U.S. High Technology Manufacturing sector outsourcing market.

Exhibit IV-30

High Technology Manufacturing Sector Outsourcing Market - U.S.



Source: INPUT

Exhibit IV-31 shows the detailed forecast data in tabular form.

Exhibit IV-31

Outsourcing Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Platform Operations	260	9.0%	400
Application Operations	550	22.2%	1,500
Desktop Services	180	29.3%	650
Applications Management	180	22.7%	500
Network Management	80	34.3%	350
Business Operations	50	14.9%	100
High Technology Manufacturing Sector TOTAL	1,300	21.9%	3,500

Source: INPUT

ii. Processing Services

The Processing Services category contains three subcategories:

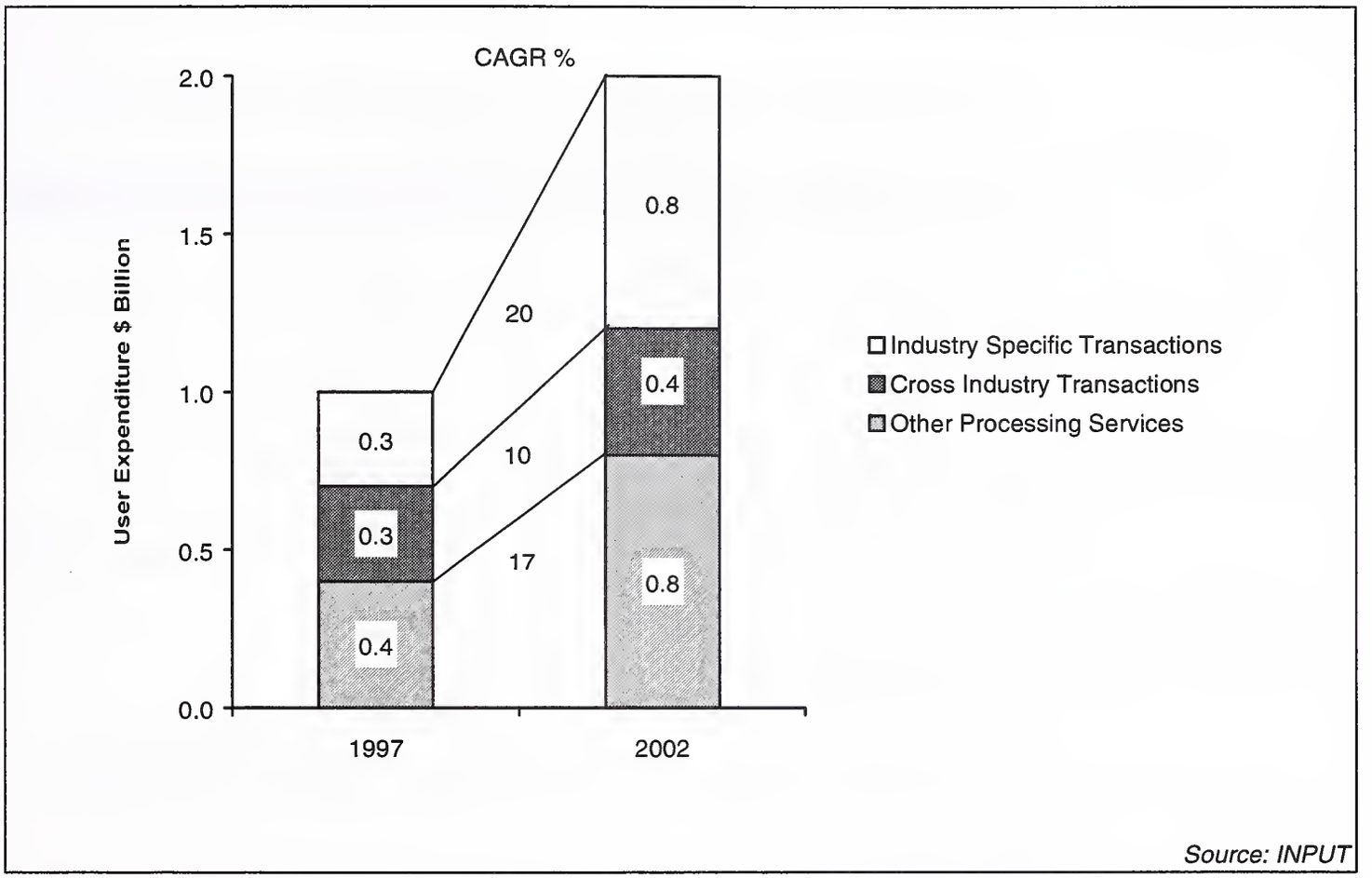
- Transaction processing – the processing of specific applications and client databases.
- Utility processing – clients develop and/operate their own programs or process data on the vendor' system.
- Other processing services – scanning and other data entry services, laser printing, computer output microfilm (COM), CD preparation and other data output services. This category also included backup, contingency and disaster recovery services.

Exhibit IV-32 shows the forecast for the U.S. High Technology Manufacturing sector Processing Services market.

It should be noted that in this Exhibit only the portion marked Industry specific transactions is counted within the industry specific part of the market analysis.

Exhibit IV-32

High Technology Manufacturing Sector Processing Services Market - U.S.



Source: INPUT

Exhibit IV-33 shows the detailed forecast data in tabular form.

Exhibit IV-33

Processing Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Industry Specific Transactions	300	20.1%	750
Cross Industry Transactions	250	9.9%	400
Other Processing Services	350	16.5%	750
High Technology Manufacturing Sector TOTAL	900	16.1%	1,900

Source: INPUT

iii. Network Services

Network Services include a variety of High Technology Manufacturing-based functions and operations, including those relating to the Internet.

This category, as can be seen from Exhibit IV-34, contains two subcategories:

- Electronic Information Services.
- Network Application Services.

Electronic Information Services are based on databases that provide specific information via a communications network.

Typical applications include stock prices, legal documents, economic indicators, periodical journals, medical diagnosis and airline schedules.

The two main categories of electronic information services are:

- On-line databases – structured, primarily numerical, data on economic and demographic trends, financial instruments, companies, products and materials, etc.

- On-line News (Text) Services – unstructured, primarily textual information on people, companies events, etc. These are most often news services.

There are four types of Network Applications Service:

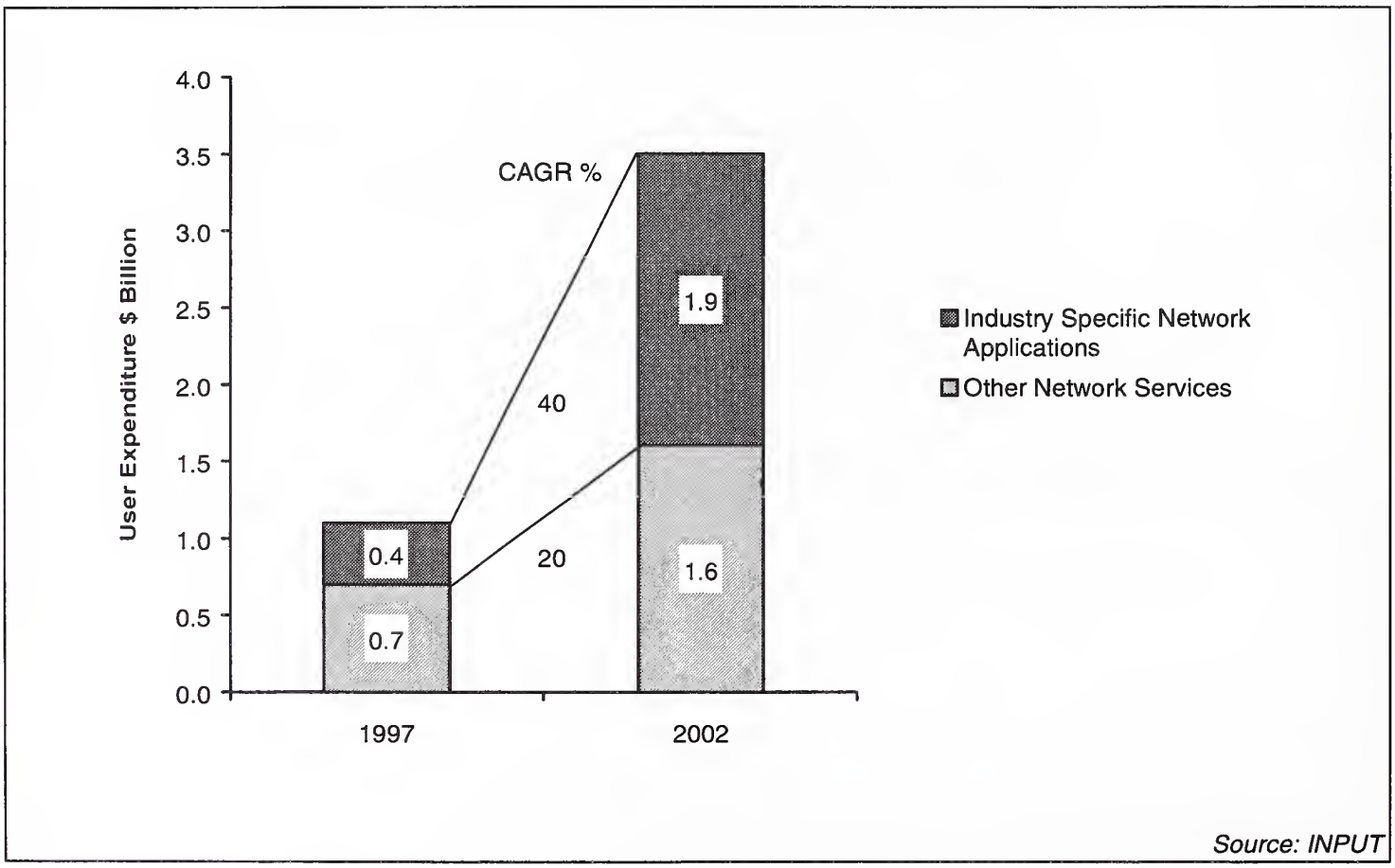
- Value Added Network Services (VAN Services) – are enhanced transport communications services.
- Electronic Commerce Services – a category that is going to become increasingly significant with the commercial exploitation of the Internet.
- Electronic Data Interchange (EDI) Services – traditional electronic commerce provided as application to application electronic exchange of business data between trade partners or facilitators.
- Electronic Information Interchange – the transmission of messages across an electronic network managed by a services vendor, including electronic mail, voice mail and messaging and including bulletin board services.

Exhibit IV-34 provides the forecast for the U.S. High Technology Manufacturing sector Network Services market.

It should be noted that Network Services are categorized only as falling within the Industry Specific or Other Network services categories.

Exhibit IV-34

High Technology Manufacturing Sector Network Services Market - U.S.



Source: INPUT

Exhibit IV-35 provides the detailed forecast data in tabular format.

Exhibit IV-35

Network Services – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Industry Specific Network Applications	350	39.5%	1,850
Other Network Services	650	19.7%	1,600
High Technology Manufacturing Sector TOTAL	1,000	28.1%	3,450

Source: INPUT

d. Applications Software Products

Applications software products are defined as products that enable a user or a group of users to support an operational or administrative process within an organization.

Examples include accounts payable, order entry, project management and office systems.

Applications software products are classified into two groups:

- Industry specific applications software products.
- Cross-industry or process applications software products.

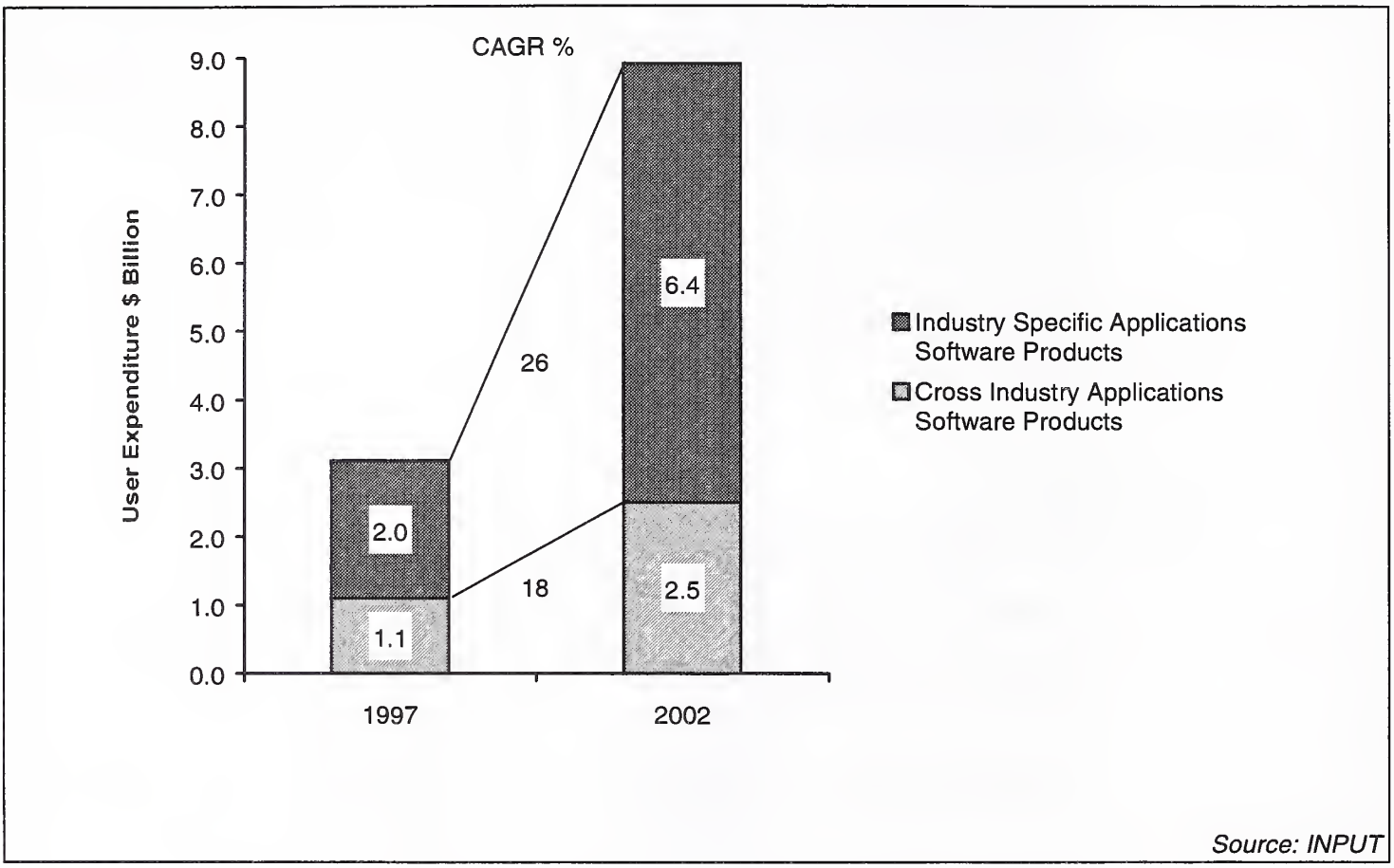
In this section we are only concerned with industry specific applications software products for the High Technology Manufacturing sector.

Industry specific applications products perform functions related to fulfilling business or organizational needs unique to a specific industry market and sold to that market only, in this case the High Technology Manufacturing industry.

Exhibit IV-36 provides the forecast for the U.S. High Technology Manufacturing sector Applications Software Product market.

Exhibit IV-36

High Technology Manufacturing Sector Applications Software Product Market - U.S.



Source: INPUT

Exhibit IV-37 provides the forecast data in tabular form.

Exhibit IV-37

Applications Software Products – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Industry Specific Applications Software Products	2,000	26.2%	6,400
Cross Industry Applications Software Products	1,100	17.8%	2,500
High Technology Manufacturing Sector TOTAL	3,100	23.5%	8,900

Source: INPUT

e. Turnkey Systems

A turnkey system integrates equipment, systems software products and packaged applications software products into a single product developed to meet a specific set of user requirements.

Value added by the turnkey system vendor is primarily in the software and professional services provided.

INPUT classifies turnkey systems into two groups as it does for applications software products, systems that are industry specific and those that address a cross-industry process market. This section is only concerned with those systems specifically targeted at the High Technology Manufacturing sector.

Most turnkey systems are sold through channels known as value-added resellers (VARs) and defined as:

- A VAR adds value to computer hardware and/or software products and then resells it.

- The major value add is usually applications software products but may include many of the other components of a turnkey system solution, such as professional services, software product support and applications upgrades.

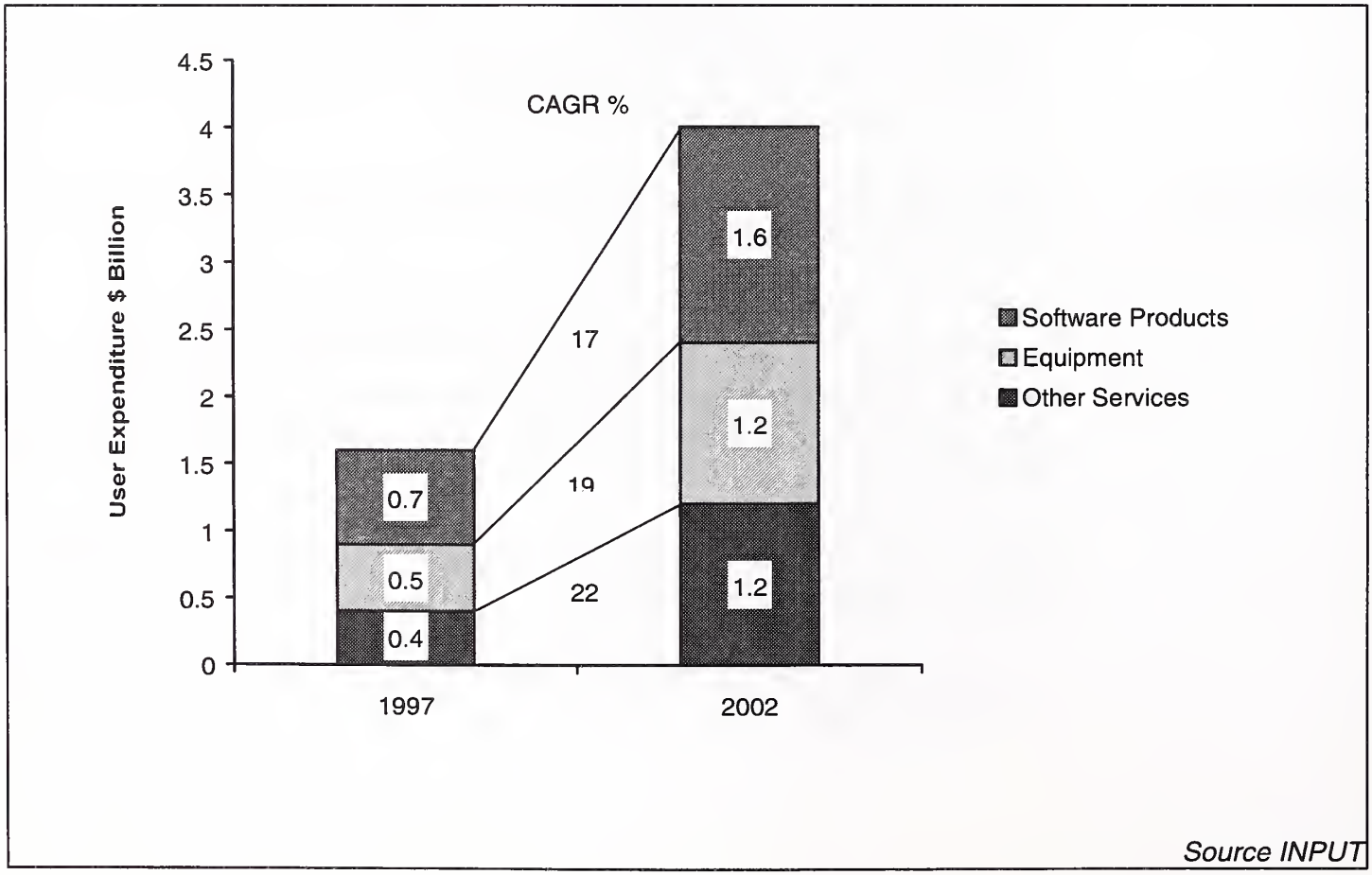
Turnkey systems have three components:

- Equipment – computer hardware supplied as part of the turnkey system.
- Software products – prepackaged systems and applications software products.
- Professional services – services to install or customize the system or train the user, provided as part of the turnkey system sale.

Exhibit IV-38 provides the forecast for the U.S. High Technology Manufacturing sector industry specific Turnkey Systems market.

Exhibit IV-38

Industry Specific High Technology Manufacturing Sector Turnkey Systems Market - U.S.



Source INPUT

Exhibit IV-39 provides the detailed forecast data in tabular form.

Exhibit IV-39

Industry Specific Turnkey Systems – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Software Products	720	17.3%	1,600
Equipment	520	18.6%	1,220
Other Services	430	22.4%	1,180
High Technology Manufacturing Sector TOTAL	1,670	19.1%	4,000

Source: INPUT

For the sake of completeness Exhibit IV-40 provides the detailed forecast data for the non-industry specific Turnkey Systems sold into the High Technology Manufacturing sector.

Exhibit IV-40

Cross Industry Turnkey Systems – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Software Products	35	9.5%	55
Equipment	25	14.9%	50
Other Services	20	11.8%	35
High Technology Manufacturing Sector TOTAL	80	11.8%	140

Source: INPUT

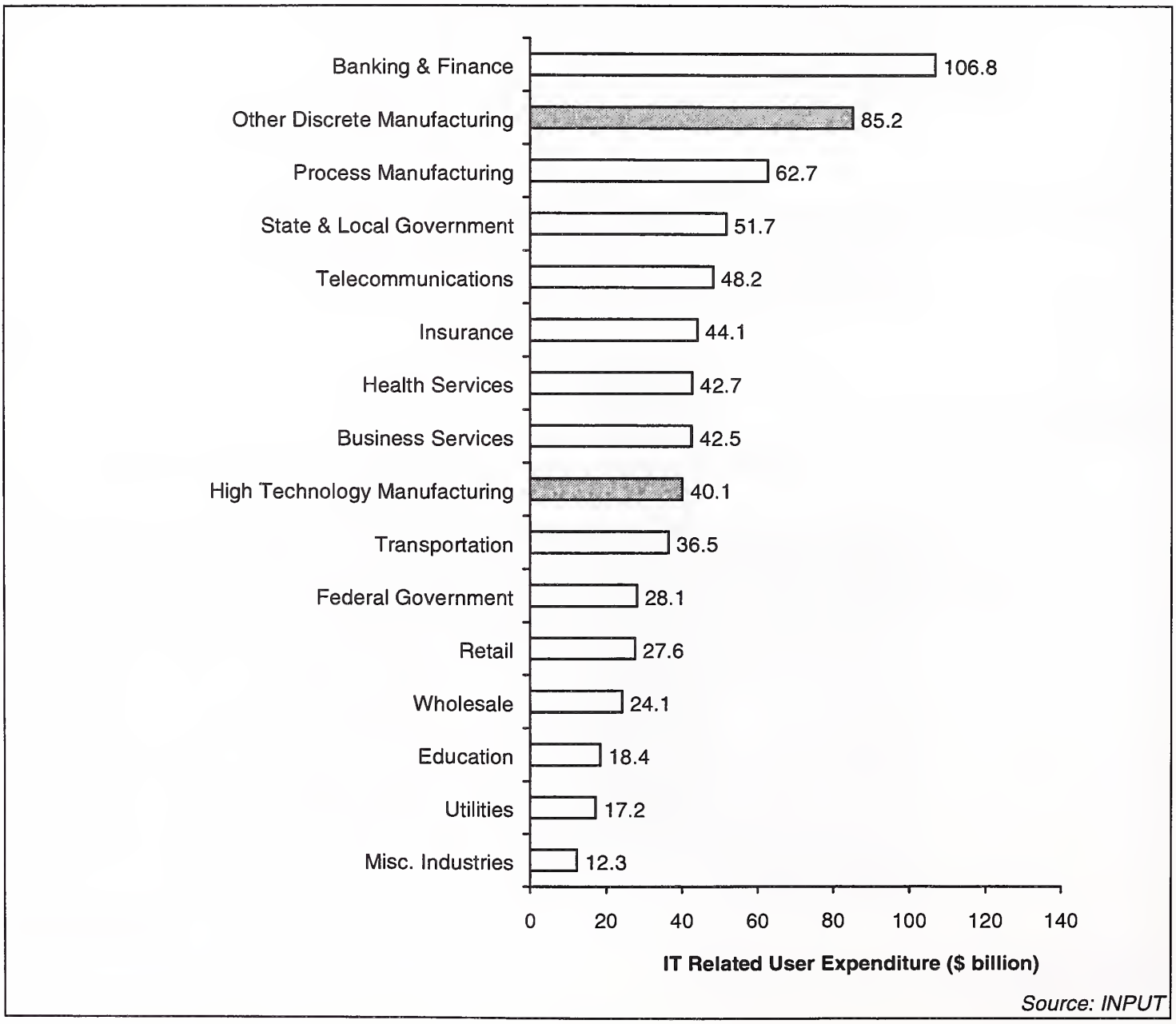
C
Comparison to Other Sectors

This section provides a comparison between the High Technology Manufacturing sector and the other industry sectors in the U.S. IT Software & Services market for a number of key statistics.

Exhibit IV-41 shows a comparison of the total IT expenditure for each of the U.S. industry sectors.

Exhibit IV-41

Industry Sector Comparison – U.S., 1997

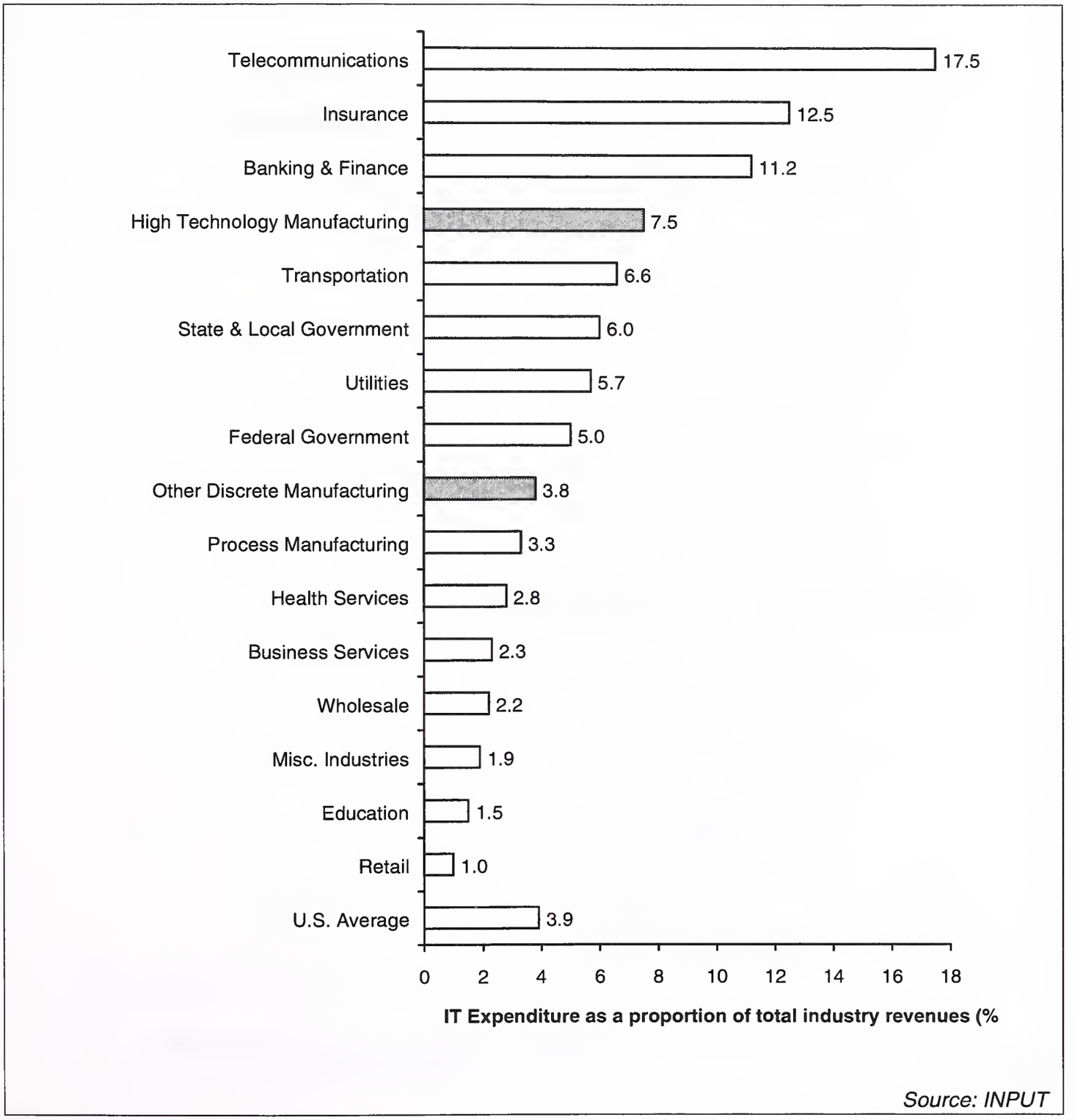


Source: INPUT

Exhibit IV-42 shows the comparison of the percentage of annual revenues spent on average on IT across the different industry sectors.

Exhibit IV-42

Industry Sector Comparison – IT Expenditure U.S., 1997

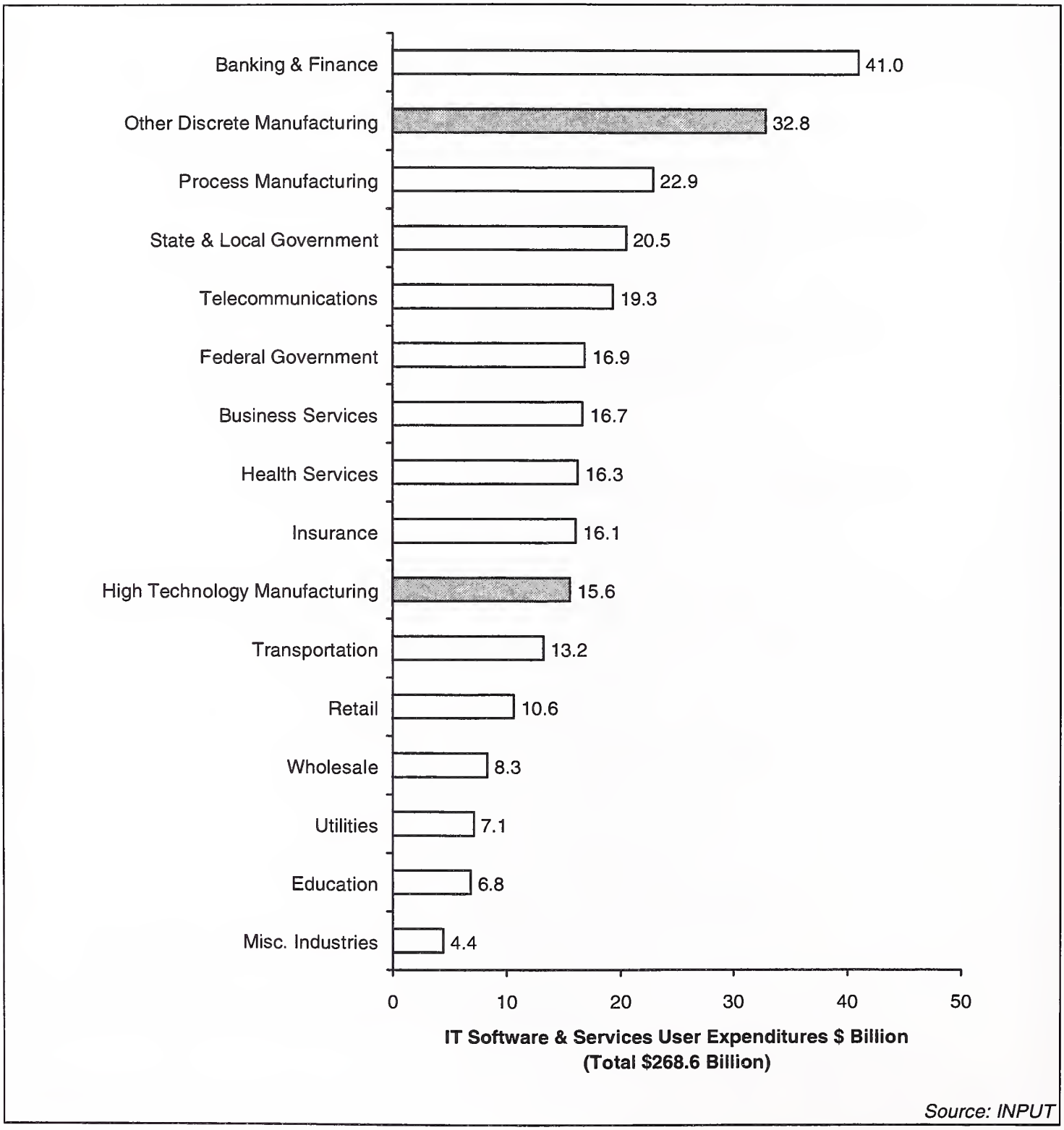


Source: INPUT

Exhibit IV-43 shows the comparison for total IT Software & Services expenditure across the different industry sectors.

Exhibit IV-43

Industry Sector Comparison – IT Software & Services – U.S., 1997

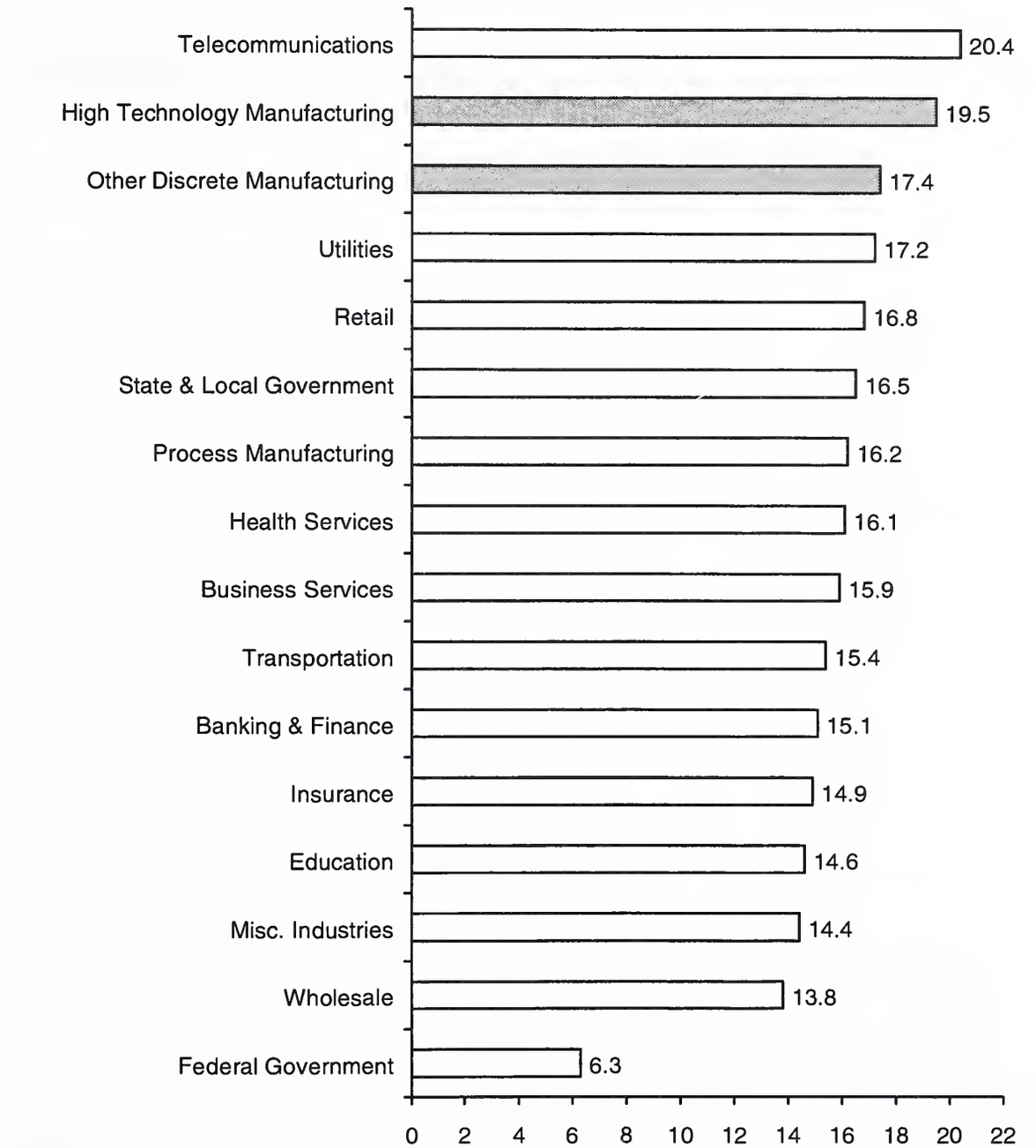


Source: INPUT

Exhibit IV-44 provides a comparison of the expected growth in IT Software & Services for each individual industry sector.

Exhibit IV-44

Industry Sector IT Expenditure Growth Comparison – U.S., 1997

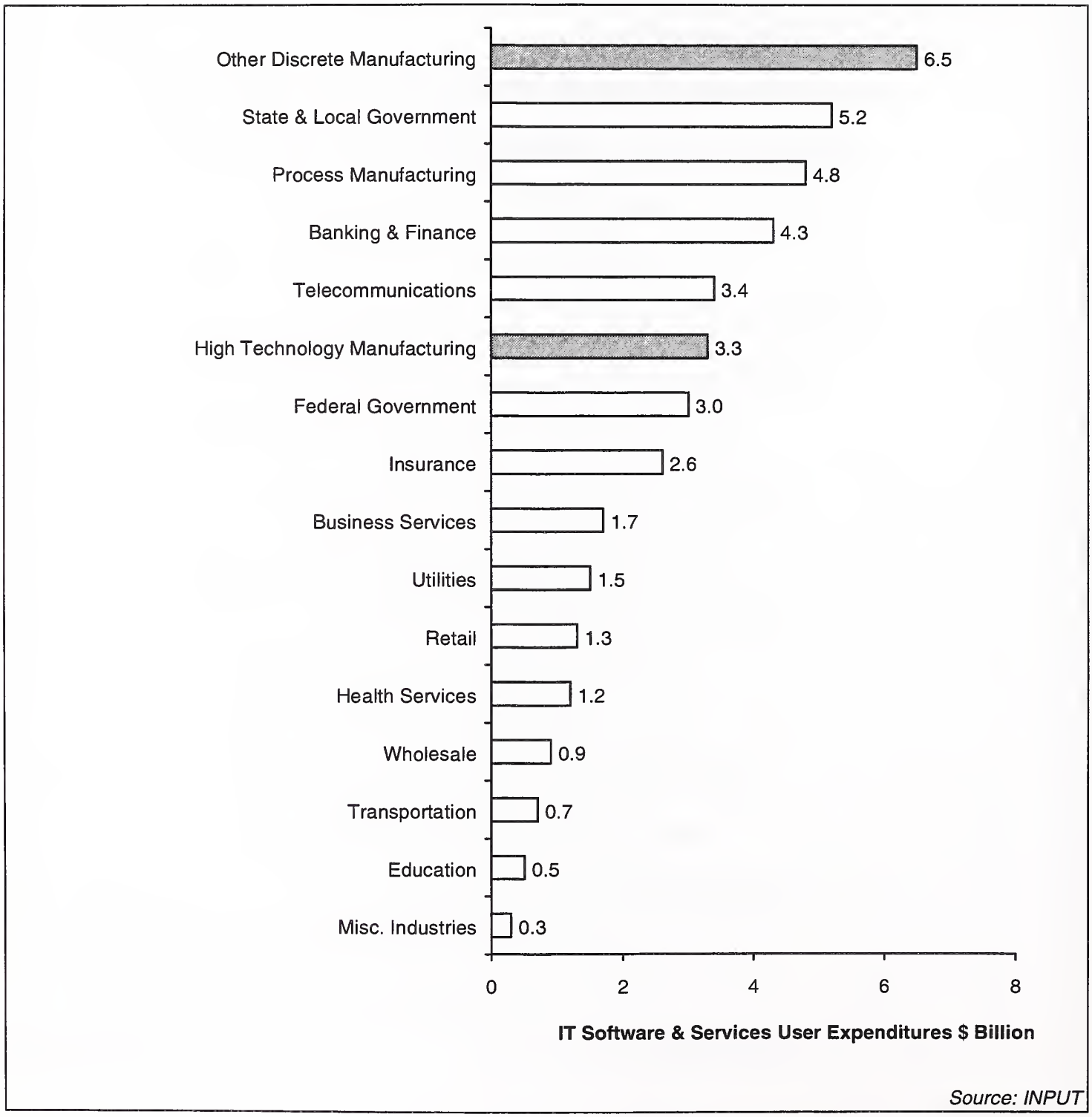


Source: INPUT

Exhibits IV-45 through 47 show comparative industry sector tables for the respectively the Professional Services, Systems Integration and Outsourcing sectors.

Exhibit IV-45

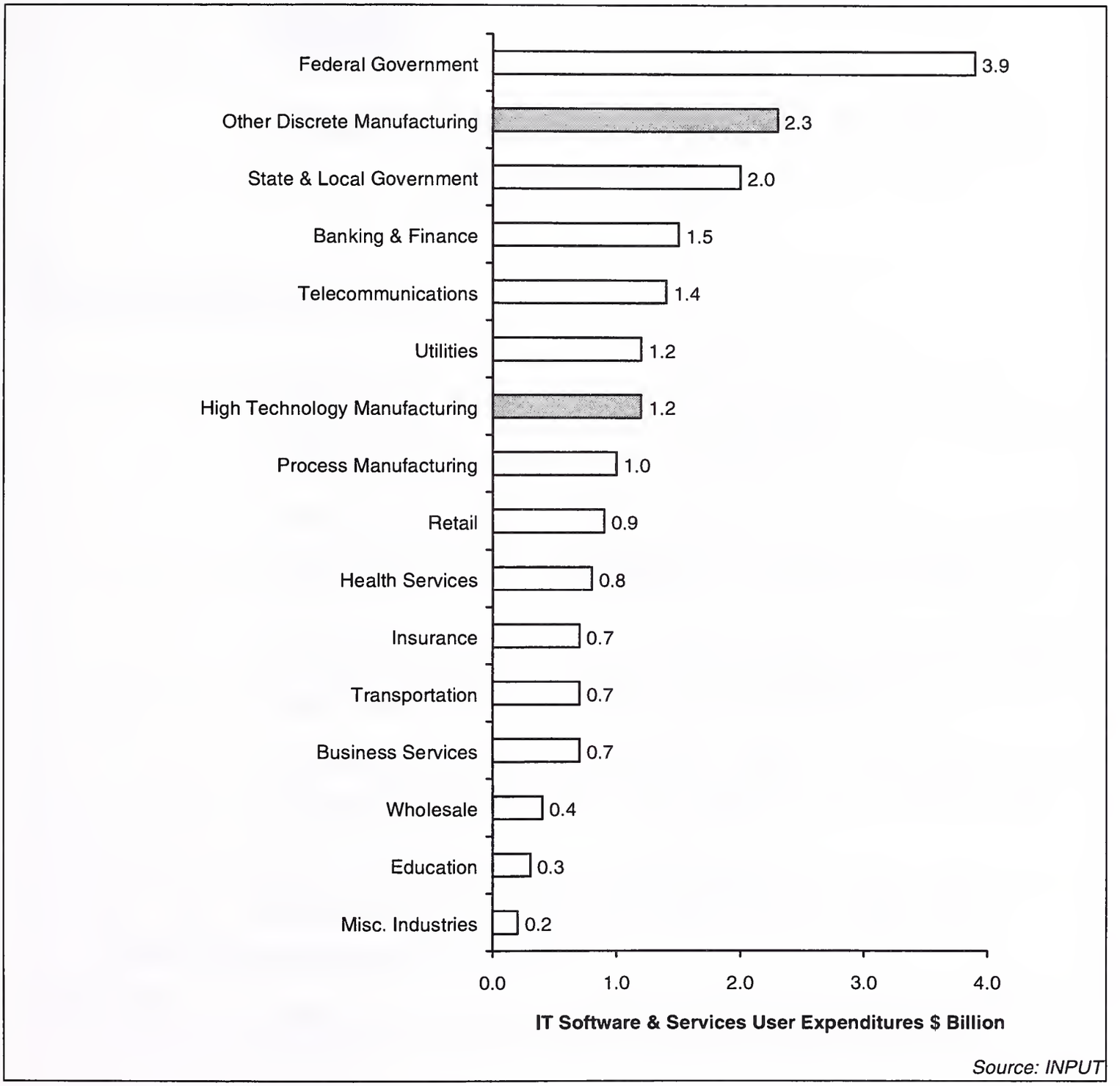
Industry Sector Comparison – Professional Services – U.S., 1997



Source: INPUT

Exhibit IV-46

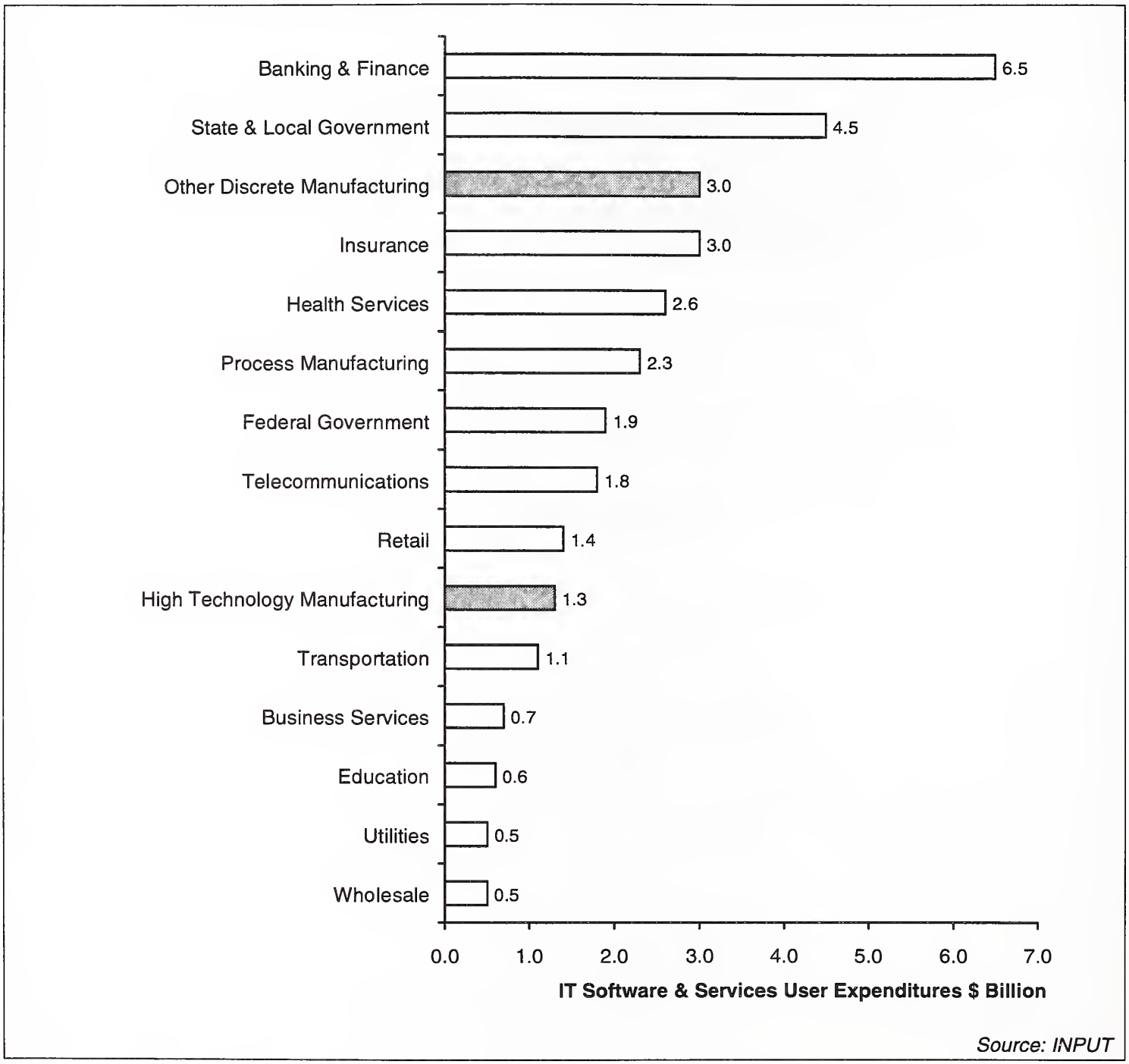
Industry Sector Comparison – Systems Integration – U.S., 1997



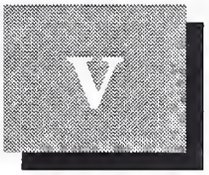
Source: INPUT

Exhibit IV-47

Industry Sector Comparison – Outsourcing – U.S., 1997



Source: INPUT



Electronic Business Directions

A
Electronic Business Futures

The High Technology Manufacturing sector, like many other areas of business and commerce, is being challenged by a variety of forces including falling technology costs, increasing operational expenses, global competition and highly competitive markets.

Internally manufacturing firms are being challenged by the need to create flexible and lean manufacturing processes through the harnessing of IT and factory automation systems.

The manufacturing industry is thus in the process of transforming from a hierarchical information transfer and control model to one that is process centric and cuts across the traditional departmental divisions.

IT, particularly data communications technology and the Internet, is now creating the necessary conditions for the development of the Electronic Manufacturing era.

Electronic Manufacturing can be considered as part of the wider Electronic Business revolution that is discussed more fully in the remaining parts of this chapter.

Electronic Manufacturing implies the design of the business from the beginning in a way that would have been impossible without IT.

Designing the business from the beginning provides the opportunity to achieve optimum *product* engineering as well as optimum *production* engineering.

Very few manufacturing firms have yet been able to achieve such a radical approach towards meeting their ultimate goals of concurrent design/engineering and flexible manufacturing systems.

However, the High Technology manufacturing start up or new development is well placed to reap the rewards of such an approach.

Almost the entire technology of the semiconductor manufacturing area has been developed in the last thirty years.

Most High Technology manufacturing firms are concentrating their current efforts on improved processes in the area of product development, customer relationship management and supply chain management.

In the future, as more and more of these systems get married together into an integrated, yet understandable and flexible management system true Electronic Manufacturing systems will have been created.

In the 21st century Electronic Manufacturing System, the information process will be even more important that the actual production process.

These 21st century Electronic Manufacturing firms will be a key representation of the Electronic Business revolution.

More generally Electronic Business can be described as the combination of Information Technology and business process to form a new way of working.

Electronic Business is all about enterprise wide change. It impacts strategy, business processes, the use of technology, not just IT, and the interactions of the people involved in the enterprise.

Some of the problems and challenges being faced by the High Technology Manufacturing sector that can be addressed by the implementation of Electronic Business solutions include:

- Capturing new market opportunities.
- Creation of a market-driven culture.
- Improvements in customer service.
- Process rationalization.
- Redesigning the business.

The remaining sections of this Chapter cover:

- The definition and description of Electronic Business and its distinction from Electronic Commerce.
- The impact of the Internet on the development of Electronic Business systems and processes.
- The effect of Electronic Business developments on corporate computing.

B
Electronic Business and Electronic Commerce

The term 'Electronic Business' is frequently used as a synonym for Electronic Commerce, the latter term being used to describe the conduct of business transactions electronically.

In the past 10 to 15 years, Electronic Commerce implied the use of EDI (Electronic Data Interchange) systems, now the focus has switched to the possibilities for conducting commerce over the Internet.

The term 'Electronic Business' is however used by INPUT to signify something much deeper and more profound about the way that organizations are adapting IT systems, including the Internet, to reengineer and redesign the fundamental processes and value chains of their business.

There is a clear need to be precise about the way in which we use these two terms and what exactly we mean by them.

1. Electronic Commerce Definition

INPUT defines Electronic Commerce as the use of IT systems to carry out the interorganizational business processes of buying and selling goods and services.

This basic definition has been extended by contemporary use to include Electronic Retailing. Usually Electronic Retailing is referred to as Business-to-Consumer (B-to-C) Electronic Commerce and interorganizational trade as Business-to-Business (B-to-B) Electronic Commerce.

Electronic Commerce places emphasis on activities that are external to the organization, how customers are grouped and the firm's interactions with them.

Electronic Commerce is, however, only a part of the wider phenomenon of Electronic Business.

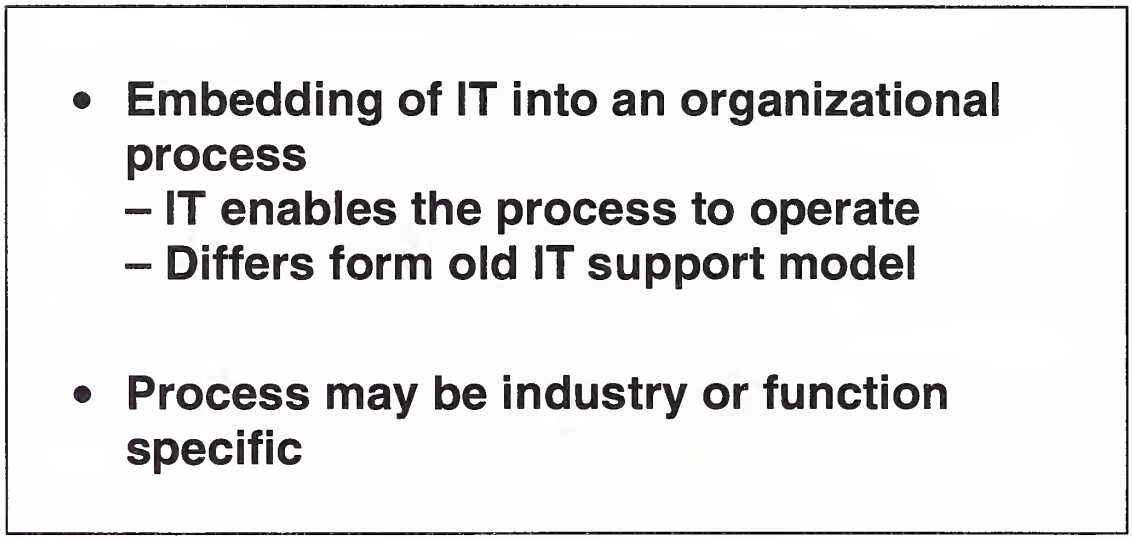
2. Electronic Business Definition

The Electronic Business revolution is possibly the most important change affecting organizations as we go forward into the 21st century.

Whilst Electronic Commerce places emphasis on activities that are external to the organization, Electronic Business places emphasis on the reengineering and/or automation of internal processes based on IT systems, see Exhibit V-1.

Exhibit V-1

What is Electronic Business?



Source: INPUT

Electronic Business is the embedding of IT into a business process to create a system that would not be possible without IT support. IT enables that process to operate.

The Electronic Business model differs form the old or traditional model of IT use where it was used just to support the operation of a process which hitherto had run without the use of computer technology at all.

A critical test for an Electronic Business process is whether or not that process can operate at all if the IT system is inoperable.

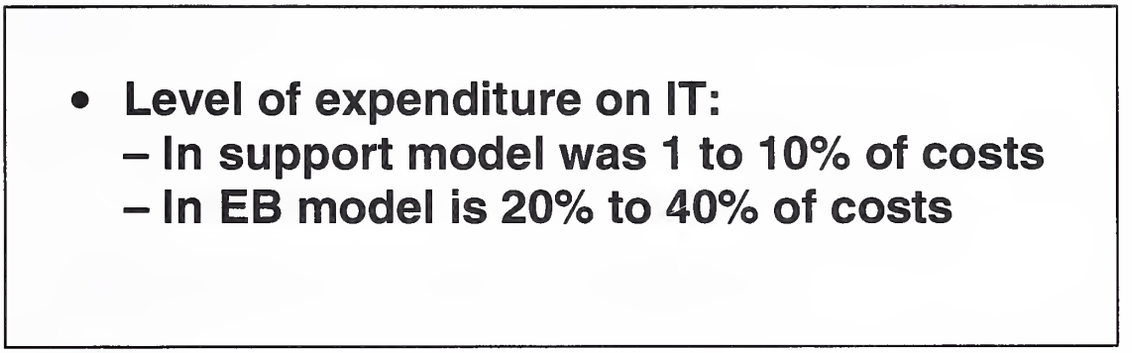
For example, a reservation clerk that uses a reservation system to make airline bookings is not an example of Electronic Business.

An on-line system that allows a passenger to make a booking, obtain a ticket and a boarding pass electronically without intervention of a reservations clerk, is an example of Electronic Business.

In the 'old' IT support model the expenditure on IT is typically in the range of one to five percent of an organizations annual revenues, see Exhibit V-2.

Exhibit V-2

Electronic Business Expenditure



Source: INPUT

In the U.S., as was shown in Exhibit IV-4 earlier, the average for all industries is currently just under four percent with about half the identified sectors spending at a higher rate.

In the Electronic Business model IT expenses are going to be commonly measured in the range of 20% to 40% of organizations revenues or total expenses. In some cases they will be even higher as we continue our journey in the 21st century towards the electronic society.

In the past competitive advantage was based on structural characteristics like market presence/power, economies of scale and the comprehensiveness of a firm's product range.

Today, and increasingly in the future, competitive advantage is based on capabilities that consistently deliver superior value to customers. For example capabilities such as better internal co-ordination, workflow management, product and service customization and supply chain management.

Electronic Business is thus going to have a major impact on the way that commerce and industry, government and consumers conduct business in the 21st century.

C
Impact of the Internet

Improvements in transportation technology, the railway system from the middle of the 19th century, the road systems from the middle of the 20th century, reduced transportation costs and thus revolutionized the movement of goods and people.

Now the Internet is in the process of revolutionizing the transport of information as a result again of a drastic reduction in costs, this time for the transport of bits.

The Internet is particularly important as an enabler of both Electronic Business and Electronic Commerce.

The fabric of business and commerce is transactions.

The broad categorization of business transactions is:

- Transactions for acquiring data and information.
- Transactions for disseminating information.
- Transactions between business parties, B-to-B transactions.
- Transactions between a business and a consumer, B-to-C transactions.

To date there still exist some reluctance to use the Internet.

Characteristics of message handling of importance to trading partners are:

- Integrity – assurance that the message has not been altered.
- Confidentiality – message not viewed by third party.
- Non-repudiation – senders/receivers cannot deny sending/receiving.
- Authentication – assurance that message did come from the indicated party.

For Electronic Business and Commerce to flourish many common business services need to be established that will provide an infrastructure for facilitating inter firm transactions and the buying and selling process.

We are still at the stage where the technical infrastructure is being established.

D
Issues for Corporate Computing

The movement towards Electronic Business is going to have important implications for corporate computing.

We have already witnessed the march of the Outsourcing business.

We are now seeing the start of the Business Process Outsourcing phenomenon.

One of the most significant impacts on corporate computing has been the Intranet.

Intranets are still most commonly used for low-value applications.

The primary motive for their use is to extend the reach of IT within an Organization, not reduce cost. This is an interesting sign of EB.

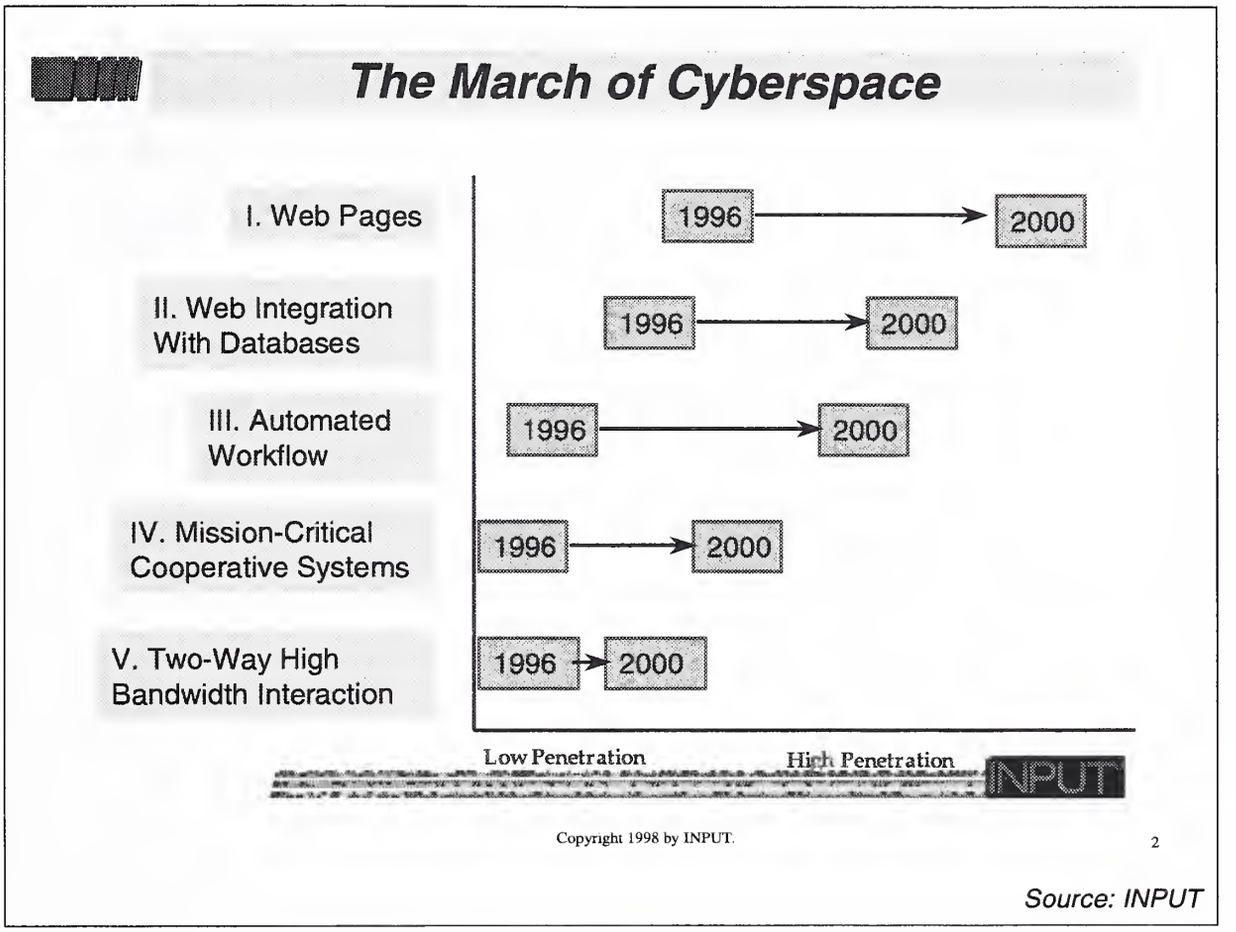
To date Intranets have tended to be funded from centralized budgets and largely been developed in-house.

They are still in early phase of use, mostly used for internal distribution of information and of most help to administrative staff.

Five phases of development are envisaged and observable now, see Exhibit V-3.

Exhibit V-3

Internet Development



Source: INPUT

I. Static info distribution, e.g. policies, directories, registers.

II. Information sharing between units/departments. E.g. product plans, financial data, customer services records and sales contacts.

III. Group collaboration. Project management, GroupWare and desktop conferencing.

IV. Integration of existing systems with Intranet. Web enabled data warehouse, front-end to legacy database, live customer queries.

V. Replacement of legacy systems.

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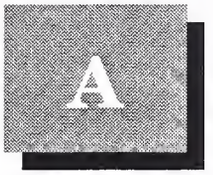

High Technology Manufacturing Sector Database, 1997-2002, U.S.

This appendix contains data tables from the main body of the report to provide a convenient reference source.

AA
Total IT Software & Services

Exhibit A-1

Analysis of IT Software & Services Expenditure – High Technology Manufacturing Sector U.S., 1997

Segment		User Expenditures $ Billion		
		Industry Specific	Cross Industry	Other Services
Professional Services	Total	3,250		
Systems Integration	Total	1,150		
	Software Products	85		
	Equipment	600		
	Other	465		
Outsourcing	Total	1,300		
Processing Services	Transactions	300	250	
	Other services			350
Network Services	Total	350		650
Applications Software Products	Total	2,000	1,100	
Turnkey Systems	Total	1,670	80	
	Software Products	720	35	
	Equipment	520	25	
	Other	430	20	
Systems Software Products	Total			1,600
Equipment Services	Total			1,550
Total		10,020	1,430	4,150

Source: INPUT

Exhibit A-2

Equipment Expenditure – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Systems Integration	600
Turnkey Systems – Industry Specific	520
Turnkey Systems – Cross Industry	25
High Technology Manufacturing Sector TOTAL	1,145

Source: INPUT

Exhibit A-3

Software Products Expenditure – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Systems Integration	85
Applications Software Products – Industry Specific	2,000
Applications Software Products – Cross Industry	1,100
Turnkey Systems – Industry Specific	720
Turnkey Systems – Cross Industry	35
Systems Software Products	1,600
High Technology Manufacturing Sector TOTAL	5,540

Source: INPUT

Exhibit A-4

IT Software & Services Components – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Equipment	1,145
Software Products	5,540
IT Services	8,915
High Technology Manufacturing Sector TOTAL	15,600

Source: INPUT

Exhibit A-5

Total IT Software & Services – High Technology Manufacturing Sector

Sector	1997 Expenditure ($ million)
Industry Specific	10,020
Cross Industry	1,430
Other Services	4,150
High Technology Manufacturing Sector TOTAL	15,600

Source: INPUT

AB
Industry Specific IT Software & Services

Exhibit A-6

High Technology Manufacturing Industry Specific IT Software & Services Market, U.S. ($million)

Sector	1997	CAGR	2002
Professional Services	3,250	19.7%	8,000
Systems Integration	1,150	21.9%	3,100
Outsourcing	1,300	21.9%	3,500
Processing Services	300	20.0%	750
Network Services	350	39.5%	1,850
Applications Software Products	2,000	26.2%	6,400
Turnkey Systems	1,670	19.1%	4,000
Sector TOTAL	10,020	22.5%	27,600

Source: INPUT

Exhibit A-7

Professional Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
IS Consulting	1,720	16.6%	3,700
Education & Training	530	17.8%	1,200
Software Development	1,000	25.4%	3,100
TOTAL	3,250	19.7%	8,000

Source: INPUT

Exhibit A-8

Systems Integration – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Software Products	85	24.1%	250
Equipment	600	18.5%	1,400
Other Services	465	25.5%	1,450
High Technology Manufacturing Sector TOTAL	1,150	21.9%	3,100

Source: INPUT

Exhibit A-9

Outsourcing Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Platform Operations	260	9.0%	400
Application Operations	550	22.2%	1,500
Desktop Services	180	29.3%	650
Applications Management	180	22.7%	500
Network Management	80	34.3%	350
Business Operations	50	14.9%	100
High Technology Manufacturing Sector TOTAL	1,300	21.9%	3,500

Source: INPUT

Exhibit A-10

Processing Services – High Technology Manufacturing Sector, U.S. ($million)

Subsector	1997 Expenditure	CAGR	2002 Expenditure
Industry Specific Transactions	300	20.1%	750
Cross Industry Transactions	250	9.9%	400
Other Processing Services	350	16.5%	750
High Technology Manufacturing Sector TOTAL	900	16.1%	1,900

Source: INPUT

Exhibit A-11

Network Services – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Industry Specific Network Applications	350	39.5%	1,850
Other Network Services	650	19.7%	1,600
High Technology Manufacturing Sector TOTAL	1,000	28.1%	3,450

Source: INPUT

Exhibit A-12

Applications Software Products – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Industry Specific Applications Software Products	2,000	26.2%	6,400
Cross Industry Applications Software Products	1,100	17.8%	2,500
High Technology Manufacturing Sector TOTAL	3,100	23.5%	8,900

Source: INPUT

Exhibit A-13

Industry Specific Turnkey Systems – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Software Products	720	17.3%	1,600
Equipment	520	18.6%	1,220
Other Services	430	22.4%	1,180
High Technology Manufacturing Sector TOTAL	1,670	19.1%	4,000

Source: INPUT

Exhibit A-14

Cross Industry Turnkey Systems – High Technology Manufacturing Sector, U.S.

Subsector	User Expenditures ($ Million)		
	1997	CAGR	2002
Software Products	35	9.5%	55
Equipment	25	14.9%	50
Other Services	20	11.8%	35
High Technology Manufacturing Sector TOTAL	80	11.8%	140

Source: INPUT

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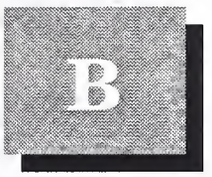


Market Forecast Reconciliation

This appendix provides a reconciliation between the market forecast included in this report in comparison with those previously published by INPUT in 1996 for the Discrete Manufacturing sector.

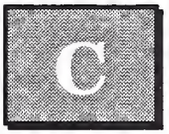
INPUT has not previously provided a separate analysis of the High Technology Manufacturing sector in the United States.

Exhibit B-1

U.S. IT Software & Services
Forecast Reconciliation – Discrete Manufacturing Sector 1997
$ Millions

PRODUCT/ SERVICE CATEGORY	1997 Market				2001 Market				1996 Report %CAGR (Fcst)	1997 Report %CAGR (Fcst)
	1996 Report	1997 Report	1996 – 1997 Variance		1996 Report (Fcst)	1997 Report (Fcst)	1996 – 1997 Variance			
			Amount	%			Amount	%		
Professional Services	9,351	9,750	399	3	17,241	19,800	2,559	15	16	19
Systems Integration	3,491	3,505	14	-	7,350	7,600	250	3	21	21
Outsourcing	2,259	4,279	2,020	1,000	5,497	9,600	4,103	75	25	22
Processing Services	1,090	1,100	10	-	2,708	2,600	(108)	4	23	23
Network Services	470	970	500	1	1,615	3,800	2,185	135	37	37
Applications Software Products	6,174	5,995	(179)	3	15,164	16,000	836	6	25	26
Turnkey Systems	5,427	5,400	(27)	-	9,564	11,000	1,436	15	15	19
Total Industry Specific	**28,262**	**30,999**	**2,737**	**16**	**59,139**	**70,400**	**11,261**	**19**	**20**	**22**

Source: INPUT



Terms and Definitions

CA
IT Market Structure

- INPUT now recognizes two broad market segments, Electronic Business (EB) and IT Software & Services.

- IT Software & Services expenditures are a component of total user expenditure on IT which also includes equipment and in-house personnel.

- INPUT provides an analysis of total user IT expenditure in its Worldwide Market Forecast Program. In this analysis it recognizes six major discrete components of expenditure:

  - Equipment – expenditure on computer and data communications hardware products.

  - Communications – all expenditure on IT - related data communications services.

  - Software Products – all expenditure on systems software products and applications software product licenses including support services where these are included within the basic license fee.

  - IT Services – all expenditure on professional services, systems integration, outsourcing, processing services, network services, turnkey systems.

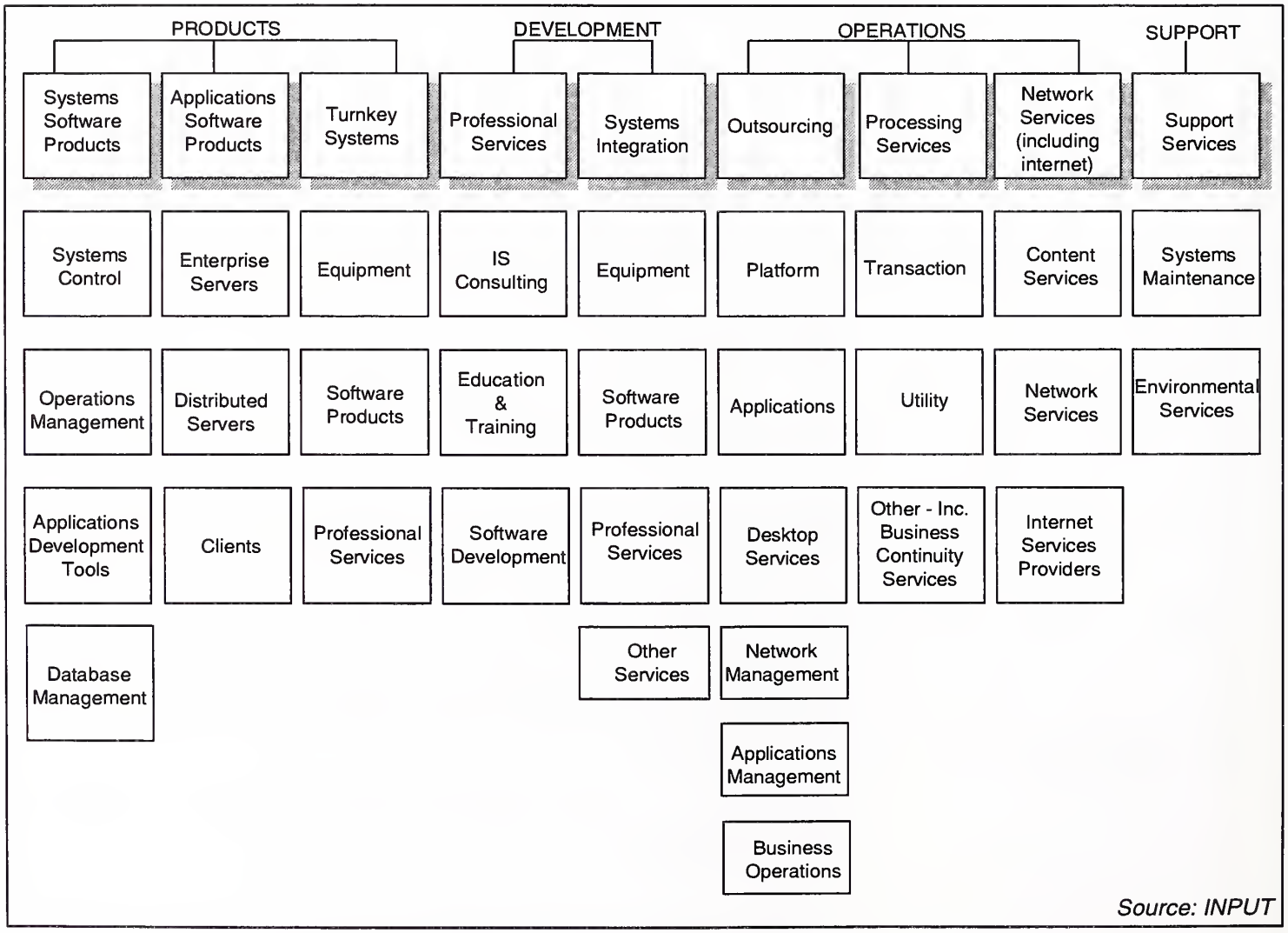
  - Staff – direct in - house staff costs directly concerned with IT or the support of it.

  - Facilities – IT budget expenditure on overheads such as space, heating, lighting, furniture, vehicles etc.

- INPUT's service sectors, described in detail below, can involve the delivery of a combination of components of people, computer processing and software products.
- The six categories defined above represent, however, the basic components or `inputs' to the operation of IT by a user
- N.B that the IT Services category defined above does not correspond to INPUT'S definition of the IT Software & Services market since the latter includes all software products and the equipment delivered through service channels.
- The structure and components of the IT Software & Services market are shown in Exhibit C-1.

Exhibit C-1

IT Software & Services Market Structure



CB
Industry Sectors

1. Industry Sector Definitions

Industry sectors are based on the most recent revision of the Standard Industrial Classification (SIC) code system, as shown in Exhibit C-2.

Exhibit C-2

Industry Sector Definitions

Industry Sector	SIC Code	Description
Discrete Manufacturing	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
Process Manufacturing	10xx	Metal mining
	12xx	Coal mining
	13xx	Oil and gas extraction
	14xx	Mining/quarrying nonmetallic minerals
	20xx	Food and kindred products
	21xx	Tobacco products
	22xx	Textile mill products
	24xx	Lumber and wood products, except furniture
	26xx	Paper and allied products
	28xx	Chemicals and allied products
	29xx	Petroleum refining and related industries
	30xx	Rubber and miscellaneous plastic products
	32xx	Stone, clay, glass and concrete
	33xx	Primary metal industries
Transportation Services	40xx	Railroad transport
	41xx	Public transit/transport
	42xx	Motor freight transport/warehousing
	43xx	U.S. Postal Service
	44xx	Water transportation
	45xx	Air transportation (including airline reservation services in 4512)
	46xx	Pipelines, except natural gas
	47xx	Transportation services (including 472x, arrangement of passenger transportation)

Source: INPUT

Exhibit C-2 (continued)

Industry Sector Definitions

Industry Sector	SIC Code	Description
Telecommunications	48xx	Communications
Utilities	49xx	Electric, gas and sanitary services
Retail Trade	52xx 53xx 54xx 55xx 56xx 57xx 58xx 59xx	Building materials General merchandise stores Food stores Automotive dealers, gas stations Apparel and accessory stores Home furniture, furnishings and accessory stores Eating and drinking places Miscellaneous retail
Wholesale Trade	50xx 51xx	Wholesale trade - durable goods Wholesale trade - nondurable goods
Banking and Finance	60xx 61xx 62xx 67xx	Depository institutions Nondepository credit institutions Security and commodity brokers, dealers, exchanges and services Holding and other investment offices
Insurance	63xx 64xx	Insurance carriers Insurance agents, brokers and services
Health Services	80xx	Health services
Education	82xx	Educational services

Source: INPUT

Exhibit C-2 (continued)

Industry Sector Definitions

Industry Sector	SIC Code	Description
Business Services	65xx	Real estate
	70xx	Hotels, rooming houses, camps, and other lodging places
	72xx	Personal services
	73xx	Business services (except hotel reservation services in 7389)
	7389	Hotel reservation services
	75xx	Automotive repair, services and parking
	76xx	Miscellaneous repair services
	78xx	Motion pictures
	79xx	Amusement and recreation services
	81xx	Legal services
	83xx	Social services
	84xx	Museums, art galleries, and botanical/zoological gardens
	86xx	Membership organizations
	87xx	Engineering, accounting, research, management, and related services
	89xx	Miscellaneous services
Federal Government	9xxx	
State and Local Government	9xxx	
Miscellaneous Industries	01xx	Agricultural production - crops
	02xx	Agricultural production - livestock/animals
	07xx	Agricultural services
	08xx	Forestry
	09xx	Fishing, hunting, and trapping
	15xx	Building construction - general contractors, operative builders
	16xx	Heavy construction - contractors
	17xx	Construction - special trade contractors
Personal Households	88xx	

Source: INPUT

2. Process or Cross-Industry Sector Definitions

- These sectors or markets involve multi-industry applications such as human resource systems, accounting systems, etc. In order to be included in an industry sector, the service or product delivered must be specific to that sector only. If a service or product is used in more than one industry sector, it is counted as cross-industry.

- INPUT only includes the turnkey systems, applications software products, and transaction processing services in the cross-industry sectors.

- The cross-industry markets are:

a. Accounting/Finance

- Consists of such functions as:
  - General ledger
  - Financial management
  - Accounts payable
  - Accounts receivable
  - Billing/invoicing
  - Fixed assets
  - International accounting
  - Purchasing
  - Taxation
  - Financial consolidation.

- Excluded are accounting products and services directed to a specific industry, such as tax processing services for CPAs and accountants within the business services industry sector.

b. Human Resources

- Human resources companies:
  - Benefits administration.
  - Government compliance.
  - Employee relations.
  - Manpower planning.
  - Compensation administration.
  - Applicant tracking.
  - Position control.
  - Payroll processing.

c. Education and Training

- Education and training consists of education and training for information systems professionals and users of information systems delivered as a software product, turnkey system, or through processing services. The market for computer-based training tools for the training of any employee on any subject is also included.

d. Office Systems

- Office systems companies the following six categories:
  - (1) **Integrated** *Office Systems (IOSs)* - IOSs integrate the applications that perform common office tasks. Typically, these tasks include the following core applications, all of which are accessed from the same terminal, microcomputer, or workstation:
    - Electronic mail/groupware.
    - Decision support systems.
    - Time management/workflow.
    - Filing systems/document management.

- (2) Text *Processing* - is the most common microcomputer application and is a basic application within the office systems sector. Text processing addresses several levels of functionality, from the production of simple correspondence to large document generation in which many people from different departments have input.

- (3) Desktop *Publishing (DTP)* - refers to the page-design software programs that allow small and midsized organizations to publish printed documents (brochures, catalogs, newsletters, reports, etc.) from the desktop. The primary functions of DTP software include the manipulation of the following functions:

  - Layout and design of columns
  - Text manipulation (font type)
  - Graphic manipulation
  - Print Control (color type, paper type)

- (4) Electronic *Publishing* - includes composition, printing, and editing software for documents containing multiple typefaces and graphics, including charts, diagrams, computer-aided design (CAD) drawings, line art, and photographs. Electronic publishing products may also have different data formats such as text, graphs, images, voice and video.

- The fundamental difference between electronic publishing and desktop publishing is that electronic publishing facilitates document management and control from a single point, regardless of how many authors/locations work on a document. Desktop publishing (DTP), on the other hand, is considered a personal productivity tool and is generally a lower-end product residing on a personal computer.

- (5) Graphics - Graphics packages that are used for presentations or freehand drawings and/or are ancillary to desktop publishing are part of office systems. Thus, the graphics component of office systems sector includes the following elements:

- Presentation graphics represent the bulk of office systems graphics. Most presentations involve a combination of graphs and text. They are used to communicate a series of messages to an audience rather than to analyze data.

- Paint and line art drawing programs are used for illustrations, while page layout programs are used to integrate text and graphics.

- Electronic form programs allow users to create and print forms in-house. Some applications work with OCR scanners, allowing users to scan pictures and logos directly onto forms.

  - (6) Document *Imaging Software* - allows users to manipulate (store, retrieve, print) images that have been scanned from paper documents. The applications that imaging software generates include full text retrieval, document management, and database management. Document imaging software is a component of an imaging system. Hardware components of imaging systems include: scanners, image servers, workstations, optical drives, printers, and storage devices.

e. Engineering and Scientific

- Engineering and scientific activities encompass the following applications:

  - Computer-aided design and engineering (CAD and CAE).

  - Structural analysis.

  - Statistics/mathematics/operations research.

  - Mapping/GIS (Geographic Information Systems).

  - Computer-aided manufacturing (CAM) or CAD that is integrated with CAM is excluded from the cross-industry sector, as it is specific to the manufacturing industries. CAD or CAE that is dedicated to integrated circuit design is also excluded because it is specific to the semiconductor industry.

f. Planning and Analysis

- Planning and analysis consists of software products and information services in four application areas:

  - Executive Information Systems (EIS).

  - Financial modeling or planning systems.

  - Spreadsheets.

- Project management.

g. Sales and Marketing

- Sales and marketing encompasses the following marketing/sales applications:
  - Sales analysis.
  - Marketing management.
  - Demographic market planning models.

h. Other Processes

- Two other process areas that are emerging as significant cross-industry sectors are Customer Services and Logistics. They comprise the following:
- Customer Care/Services:
  - Support.
  - Repair/diagnostics.
  - Help desk.
  - Consulting.
- Logistics:
  - Invoice management.
  - Replenishment.
- Distribution.

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