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The US Domination Of Worldwide Software Products Sales Increased In 1995.

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Contrary to expectations, the percent of software products sold by US firms increased from 74% of products sold worldwide in 1993 to 77% of the market in 1995, as reported by the International Data Corporation. This phenomenal domination of an important new industrial sector was expected to erode naturally as software sophistication spreads to both developed and developing countries. However, despite exceptional growth by several non-US companies, US software publishers have strengthened their position over the last two years.

The software industry is divided into four segments

In our study of the software industry at Stanford University's Computer Industry Project, we are working on an Alfred P. Sloan Foundation grant to understand the public policy issues that will shape the future of the software industry: patent law, piracy, trade policy, labor, immigration, education, antitrust, international competition, quality and technology change. After three years of study, we have come to view the software industry in terms of the total output of all software developers and we have broken it into four segments (Figure 1).

The 'software products' segment is the smallest of the four and refers to programs that are sold to many customers, as opposed to custom-built software. The products include those from familiar publishers like IBM, Microsoft, Nintendo and Oracle, as well those

from thousands of other firms around the world. Total 1995 sales of these products was estimated to be $92 billion.

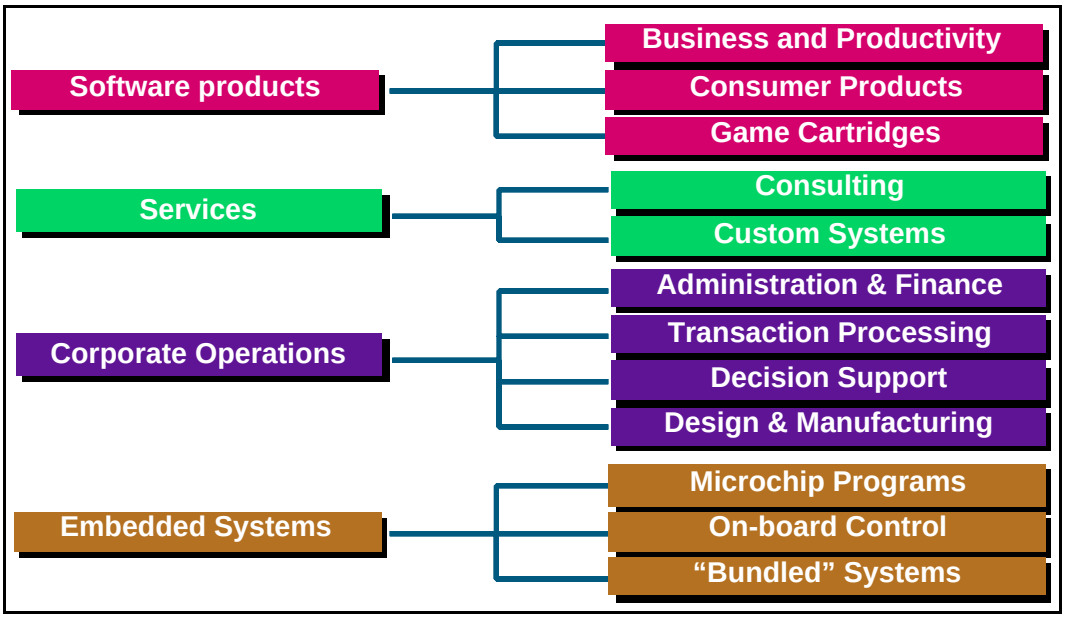

Figure 1. The four segments of the software industry.

'Software services' includes system consulting and design, custom system development, and contract programming. This segment is roughly twice as big as the software products segment — $170B worldwide in 1995. We've listed the top 10 firms in each segment in Figures 2 and 3.

Publishers	$B in '95
IBM	12.7
Microsoft	7.6
Fujitsu	4.4
Digital	3.2
Computer Associates	2.5
NEC	2.3
Nintendo	2.1
Novell	1.9
Oracle	1.7
SAP AG	1.4

Figure 2. Top 10 software publishers in 1995.

Services Firms	$B in '95
IBM	12.7
EDS	12.4
Hewlett Packard	6.3
Digital	6.2
Andersen Consulting	4.1
Comp. Science Corp.	3.9
Fujitsu	3.8
CAP Gemini	3.6
Unisys	3.5
ADP	3.2

Figure 3. Top 10 software services firms in 1995.

Software's biggest impact on the national economy is via other industries

The Department of Commerce's *US Industrial Outlook* report puts the total revenues from software products and services was 5% of the US GDP in 1993 and is expected to be 10% by 2000. And since the US is a net exporter of software, the software industry already has a positive impact on the trade balance. But the biggest impact of software

on the national economy is indirect — software has become a strategic tool in many industries, as represented by our third and fourth segments.

The third segment of the software industry, which we call 'corporate operations,' refers to the cost of the programs that corporations write "in-house" to improve efficiency and other aspects of their business (communications, decision making, customization of products, etc.) Numbers for this investment in software development are hard to estimate, but we estimate it to be over $250B in expenses last year, in the US alone. Included also in this segment are in-house projects to enhance product offerings, like frequent flyer programs, and specialized services, like on-line information retrieval, that are provided via custom-built software.

But the fourth segment of the software industry, 'embedded software,' is by far the biggest, and the most important for the economy in general. We are unable to estimate its size at this time. It represents the software that is embedded as part of products of all sorts: electric shavers (2,000 lines of code), cellular telephones and laser printers (300,000 lines). televisions (500,000 lines), and automobiles and airplanes (millions of lines of software).

As computer chips pervade the design of products in all industries, more and more engineers are writing the software that's running on those chips — a lot of software. And the trend is for more product functionality to be based on software and firmware (programs burned into the chip itself). Since this software-based functionality has become a key element in hundreds of different kinds of products, software engineering capability has come to have a broad and growing impact on industrial competitiveness and thus on the economy generally.

The US lead in software will not erode quickly

The Stanford Computer Industry Project continues to monitor the software industry. But far from raising an alarm about foreign competition, our research indicates that the US will continue to dominate. In other words, the reasons that the US achieved its current position of dominance were neither superficial nor transitory.

Many factors contributed to the early lead taken by the US in software in the '60s and '70s, including leadership in computer technology in general, which in turn was a result of years of R&D investment, funded largely by the Department of Defense. But other countries continued to fall behind well into the '80s. The reason boils down to the different speeds at which various societies can accept certain kinds of change. Since software appeared on the commercial scene 35 years ago, the following cultural characteristics have contributed to its dramatic growth in the US:

- The prestige of programming as a profession has gone from clerk-level to folk hero (like Bill Gates) in 25 years.
- Top engineering talent has been attracted to software development and away from alternative engineering careers.

- Software has been broadly accepted by society as a real product with intrinsic value, rather than something that comes bundled for free with computing hardware, for instance.
- Piracy has dropped to relatively low levels, creating a much larger effective domestic market for software publishers.
- Youthful decision makers are widely accepted as key to software product evolution (vs. strictly seniority-based management structures).
- In Silicon Valley especially, we have created a new style of industrial organization that is highly tuned for succeeding amid the uncertainties that accompany rapid technological change. This industrial structure involves mechanisms for pursuing diverse product and technology strategies, knowing that only a fraction will eventually succeed. The evolution of Silicon Valley's unique style required cultural acceptance of risk-taking and entrepreneurism (vs. working for a big firm), economic incentives for small start-up companies, high-risk (venture) capital markets, extensive corporate partnering, and lower social stigma attached to failure, which is an unavoidable consequence of rapid change.
- The US software industry also developed mechanisms for achieving sensitivity to rapidly-changing market requirements in product definition, including understanding the minimal level of quality that will be tolerated if other market needs are satisfied.

In summary, while there are excellent programmers all over the world, no other country has adapted to the digital revolution and the new field of software engineering as fast as the US has. Since the rate of technology change is still accelerating, this adaptivity will continue to be an advantage. Therefore, while there may be issues in international competitiveness (for example, the quality requirements for the software that is embedded in products compared to other software), we do not expect the US position in the software industry to erode substantially for many years to come.

Avron Barr and Shirley Tessler are consultants to SCIP and co-directors the Software Industry Study. Mr. Barr was an early pioneer of expert systems technology and editor of the four-volume *Handbook of Artificial Intelligence.* He was a founder of Teknowledge and has, since 1981, been a management consultant to advanced software technology companies and their customers. Ms. Tessler is a Wharton MBA and Stanford MS/CS with 15 years' experience in banking and corporate finance. Her expertise is in software startup financing and management. Her current research interests include electronic commerce and electronic communities.

The software industry study team leader is Prof. William Miller, Director of SCIP. Our research assistants are Marisa Quinn and Jim O'Brien.