Software industry

Evolution

- From 1950 the sw industry has evolved to become the 4th largest industrial sector in US economy
- Evolution:
  - In time
  - Sectorization of the industry
    - Software contractors
    - Producers of corporate sw products
    - Makers of mass market sw
  - Products and markets

Time

- Each of the 3 sectors emerged at a moment when contemporary computer technology created a business opportunity for a new mode of software delivery:
  - **Software contracting** ➔ corporate mainframe (mid 50s) - very expensive (range of 1 Million $)
  - **Corporate software products** ➔IBM System/360 computer family (mid 60s) - expensive (range between 5000 to 100.000 $)
  - **Mass market software** ➔ personal computer (mid 70s) -cheap (range between 100 and 500 $)

Software contractors

- Business model: engineering or construction contractor
  - They existed by bidding for and winning contracts executed on a time-material base or a fixed price base
  - Critical capabilities: exploitation of scope, cost estimation, project management
    - Necessary to exploit economies of scope by specializing in particular submarkets
    - Specialized domestic knowledge enabled non US firms to survive
  - Profits low, typically less than 15% of sales

Software contractors

- First very large project: new US Air Defense system
  - Fully deployed in 1962, total cost of software 150 Million $
- By 1960 hardware and software technologies had improved dramatically
  - Possibility for large and medium firms for computer automation of tasks
  - First ones: airline reservations, bank automation, retail systems
  - First classic civilian real-time project was SABRE airline reservation system (IBM for American Airlines)
    - Fully operational in 1964
- Integration of systems

Major players

- Growth from a few at the end of the 50s up to 3000 in 1968
- Startups were established by entrepreneurially minded individuals from the technical computing community who combined the skills of the technical expert and the business promoter
  - A high level of programming competence was necessary for being in the business
- Computer Science Corporation (CSC) has been the most successful of the startups
  - 2000: annual revenues of 9.4 Billion $, nearly 60.000 employees
  - Started as a niche player in systems software (compilers)

Development

- Throughout the 50s programs were perceived as objects without intrinsic value
  - Users got free software from computer manufacturers or they wrote it in house
  - Manufacturers provided standardized sets of tolls: assemblers, programming languages, libraries, I/O control systems, simple operating systems
- The creation of application programs remained a job to the user
- COBOL and FORTRAN simplified the creation of programs allowing transfer of programs development to third parties (software contractors)

Sectors of software industry in the 60s

- Programming services
  - Lowest barriers to entry ⇨ specialized in market niches in which over a few years companies developed capabilities against which it was difficult for newcomers to compete
  - Exploit economies of scope leading to pre-packaged software
- Processing services
  - Perform routine data processing for organizations that did not own a computer
  - Users charged on the basis of machine-time and man-hours consumed
- Facilities management
  - Manage a data processing installation on behalf of the firm that owned it (EDS in 1962)
- Teleprocessing services
  - Activities in which computing was supplied to the user by means of public or private telecom networks
  - Type of activities: routine data processing, database access, machine time for software development

Corporate Software Products

- Until the 1970 IBM and other computer manufacturers provided software free of charge to customers
- 1970 unbundling under Antitrust pressure: IBM charged separately software and services
- ⇨ Establishment of a market for software products
- Business model: producer of capital goods
  - Due to high marketing costs

The rise of software products

- 4 factors in the 60s:
  - Proliferation and growing capabilities of computers
  - Changing balance of hardware and software costs
    - In mid 50s 80% hw, 20% sw while in the 80s we have a 50% share
  - Software crisis
    - Programmers shortage
    - Low productivity of programmers
    - Poor reliability of programs
    - Cost overruns
  - Introduction of a standard platform (IBM System/360)

Corporate software products: business model

- Critical capabilities:
  - Exploitation of scale
    - Selling in volumes was the only way to recover the high initial development costs of a generalized sw product
  - Corporate marketing
    - High importance of volumes ⇨ develop quota-based sales operations
  - Quality assurance
    - Database and industrial programs were usually "mission critical" ⇨ importance of reliability
  - Pre and after sale support
    - Necessary to establish long-term relationship with customers
    - ⇨ Product customization, user training, regular upgrades
    - ⇨ Services turned out to be unexpected sources of income

The '70s

- Unbundling decision of IBM and crash in computer stocks in 1970-71

  At the end of the decade the market for software products was < $2 billion
- 3 major sources of supply of software products:
  - Computer manufacturers
  - Independent software vendors
  - Turnkey suppliers: owed their existence to the convenience of supplying not simply a software product but a bundle of hw components integrated by sw (e.g. Word processing and CAD)

Classification of sw products

- Systems software products
  - Operating systems: OS/360, EXEC-8, Unix
  - Database management systems: IMS, DL/1 (IBM)
  - Teleprocessing monitors: CICS
  - Programming aids: Autoflow
  - Utilities: Syncsort, CA_SORT
- Application software
  - Industry specific: manufacturing systems, banking, insurance
  - Cross-industry: payrolls, general ledger

Operating systems

- Most sophisticated mass-produced software artifacts, both in size and logical complexity
  - Costly to develop and difficult to debug
  - Most OS have evolved over 10,20,30 years constantly growing in functionality and reliability
- Captive operating systems (IBM OS/360)
- Unix: non proprietary OS originated in the 70s at Bell Labs for minicomputers
  - Early 80s available on many platforms coinciding with the technological shift from centralized mainframes to open systems
  - Highly fragmented industry with more than 100 suppliers

The maturing of the corporate sofware industry

- Started at the beginning of the 80s after recovery from stock market collapse in the 70s.
- US leadership
  - Makers of mainframes were also major vendors of software packages for their machines
- The 80s saw the rise of a small number of truly independent global vendors with sales in excess of $1 billion
  - Computer Associates: consolidation (system building) with large portfolios of products for the organization
  - Oracle: relational databases
  - SAP: non US developed thanks to the underdevelopment of Europe in computerization with respect to the US (5 to 10 years)

Mass-market software products

- Began in the late 70s with the establishment of hundreds of very small software firms, almost none of which had any connection with the existing software industry.
  - Microsoft was one of them
- Industry took off in 1979-80, with VisiCalc spreadsheet and Wordstar word processor
- Closely related is the recreational software industry
- Personal computer software industry was completely disjoint from the corporate software products industry
  - Essential difference: size of the market in # of units sold
    - Example 1984: best selling corporate sw 3000 units, best selling PC software 700.000 units sold

Mass-market software products: business model

- Producer of information goods or pharmaceutical industry
  - Similar cost structure based on high R&D, low production costs, high marketing expenses
- Critical capabilities:
  - Exploitation of scale through high volumes
  - Mass marketing
    - Targeted at the end user using low-cost distribution channels
  - Ease of use

Microsoft

- Extraordinarily profitable company, with earnings typically in the range of 30-40% of revenues
- Dominates its sector not through profitability but through its ability to gain market share
  - Since the early 80s the PC software market has been relatively concentrated, between 10 and 20 firms having 80% of the market
    - In 1995 Microsoft reached 50% of the market share
- Aggressive company but benefited of strategic errors and plain old market forces of the competitors
- For most of the 80s it grew on the strength of its MS-DOS OS, which probably generated 40 to 50% of its revenues
- Beginning 90s Microsoft achieved much of its growth by publishing application packages in addition to system's software
- By 1995 the situation in PC software was similar to the 60s computer industry (IBM and the seven dwarfs): Microsoft dominated every market in which it operated: operating systems, programming languages, productivity applications
  - Its competitors survived by operating in markets in which Microsoft did not enter (Autodesk with Autocad, Adobe, Novell, Symantec)
- Microsoft still constitutes about 1/10 of the PC software industry

PC software sector

- PC software sector: **economics of increasing returns**
  - Major PC software firms dominate their individual segments, with 60-70% of the market
- The rise of Windows (at its third release) led Microsoft to dominate the most lucrative segment of the industry: office productivity applications with Word and Excel
  - The competitiors did not have Lotus and Wordperfect for that platform but only for OS/2

Recreational software

- Videogames
  - Similar to the recorded-music and movie industries
  - Most internazionalized sector of the software industry dominated by US and Japan
- CD encyclopedias
  - Intellectual contents and program code for search
- Personal finance software
  - In the early 80s stand alone products
  - Now they include services for on-line payment, on-line home banking and portfolio valuation
- Historical trend for software to become subordinate to the intellectual content or the complementary services offered

Concluding remarks

- No magic formula for creating a successful national software industry
  - Clustering effects (regional and trade)
  - R&D and US government role
  - Manpower training
  - Market size: the most important factor
    - The bigger the market the better the prospect of getting a return in investment