Assessing Intellectual Property

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Intangibles

- Product of knowledge by
- Cost of original >> cost of copies
  1. Books authors
  2. Software programmers
  3. Inventions engineers
  4. Trademarks advertisers
  5. Knowhow managers
  6. Customer Loyalty long-term quality
1. **Intellectual property** refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce [WIPO].
   a. Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source;
   b. Copyright, includes literary, artistic works, focusing on presentation; and software, including transformations of representation.

2. "Workforce in place" has much value but **People cannot** be considered **property** anymore

3. **Goodwill** everthing else – mainly in 

\[ \Sigma^{1-3} = \text{Intangible contribution to corporate value} \]

- **Tangible property** including cash is the rest
IP is the Link to the workforce

To be effective a worker has to know what has to be done

• That knowledge consists of
  ▪ The technology
    o Documentation, prior versions, quality control
  ▪ The business methods
    o How technology in the product is marketed
    o The flow from buyers to improved products and methods

• Companies distinguish themselves by proprietary IP
  1. Patents, sometimes Copyrights
  2. Confidential Documents
  3. Knowledge within its people - protected by NDAs
  4. Software ---> new quantitative model
Magnitude of intangibles

Implicitly estimated by share holders

Example: Value of a company (SAP)

• Largely intangible – like many modern enterprises

1. Market value = share price × no. of shares  €31.5B  100%
2. Bookvalue – sum of all tangible assets  € 6.3B  20%
   Equipment, buildings, cash
3. **Intangible** value per stock market  €25.2B  80%

**Intangible/tangible = 4 x**

- How much of it is software?
1987 Quote

“Some day, on the corporate balance sheet, there will be an entry which reads, ‘Information'; for in most cases the information is more valuable than the hardware which processes it.”

-- Grace Murray Hopper
The inventor of COBOL
Basis for SW value  \( NPV \)

- **Sum of future income**
  - Sales = price * copy count
  - Maintenance fees if service subscription

- **Minus sum of future costs**
  - Cost of goods
  - Cost of marketing
  - Cost of doing business
  - Cost of maintenance

- **Discounted to today**
  - To account for risk
Current State of Valuing SW

• Software producers traditionally care about
  ▪ Cost of writing software
  ▪ Time to complete products
  ▪ Capabilities

• When the value is a concern
  ▪ Business people
  ▪ Economists
  ▪ Lawyers
  ▪ Promoters

inconsistent
Why a Technical Concern

• Making decisions about creative tradeoffs
  ▪ Elegance versus functionality
  ▪ Rapid generation versus maintainability
  ▪ Careful specification versus flexibility

• *Dealing with customers*
  Dijkstra model: *for self-satisfaction*
  Engineering model: *formal process driven*
  Startup model: *see if it sticks to the wall*

• Gain respect: *know what you are doing*
Why an Economic Concern

• Software is the driving force for generating income in many modern enterprises
  ▪ Companies that sell software
  ▪ Companies that sell other stuff on the web
  ▪ Companies that sell financial services
    ▪ There are no real, tangible piles of money there
  ▪ Companies that rely on their supply-chain prowess
  ▪ Multi-nationals that coordinate their operations
Why now

Worrying about economics is a sign of a maturing field:

Phases:

1. Get it to work
2. Getting adequate performance
3. Get it to be sufficiently reliable to be useful
4. Get it into routine production
5. Increase capacity
6. Make it safe
7. Make it affordable
Why me

• Much software is being exported as part of offshoring (offshore outsourcing)
• It is typically property – i.e., protected
• If it is not valued correctly – i.e., too low
  1. Loss of income to the creators in the USA
  2. And loss of taxes to the US treasury
  3. Excessive profits kept external to the USA
  4. Increased motivation for external investment
Software is slithery!

Continuously updated

1. Corrective maintenance
   *bugfixing reduces for good SW*

2. Adaptive maintenance
   *externally mandated*

3. Perfective maintenance
   *satisfy customers' growing expectations*

[IEEE definitions]

Ratios differ in various settings
IP sources

• Corrective maintenance
  ▪ Feedback through error reporting mechanisms
    o Inadequate protection from virus etc.
    o Taking care of missed cases
    o Complete inadequate tables and dimensions

• Adaptive maintenance
  ▪ Staff to monitor externally imposed changes
    o Compliance with new standards
    o Technological advances

• Perfective maintenance
  ▪ Feedback through sales & marketing staff
    o Minor features that cannot be charged for
Effect: SW Growth

Rules:

\[ S_{n+1} = 2 \text{ to } 1.5 \times S_n \text{ per year} \quad \text{[HennesseyP:90]} \]
\[ V_{n+1} \leq 1.30\% \times V_n \quad \text{[Bernstein:03]} \]
\[ V_{n+1} = V_n + V_1 \quad \text{[Roux:97] [earlier indications]} \]

Deletion of prior code = 5% per year \quad \text{[W:04]}
Observations

- Software cannot grow exponentially [e] no Moore's Law

Because
1. Cost of maintaining software grows exponentially with size [Brooks:95]
2. If [e & 1.] would need to hire staff at exponential $e^2$
3. Cannot have large fraction of changes in a version
4. Cannot impose version changes on users < 1 / year
5. Deleting code is risky and of little benefit except in game / embedded code
Price \( \text{remember } IP = f(\text{income}) \)

- **Price stays \( \approx \) fixed over time** like hardware Moore's Law

  Because
  1. Customers expect to pay same for same functionality
  2. Keep new competitors out
  3. Enterprise contracts are set at 15% of base price
  4. Shrink-wrapped versions can be skipped

- **Effect**
  The income per unit of code reduces by \( 1/\text{size} \)
Growth diminishes IP

For constant unit price

Assumptions:
- $IP \approx code\text{size}$
- deletion $\approx code\text{size}$

Note:
- less steep if start with $V > 1$,
  if $V > 2$ obeys rule B
Total income

Total income = price × volume (year of life)
• Hence must estimate volume, lifetime
Best predictors are Previous comparables
  ➢ Erlang curve fitting (m=6 to 20, 12 is typical)
and apply common sense limit = Penetration
  ➢ estimate total possible sales F × #customers
  ➢ above F= 50% monopolistic aberration
Sales curves used
Sales models

1. Normal curve: simple, no defined start point
2. Erlang: realistic, more complex
both have same parameters: mean and variance
Erlang sales curves $m=\text{mean/\text{variance}}$

For 50,000 units over 9 years

Erlang $m = 6$

Erlang $m = 12$

When $Erlang \ m \sim \text{infinite}$

^ 50,000 when

end of time horizon

9 years
Predicted product sales for 5 versions, stable rate of product sales
3 year inter-version interval, first-to-last product 12 years, life ~15 years
Companies that

1. develop & sell software
   • Basis of IP: income from sales
2. purchase & license software for internal use
   • Do not generate IP with software
3. develop software internally for their own use
   • Basis of IP: relative SW expense × all income (Pareto rule)
4. combinations
Income in a software company is used for

• Cost of capital
  ▪ Dividends and interest  typical  ≈ 5%

• Routine operations -- not requiring IP
  ▪ Distribution, administration, management  ≈ 45%

• IP Generating Expenses (IGE)
  ▪ Research and development, i.e., SW  ≈ 25%
  ▪ Advertising and marketing  ≈ 25%

These numbers are available in annual reports or 10Ks
Discounting to NPV

Standard business procedure
• Net present Value (NPV) of
  getting funds 1 year later = F×(1 – discount %)
Standard values are available for many businesses
  based on risk (β) of business, typical 15%
Discounting strongly reduces effect of the far future
  \[ NPV \text{ of } $1.- \text{ in 9 years at 15\% is } $0.28 \]

Also means that bad long-term assumptions have less effect
Example

Software product

- Sells for $500/copy
- Market size 200,000
- Market penetration 25%
  - Expected sales 50,000
  - Expected gross income $25M
### Combining it all

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<th>y3</th>
<th>y4</th>
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Approximately $1 million

October 2006 Gio: Worth & Outsourcing
Result of Example

• Selling 50,000 SW units at $500 ≈ $1M
  not $25M

Once its in a spreadsheet, the effect of the many assumptions made can be checked. When assumptions later prove unwarranted then management can make corrections. To be wise, don't spend more than ≈ $500,000 to develop the software product.
Alternate business model

Consider maintenance and its income

"Service model"

• More assumptions – now include cost
1. Original cost $516,000 (used to estimate 2.)
2. Maintenance cost 15%/year of original cost
3. Maintenance fee 15%/year of original price
4. Lag = Δ (t cost , t income) = 2 years
5. Stop maintenance when cost > income
### Effect of service model

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<tr>
<th>factor</th>
<th>today</th>
<th>y1</th>
<th>y2</th>
<th>y3</th>
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<td>2.0</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td>129</td>
<td>181</td>
<td>232</td>
<td>284</td>
<td>339</td>
<td>387</td>
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<td>77</td>
<td>207</td>
<td>387</td>
<td>619</td>
<td>903</td>
<td>1239</td>
<td>1626 not discounted</td>
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<tr>
<td>Disc.(lag)</td>
<td>0</td>
<td>102</td>
<td>171</td>
<td>239</td>
<td>307</td>
<td>376</td>
<td>444</td>
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<td>240</td>
<td>946</td>
<td>1413</td>
<td>1424</td>
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<td>776</td>
<td>1174</td>
<td>1117</td>
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<td>351</td>
<td>94</td>
<td>-64</td>
<td>32</td>
<td>6</td>
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<tr>
<td>Total</td>
<td>2537</td>
<td>≈ $2.5 million but $1626 for maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

- Assume designed for maintenance
- Good time to quit
- Reduce income 1/3 each year

Cost of maintenance = $1626/(516+1626) = 61% of total
Service model

Analysis shows » profitability in service model

- To achieve such a beneficial model
  1. Management must value maintenance
  2. Marketing and sales must provide feedback
  3. Education and training must recognize the value of maintenance and maintainability

  - Often ignored today
    1. Academics don't teach it (3/850 pages [Pressman:01])
    2. Companies give maintenance tasks to novices
      ➢ Experienced programmers should maintain their work
Offshoring

Outsourcing to Enterprises in Foreign countries

Two aspects:

1. Work migration: jobs are moved to lower-cost countries

2. Support software etc. is moved to enable similar productivity in those countries

• Income is generated by people and (intellectual) capital
Hypothesis

• Offshoring of jobs is effective because of concurrent Intellectual Property (IP) transfer
• Much of that IP is corporate property
• Transfer of corporate IP is poorly understood
  ▪ IP as property is not well defined, hard to measure
  ▪ There are many components to IP, coming from
    o open source, R&D, marketing, reputation as
    o Patents, copyright, trade secret (covered by NDAs)
• But can't ignore IP, it is a valuable, significant export
Types of Foreign Destination Entities

- **Independent Foreign Contractors**
  - IFG may serve multiple customers
    - Share trade secrets with competitors
  - Owners need contracts to protect the IP
    - Hard to monitor and enforce

- **Owned, Controlled Foreign Corporations**
  - CFC provides much more control over IP
  - Ownership often in third-party countries
    - Avoids *taxation* of sales to other countries
Export of (I) Property

- **Tangible**: value based on cost + margin ≈ price

- **Intangible**: value based on income potential, ≠ cost
IP flow with fair return

- Income
- Capital
- US taxes
- Foreign taxes

Balance

IP

Income
IP flow without or poor return

Income  \rightarrow  Capital  \rightarrow  IP  \rightarrow  Income

Capital

US taxes

$  \rightarrow  IMF

Foreign taxes ?
Capital flow with a tax haven

Source → IP → CFH → Income → CFC

Tax havens:
- Vanuatu
- Cayman Islands
- Barbados

Hard to do with a tangible
Capital creates more IP and Income

Capital at Source

Capital in CFC or CFH

Income

Income
**Extreme Case: Inversion**

The foreign subsidiary (CFC or CFH) uses the capital to buy the U.S. Base (USB) company

- CFC creates a second-level subsidiary (CUS) in the U.S.
- CUS merges with USB, considered a (368)(a)(2)(E) reorganization
- USB stockholders trade their shares for CUS shares, may be taxable
- USB is now a subsidiary of FS; and FS is not subject to U.S. tax
- Stockholder value is unchanged, but their control is diminished

- For sales to the U.S., royalty is now due to the IP owner
  - Tax deductible expense
Exports and Transfers go both ways

- There is innovation everywhere
- If the U.S. imports IP, the receiver should pay
  - Basic and fundamental research in the U.S. is declining
    - Growth was motivated by WW II experience [Vannevar Bush]
    - Many countries now fund fundamental research
  - The ratio of applied to basic research is increasing
    - Technological research is rarely Basic
    - Industrial research is mainly Applied
  - Development requires more resources
    - Industrial and management infrastructure
    - Demonstration and Beta (β) sites - early adopters
Problems

• There is a lack of trustworthy data

1. $209M spent [US commerce department, 2003]
   + 4,663 jobs lost [U.S. labor dept, 1Q04]

2. $2,400M income [Business week, in 2003]
   + 50,000 jobs gained [Indian NAS&S Cos, Fy04/4]

• Attitudes are inconsistent

Greenspan 1: IP rights have assumed increasing importance [27Feb03]

Greenspan 2: Our economy is best served by full and vigorous engagement in the global economy – when defending reducing protection [11Mar03]
Convoluting non-owned IP issues

• Education: Services that transmit valuable, but non-
  proprietary knowledge to others.
  ▪ If receiver pays, can take it anywhere
  ▪ If the state pays, can it / should it be reimbursed?

• Publication: IP placed into the public domain
  ▪ Who benefits?
    o The reader gets knowledge / The writer gets fame
    o Society becomes more egalitarian, effective
Future: Outsourcing and IP export

Increasing understanding and accounting for IP exports 
*(making them visible)*

Political concern by populists & traditional conservatives 
*versus* strong lobbyists pressures and neo-conservatives

Taxation of IP exports

- will increase corporate profits in the U.S.
- reduce cash in foreign accounts, more for U.S. investment
- provide taxes that could be used to compensate
  - for R&D support provided by the government
  - for educational costs
  - for retirement benefits of workers whose IP was outsourced
- *Is unlikely to stop offshoring substantially*
- *Amounts would be large in a number of cases*
Related philosophical questions

Happiness or contentment

• Personal benefits of offshoring – short term
  ↑ More cheap stuff  --- a benefit of offshoring
  ↓ Less employment  --- a cost of offshoring

• Global benefits of offshoring -- long term
  ↑ Greater income equality among countries
  ↑ Balancing working conditions within countries

• Can a corporation or government be happy?
  Note that a corporation is legally treated as a person!
Knowing the Worth of Software

• Allows rational design decisions, as
  o Directing development efforts
  o Programming investment for maintenance
  o Understand limit to Software Life

• Allows rational business decisions, as
  o Choice of business model
  o Degree and method of outsourcing
  o Where and when to invest
  o How to assign programming talent

• Improve focus of education in software
  o Consider quality, not just quantity in assignments
  o Effectiveness of curriculum
Doonesbury 1/2

September 21, 2003

HUH?

WHAT HAPPENED?

SPACE FOR LEASE
CALL
(415) 555-1347
ext 217

BERNIE?
HEY, MIKE!
WHAT'S UP?

I'M STANDING
IN FRONT OF
YOUR OFFICE,
AND IT'S VA-
CATED! WHAT'S
GOING ON?

YOU DIDN'T
HEAR? WE
CLOSED
THE FA-
CILITY.
We've outsourced everything off-shore - back office, customer service, even distribution.

My margins are way better now. You might want to consider doing the same thing with your operation.

Um... dunno... it's the way to go. Let's talk about it over lunch. Set it up with my secretary.

Um... um... where is she?

India. Just call the main number.
To illustrate: a Sequence of Hx cases

• Moving from Sales to Transfer of property
  ▪ Country-based vs. Global companies

• Moving from Tangible to Intangible
  ▪ Visible & measurable, barely so, or not at all

• Intangible property with Intangible knowledge
  ▪ Services versus Patents and Trade Secrets

• Outsourcing
  ▪ Work and its enablers: human and intellectual capital

Definitions emerge as we proceed through 10 cases
Case 1: Tangible export only

U.S. Machine tools* producer U

* To simplify: tools are not innovative, could be be built anywhere

- U exports its products to foreign countries
  - Receives payments for those exports
  - Pays taxes on resulting profit

IP Note: U supplies documents for use of the machines. Those documents may be copyrighted. But copyright does not protect intellectual contents, only protects outright copying. Rarely valued.
Case 2: Tangible transfer

Global Machine tools producer G

• Exports machines to G’s CFC factory F, to be used in production of other products at F
  ▪ G receives transfer payments T from F for those exports
  ▪ Must show that the transfer price T is reasonable
    o Should match prices of external sales by G, or by other Co’s
    o Unreasonably low transfer prices imply U.S. tax avoidance and hiding profits at a foreign base.
  ▪ Pays taxes on resulting profit

But it's hard to be profitable without distinguishing abilities: IP
Case 3: Tangible + market value transfer

Renowned r Global Machine tools producer R

Reputation r is due to investment in quality and advertising

- Exports machines to its CSC factory Q

  - Gets higher prices T+ for external sales because of r
  - R receives transfer payments for the internal exports
    - Transfer price includes r when based on its T+ export prices
    - Harder to assess when there are no exports, and other companies in the business have different reputations
    - Reputation r is IP due to marketing & product quality
      - fast effect - long-term effect

  - Pays taxes on resulting profit
Case 4: Intangible export ≈ Case 1

U.S. Software tools creator and producer

• Exports software to foreign countries
  ▪ Receives payments for those exports
  ▪ Pays taxes on resulting profit

• Problem: software is easily copied
  ▪ Protection desired, achieved by combination of
    Only issuing licenses -- avoids property rights issues
    Copyright laws and patents -- requires govmnt cooperation
    Making copying hard -- technology game
    Restricting maintenance -- works for critical packages
Case 5: Intangible transfer \(\approx\) Case 2

**U.S. Software creator and producer with foreign distribution**

- Exports software products to foreign subsidiary, to be marketed and sold there
- Receives transfer payments for those exports
  - Must show that the transfer price is reasonable
    - By comparison with other sales by self, or by other co’s
    - More difficult to assign value than tangibles.
  - Pays taxes on resulting profit
Case 6: Intangible manufacturing

U.S. Software producer with foreign distribution

- Exports software master to its subsidiary, to be copied*, marketed, and sold there

- Receives transfer payments for single export
  - Must show that the transfer price is reasonable
    - One instance allows thousands of sales, generates substantial ongoing income over its lifetime
    - Valuation requires projection of income over life
      - When is income realized? What is the life of the software?.
  - Pays taxes on resulting profit

* equivalent to manufacturing; writing software is considered R&D
Case 7: Intangible transfer, joint creation

Software producer with foreign specialists

- Exports software master to its subsidiary, and adapted, copied, marketed, and maintained there
  - Source of foreign part of knowledge is remote
  - Assume cost of all R&D centrally accounted

- Receives transfer payments for those exports
  - Must show again that the transfer price is reasonable
  - Share R&D cost according to locale of revenue
  - Credit foreign R&D against foreign revenue
  - Pays taxes on U.S. assignable profit of foreign sales
Case 8: Shared intangible creation

Global Software producer "a Knowledge Factory"

- Develops globally, perhaps 24/7
  - Shares all knowledge globally at initiation
  - Assume that cost of all R&D centrally accounted

- Transfer payments should move both ways
  - Must show that the transfer prices are reasonable
    - Use of prior IP accounted for, or Buy-out
    - Allocation? cost, hours?
    - Compute balance
  - Pays taxes on U.S. balance of profit.
Case 9: Extreme offshoring

Company offshores everything

R&D, Production, distribution, service, feedback

• All IP has been exported
  ▪ Value of export is value of entire company, except for tangibles (HQ building, cash, option income)
  ▪ All income is offshore
  ▪ Only profits needed for dividends are repatriated
  ▪ No U.S. taxable income on continuing operations
  ▪ Initial export of IP should be (have been) taxed?
Value of Intellectual Property

Value of IP is sum of future income it generates, reduced to the present

1. If investors determine a Market value
   IP = market value – book value (tangible)
   • Book value: Much detail in corporate reports
   • IP: no information, often $10 \times \text{bookvalue}$

2. Specifics require good predictions
   • Fractions of IP from sources:
     ❖ R&D, personnel know-how, acquisitions, advertising
   • Life of IP