1. Why should software be valued?
2. Open source software. Scope. Theory and reality
4. Market value of software companies.
5. Intellectual capital and property (IP).
6. Life and lag of software innovation.
7. Sales expectations and discounting.
8. The role of patents, copyrights, and trade secrets.
10. Licensing.
11. Separation of use rights from the property itself.
12. Risks when outsourcing and offshoring development.
13. Effects of using taxhavens to house IP.
Review definitions: Intangibles

• Software is an intangible good
  If it is owned it is considered Intangible Property
In a business there are 3 parts that have value
  (Contribute to potential income)
1. **Tangible goods**: buildings, computers, money
2. The **know-how** of management & employees
3. **Intellectual property**: Software, patents, etc.
   2. + 3. make up the **Intangible Capital** of a company.
Basis for SW value as of today

• 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
Direct Valuation

• Value the software specifically by income over its lifetime

• But software is not stable over time: *Slithery*
  ➢ Getting long-term income requires maintenance
  ➢ Maintenance enables long-term income

• Much more so than other intangibles
  ▪ Books, music,

• Similar to some intangibles that contribute to life
  ▪ Costumer loyalty, trademarks
Maintenance is beneficial

Typical Life:
- PCs: 3 years
- cars: 5 years
- software: 12 years
- intangibles: 18 years

Maintenance:
- PCs: 2% / year
- cars: 5% / year
- software: 15% / year
- intangibles: 13.75% / year

Maintenance cost:
- PCs: 6%
- cars: 21%
- software: 80%
- intangibles: most over asset life

Depreciation:
- PCs: 33% / year linear
- cars: 20% / year linear
- software: 8% / year linear
- intangibles: 12% geometric
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

Software is slithery!
IP sources

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

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

• Perfective maintenance
  ➢ Feedback through sales & marketing staff
    ▪ Minor features that cannot be charged for
Technical
Parameters needed

1. **Life** of the IP in the product from that time on
   The interval from completion until little of the original *stuff* is left

2. **Diminution of the IP** over the Life
   A bit like a depreciation schedule, but based on content replacement, until little IP is left. 10% is a reasonable limit.

3. **Lag**, interval from transfer to start of IP diminution
   = the time before an investment earns revenue
   • also called “Gestation Period

4. **Relative allocation**, if there are multiple products contributing to income.
Crucial assumption

• **IP content is proportional to SW size**
  ➢ Not the value, that depends on the income

  └ Pro: Programmers efforts create code
      ▶ An efficient organization will spend money wisely

  └ Counter: not all code contributes equally
      ▶ early code defines the product, is most valuable
      └ new versions are purchased because of new features

• **Arguments balance out**
  ✔ it is the best metric we can obtain
**Maintenance**

→ SW Growth

**Rules:**

\[ S_{n+1} = 2 \text{ to } 1.5 \times S_n \text{ per year} \] [HennesseyP:90]

\[ V_{n+1} \leq 1.30\% \times V_n \] [Bernstein:03]

\[ V_{n+1} = V_n + V_1 \] [Roux:97] ([BeladyL72], [Tamai:92,02] indications) [Blum:98]

Deletion of prior code = 5% per year [W:04]
Observations

• Linear growth has been observed, is reasonable

• Software cannot grow exponentially

Because no Moore's Law

1. Cost of maintaining software grows exponentially with size
   - The number of interactions among code segments grow faster [Brooks:95]

2. Can't afford to hire staff at exponential \(^2\)

3. Cannot have large fraction of changes in a version
   - And get it to be reliable

4. Cannot impose version changes on users < 1 / year

5. Deleting code is risky and of little benefit
   - except in game / embedded code
Price

remember IP = f(income)

• But --- Price stays ≈ 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 $1/\text{size} \rightarrow$
Growth diminishes IP

For constant unit price

Assumptions:
IP ≈ codesize
deletion ≈ codesize

Note:
less steep if start with \( V > 1 \),
if \( V > 2 \) obeys rule B

Unit value

\[ v_1 \]
\[ .75 \times v_1 \]
\[ .50 \times v_1 \]
\[ .25 \times v_1 \]

New code

Years →

Versions →

8-Oct-10

CS207
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 models

1. Normal curve: simple, no defined start point
2. Erlang: realistic, more complex
both have same parameters: mean and variance
Growth and Perception

E-commerce [this slide based on a 2001 CS99/73N class exercise]

- Gartner: 2000 prediction for 2004: 7.3 T$
- Revision: 2001 prediction for 2004: 5.9 T$ drastic loss?

Examples
- Artificial Intelligence
- Databases
- Neural networks
- E-commerce

Perceived growth
Invisible growth
Extrapolated growth
Perceived initial growth
Disappointment
Realistic growth

50 companies, each after 20% of the market

Failures
• Users of the Internet  40% \(\Rightarrow\) 52% of U.S. population
• Growth of Net Sites (now 2.2M public sites with 288M pages)
• Expected growth in E-commerce by Internet users [BW, 6 Sep.1999]

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<th>Segment</th>
<th>1998</th>
<th>1999</th>
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<tr>
<td>books</td>
<td>7.2%</td>
<td>16.0%</td>
</tr>
<tr>
<td>music &amp; video</td>
<td>6.3%</td>
<td>16.4%</td>
</tr>
<tr>
<td>Toys</td>
<td>3.1%</td>
<td>10.3%</td>
</tr>
<tr>
<td>travel</td>
<td>2.6%</td>
<td>4.0%</td>
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<tr>
<td>tickets</td>
<td>1.4%</td>
<td>4.2%</td>
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<tr>
<td>Overall</td>
<td>8.0%</td>
<td>33.0%</td>
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</table>

\[\text{Overall} \Rightarrow 33.0\% = \$9.5\text{Billion}\]

*An unsustainable trend cannot be sustained* [Herbert Stein, Council Econ. Adv, 1974]

\[\Rightarrow \ \text{new services}\]
Sales curves

- Depreciation
- Normal
- Erlang or Weibull

- Sales curves with time, showing cumulative percentage of units sold.
- Key points: Vn, Vn+1, Vn+2

- Graph indicates a decline in sales over time.
- X-axis: years, from 0 to 5
- Y-axis: %, from 0 to 100
For 50,000 units over 9 years

- Erlang $m = 12$
- Erlang $m = 6$
- Flash-in-the-pan
- One-time promotion
- Long-lived single product

When $Erlang\ m \sim \text{infinite}$
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
Fraction of income for SW

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
Recall: Discounting to NPV

Standard business procedure

- Net present Value (NPV) of getting funds 1 year later = $F \times (1 - \text{discount } \%)$

Standard values are available for many businesses based on risk ($\beta$) of business, typical 15%

Discounting strongly reduces effect of the far future

*NPV of $1.-$ 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 units
  - Expected income $500 \times 50 000 = $25M

What is the result?
Combining it all

<table>
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<tr>
<th>factor</th>
<th>today</th>
<th>y1</th>
<th>y2</th>
<th>y3</th>
<th>y4</th>
<th>y5</th>
<th>y6</th>
<th>y7</th>
<th>y8</th>
<th>y9</th>
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<td>6.0</td>
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<td>unit price</td>
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<td>500</td>
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<td>500</td>
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<td>Rel.size</td>
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<td>3.00</td>
<td>3.67</td>
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<td>0.67</td>
<td>1.33</td>
<td>2.00</td>
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<td>0.08</td>
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<td>0.18</td>
<td>0.22</td>
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<td>39%</td>
<td>29%</td>
<td>23%</td>
<td>19%</td>
<td>16%</td>
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<td>3785</td>
<td>5652</td>
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<td>1081</td>
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<td>Due old</td>
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<td>320</td>
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<td>104</td>
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<td>Disct 15%</td>
<td>1.00</td>
<td>0.87</td>
<td>0.76</td>
<td>0.66</td>
<td>0.57</td>
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<tr>
<td>Total</td>
<td>1032</td>
<td>≈ $1 million</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>
• Many parameters used to estimate IP
  - Uncertainty!
  - But better than not knowing what’s going on.

• Many choices now
  a. Technical options
  b. Business options

Interact with each other.