Information Resource Economics

The intersection between Grid Economics and Information Economics

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Outline

- Motivation: what is the issue?
- Background
  - Grid Economics
  - Information Economics
- Information Resources
  - Examples
- Key Features
- Implications for Grids
- Conclusions

Motivation: Observations and Questions

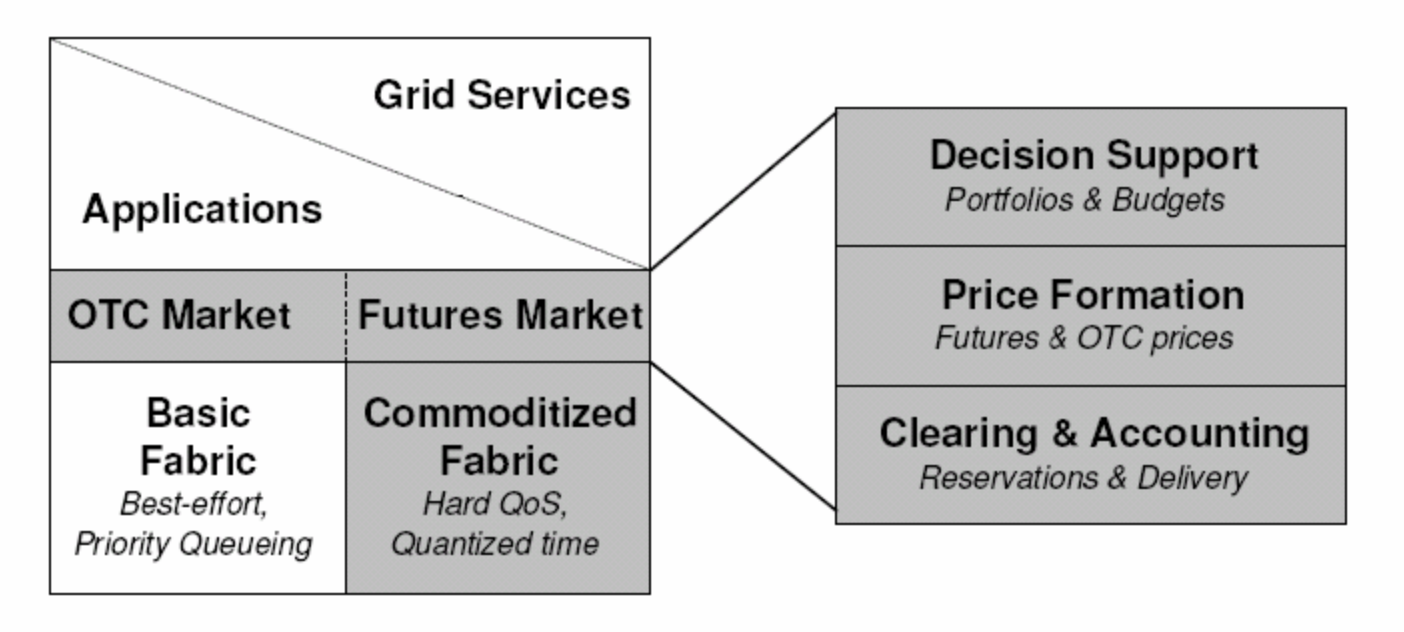
1. Rise of implicit resource monetization on Intranets
   - Most banks have grid-ified computation
   - Outsourced infrastructure is starting to be shared
2. Enormous growth of explicit monetization of the Internet
   - Rent: pay-for-location (many types: virtual; conceptual, physical)
   - Advertisements: pay-by-click, -by-sale
   - Sales: structured-content (structured by DRM)
   - Services: e.g. email, social networking

Mostly cover this …

- ***What characterizes explicit monetization?***
- Is the monetization efficient?
  - Does the implicit or explicit cost/price match the value/cost?
- How can you design for explicit monetization?

… future work

Grid Economics – studies resources



- Grid Economics studies implicit and explicit pricing of resources, i.e. of *non-storable commodities*
  - Computational resources, network resources, and storage
  - Resource capacity not used on a given day is *wasted*
- Several new research programs starting in the area, e.g. GRIDECON in the EU for 2006.

Resources are the capacity to perform or support a service

- Power (computation, electricity)
- Bandwidth (transportation)
- Storage
- Internet location
  - How valuable is the real estate on the front page of Yahoo?
- Geographical location
  - For hotels (temporary accommodation service) the three most important factors are “location, location, and location”.
- Temporal/Functional location
  - *When* and *where* an action is taking place, e.g. shopping on Monday morning or Thursday night, watching the Super Bowl.
- Expertise
  - Human (Cook, Quant, Actor)
  - Software, e.g. ray tracing package (Alias), word processing (Word), database (DB2, Oracle), ERP (SAP).

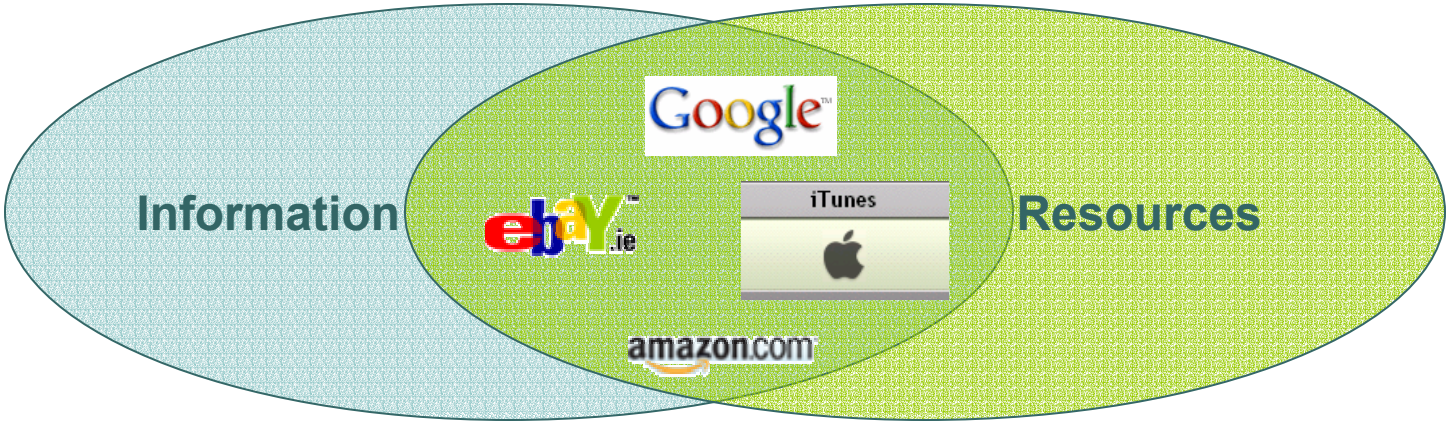
Information Economics – values content

- With competition, and perfect substitutes, price tends to the marginal cost of production of the lowest cost producer $\Rightarrow$ differentiation required for value (price discrimination)

- Digital content $\Rightarrow$ zero marginal cost of production?
  - E.g. MP3 tracks can be copied on a hard disc with little time and effort.
  - Peer-to-peer systems make finding file-names and copying bytes trivial.

- Zero marginal cost of production $\Rightarrow$ zero price?
  - Coca-cola? Sprite? Powerade? Water?
    - Brand creation
  - Fexofenadine (antihistamine, Aventis) 2004 sales $1.87bn
    - Legal defence

A first look at Information Resources



- An ***Information Resource***
  1. has characteristics of **both** information (i.e. content) and resources (i.e. capacity to perform a service)
  2. Loses its value on losing either of its characteristics
- Intuition – this is where the major value creation is taking place on line.
- **Claim:** this is what Amazon, eBay, Google, iTunes, etc. all have in common, i.e. the creation of information resources.
- **Test:** by example and by analysis … verified/falsified?

Mature Information Resources

Candidate Information Resources

Where has value been created?
Where has explicit monetization already occurred?

Search engine (1/2)

- Examples: Ask, (AOL,) Google, MSN Search, Yahoo
- Information: results *for* individual *at* time *about* X
- Resource: search engine
  - Results in user-created/defined web-page or information

- Are the results valuable without the search?
  - No, because cannot connect them to the customer.
- Is the search engine valuable without the information?
  - Great algorithm with 10^5cpus, without data, is worthless.

- Monetization: via: rent, advertisements, of:
  - Conceptual location (e.g. “airline tickets”)
  - Location on page (virtual location)
  - Linked conceptual and physical location, e.g. “restaurant” close to XYZ street

  … *when* individual asks *at* time *about* X

Search engine (2/2)

Duplication (MPC)	Accuracy	Effort	Barrier
Resource (engine)	inexact	Major company, $100M/yr on boxes	Speed of algorithm change
Information (results)	exact	Scales with scope statistics; negative long tail effect	Speed of web change; speed of query change
Detection (discrimination)			
Resource	inexact	Test design	Algorithm based
Information	exact	Trivial	Legal (as a non-lawyer!)

Digression – the Long (Heavy) Tail effect

- If you can reach everyone (*large distribution channel*) then even tiny populations of interest have value.
  - Chris Anderson [2004], Clay Shirky [2003]
- Observed in web-links and in-links to blogs [Shirky, Hammond] (power-law distributions, Pareto, etc.)
  - Amazon: "We sold more books today that didn't sell at all yesterday than we sold today of all the books that did sell yesterday."
  - Wikipedia vs Encyclopedia Britanica – higher demand created by channel + lots of (lower quality) articles.
- Prior to large distribution channels only the mainstream can be catered to, e.g. menus in restaurants.

Websites, blogs, general

- Examples: CNN, Wikipedia, http://www.history.navy.mil/ (Naval History)
- Information: specialist content
- Resource: relative location and virtual location
  - Relative location = position on search results
  - Virtual location = page real estate
- Monetization: via: (sales,) rent, advertisements

- Duplication:
  - Information → snapshots easy, continuing with specialist; difficult with blog
  - Relative location → impossible (requires others to link to it)
- Detection:
  - Exact: trivial with correct search terms
  - Inexact: unknown …
- Barriers
  - Legal for information (N.B. non-lawyer)
  - Freshness of content

Retail web sites: Amazon

- Information: books, consumer electronics, etc.
  reviews, lists, buying patterns
- Resource: database software and order fulfillment
  - Results in user-created/defined web-page or information
- Monetization: via: sales, rent, advertisements
  - Key to value is combination of, e.g., book information with delivery capability.

- Duplication:
  - Information → static content difficult (scale) progressive content (reviews, etc.) also difficult
  - Resource → any major company could create the mechanisms
- Detection:
  - Exact: trivial with same query terms
  - Inexact: unknown …
- Barriers
  - Positive return on scale
  - Brand = reliability, but not major(no evidence of brand after purchase)
  - Legal for freshness and progressive information

Song downloads: iTunes

- Information: songs, music videos, (TV programs, films). reviews, celebrity lists, buying patterns
- Resource: database software, structured-content, legal framework, player, usability
  - Results in user-created/defined web-page or information
- Monetization: via: sales, advertisements
  - Key to value is combination of song information, delivery, and transparency.

- Duplication:
  - Information → static content difficult (scale) additional content (celebrity lists, etc.) possible
  - Resource → major company for database and legal framework, but not usability
- Detection
  - Trivial
- Barriers
  - Positive return on scale
  - Brand = usability, style; major = visible after purchase (iPod)
  - Legal for freshness, minor. Legal for content, minor unless illegal then major.

Candidate Information Resources

Where may value be created?
Where may explicit monetization occur?

Personal and corporate digital storage

- Information: digital life of people and corporations
- Resource: (systems supporting that digital life)
  minor personal networking tools
  start of some search tools (e.g. GDrive, Personal Search)
  - Email starting others tbd.
- Monetization:
  - Starting with GMail for email but undeveloped otherwise

- Duplication:
  - information → static content difficult (scale, privacy), dynamic content difficult
  - resource → ?
- Detection
  - Behind firewalls, difficult to impossible unless advertised explicitly.
- Barriers
  - Positive return on scale … if large scale but long tail may make scale vital.
  - Brand?
  - Legal?

- Direction: synthesis of content (e.g. GMail)

Print books

- Information: contents
- Resource: to be developed
  - Minor for TV guides with coding
  - Some booklist attempts
- Monetization:
  - Very minor after sale – some advertisements
- Duplication:
  - information → static content difficult (copyright)
  - resource → ?
- Detection
  - ?
- Barriers
  - Positive return on reputation/value … if large scale, long tail may make scale vital
  - Series?
  - Legal?

➢ Direction: removal of isolation (RFID, search-in-the-book)

Credit cards

- Information: significant percentage of individual financial life (varies with country)
- Resource: to be developed
  - Minor
- Monetization: (apart from credit cost)
  - Some advertisements

- Duplication:
  - information → impossible due to privacy and proprietary nature.
  - resource → ?
- Detection
  - Highly personal and proprietary data behind firewalls, impossible unless advertised.
- Barriers
  - Privacy.
  - Legal?
  - Acceptance?

➢ Direction: synthesis of information & removal of isolation.

Magazines & Social Networks

- Examples: LinkedIn, AnotherFriend, The Economist
- Information: network
- Resource: operations on networks
  - Network operations developed for social networking software, but little else; tbd for magazine subscriptions
- Monetization:
  - Rent, advertisements, starting but link with content low.

- Duplication:
  - information → difficult, membership based
  - resource → any IT shop
- Detection
  - Trivial to impossible depending on openness and whether the features advertised
- Barriers
  - Privacy
  - Positive returns to scale

➢ Direction: copying social networking onto magazines & removal of isolation

Physical locations

- Examples: stores, roads, etc.
- Information: location sensitive
- Resource: location
- Monetization: depends on services
  - Rent, advertisements

- Duplication:
  - information → ?
  - resource → ?
- Detection
  - Trivial to impossible depending on openness and whether the features advertised
- Barriers
  - Location awareness
  - Legal, ownership of virtual/physical space?
  - Selection = tragedy of the commons
- Direction: GPS in phones (this year), then will take off.

Functional locations

- Examples: shopping on Monday morning, Saturday in the mall
- Information: location/action sensitive
- Resource: location/function
- Monetization: depends on services
  - Sales, rent, advertisements?

- Duplication:
  - information → ?
  - resource → ?
- Detection
  - Trivial to impossible depending on openness and whether the features advertised
- Barriers
  - Acceptance
  - Selection / identity aware
  - Location awareness

➢ Direction: identity management, then via cell phones; RFID management

Example Summary

description	information	resource	monetization and maturity
search engine	search results	results pages	advertising, mature
web-site	local content, links	search engine ranking	sales, advertising, mature
blog	experiences, links	search engine ranking	advertising, mature
books	local content	physical, search engine ranking	sales, advertising, developing
song-, ringtone-downloads	sound	download system	sales, limited advertising, developing
hard-disk drives	local content	personal computer	none as yet, hinted at with Gdrive[Goo06c]
magazine subscriptions	magazine, subscribers	pages	mostly conventional advertising
physical locations	very limited, undeveloped	location	very limited = unexploited
functional locations	limited, undeveloped	location+activity	limited = unexploited

Key Points of Explicit vs Implicit Monetization

1. Information and Resource linked in delivering the service so that margin costs of individual parts do not dominate.
2. Inherently many customers – enables price formation.

- Implicit monetization in Grid can have any number of customers
  - Bank/Pharma Grids – few budget groups but many individual users
  - Resources truly Gridified and invisible at the user level
- Shared outsourced environments – very few customers sharing at any single timepoint
  - Vertical integrated complex services

Implications for Grids

- *Caveat:* proof by example or analogy can always be designed to point in any direction … however.

- Services that are inherently resource or inherently information are more difficult to monetize in the Internet context
- There is a long history of attempts to commercialize Grids.
  - The first working futures market for computational power was 1964 [Sutherland] at MIT.
  - Deep Computing/Sun's N1 Grid/HP's efforts and not obviously dominant in the way that search engines or auctions are.

- Grids may be part of an Information Resource but they are not obviously a killer app, alone.
  - GridASP *is* in the direction of enabling and building in the linkage of resource and information [Itoh et al. GECON06].

Summary & Conclusions

- Introduced the concept of Information-Resources.
- Described successful Internet business models with Information-Resource characteristics.
- Explicit monetization with Information-Resources although mature in some areas has considerable potential.

Thankyou; questions?

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