Profiting from Innovation in the Digital Economy: The Role of Ecosystems & Platforms

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Profiting from Innovation (PFI) Framework

I. Observations:

- Pioneers are often the losers (so much for “first mover advantages”)
- Innovators seem unable to capture much of the rents from innovation (Mansfield Studies: Social returns in order of magnitude greater than private returns)
- It is not only consumers that benefit; competitors (imitators/emulators/complementors) often capture the lions share

D.J. Teece, "Profiting from Technological Innovation," Research Policy 15:6 (December 1986), 285–305.

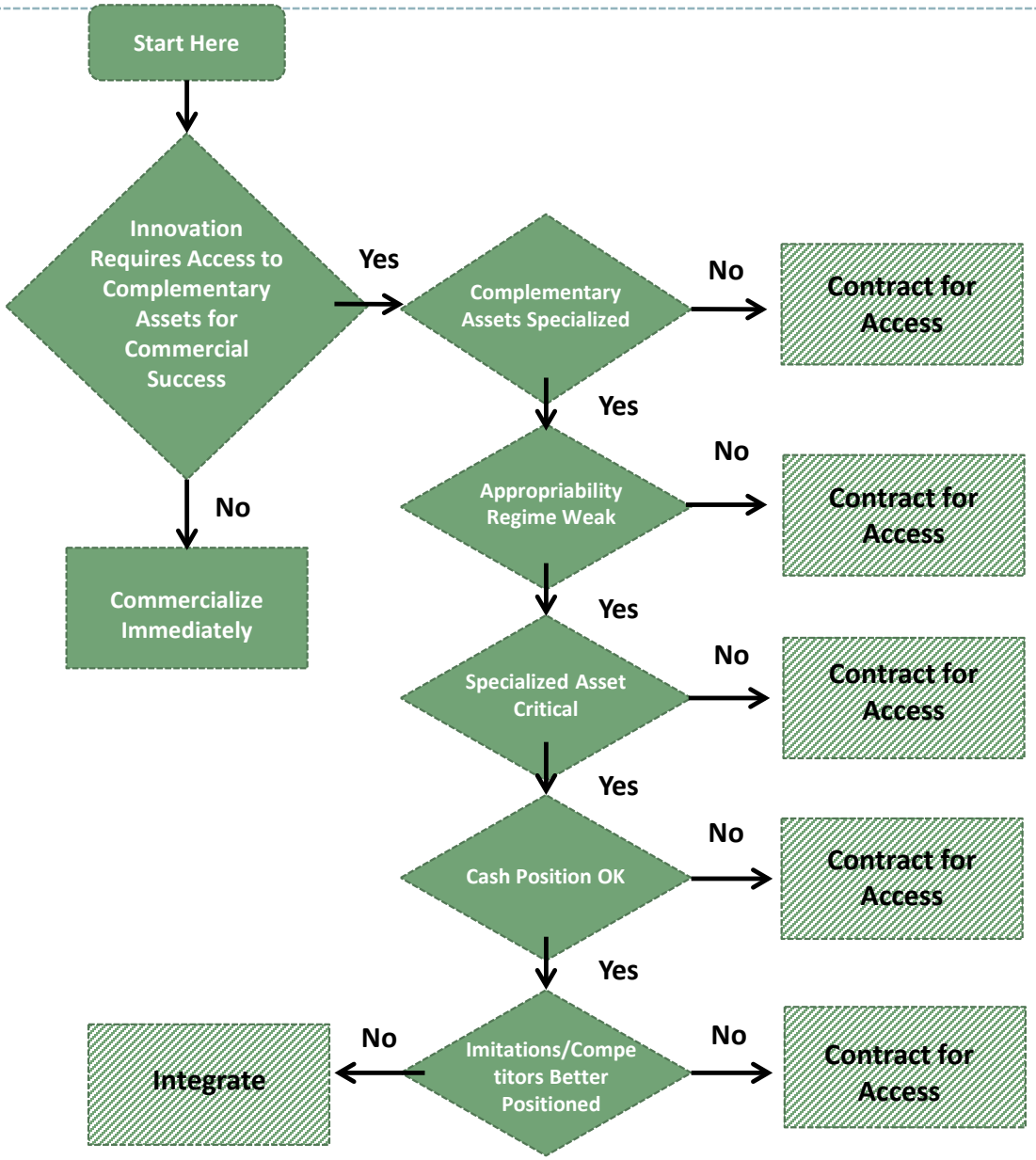
PFI Was Developed to Explain the Distribution of Returns From Innovation

A simple (appreciative) model developed which highlighted:

- Strength of appropriability regime
  - Intellectual property rights
  - Nature of knowledge (difficult to copy?)
- Standards and timing
  - Pre or post dominate design?
  - Does innovator "control" the standard?
  - Is investment strategy consistent with standards evolution?
- Complementary Assets
  - Specialized or co-specialized?
  - Generic?
- Strategy / Business model

Value Capture Strategy

Business model choice (licensing vs. integration) to determine value capture strategy



Contract and integration strategies and outcome for Innovators: Specialized asset case

Strategy / Outcomes	Weak Legal/Technical Appropriability: Innovator Excellently Positioned vs. Imitators w/Respect to Commissioning Complementary Assets	Weak Legal/Technical Appropriability: Innovator Excellently Positioned vs. Imitators w/Respect to Commissioning Complementary Assets
Strong Legal/Technical Appropriability: Innovators & Imitators advantageously positioned vis a vis independent owners of complementary assets	(1) Contract / Innovator will win	(2) Contract / Innovator should win
Strong Legal/Technical Appropriability: Innovators & imitators disadvantageously positioned vis a vis independent owners of complementary assets	(4) Contract if can do so on competitive terms; integrate if necessary / Innovator should win; may have to share profits w/ asset holders	(5) Integrate / Innovator should win

Strategy / Outcomes	Weak Legal/Technical Appropriability: Innovator Excellently Positioned vs. Imitators w/Respect to Commissioning Complementary Assets
Strong Legal/Technical Appropriability: Innovators & Imitators advantageously positioned vis a vis independent owners of complementary assets	(3) Contract / Innovator or imitator will win: owner's won't benefit
Strong Legal/Technical Appropriability: Innovators & imitators disadvantageously positioned vis a vis independent owners of complementary assets	(6) Contract (to limit exposure) / Innovator will probably lose to imitators &/or asset holders

"Reflections on 'Profiting from Innovation,'" Research Policy 35:8 (December 2006), 1131–1146.

The "Reflections" Paper (2006) Added:

- Installed base effects
- Complementary innovations
- Integration strategy recast as business model choice (licensing vs. direct investment)
- Summarized the challenge of PFI as crafting the right business model and identifying and owning (controlling) the "bottleneck" asset (which could change with industry evolution)
- Standards expanded beyond "dominant design" (de facto standard) idea

"Reflections on 'Profiting from Innovation,'" Research Policy 35:8 (December 2006), 1131–1146.

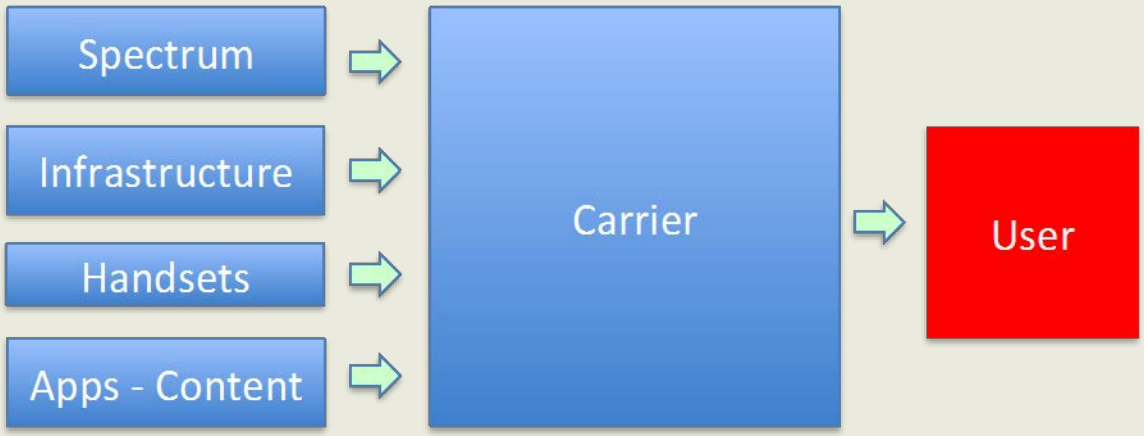
The Goal of the PFI has Always Been to Ask:

1. Where is the bottleneck in the value chain?

2. What is the business model to let the innovator control the bottleneck?

3. Bottlenecks can be proprietary standards, intellectual property, and/or complementary assets

Traditional Market Organization in Mobile Markets: Is There a "Bottleneck"?



Evolving Organizational Structure as Apps Come to Mobile Markets. Has the "Bottleneck" Migrated?

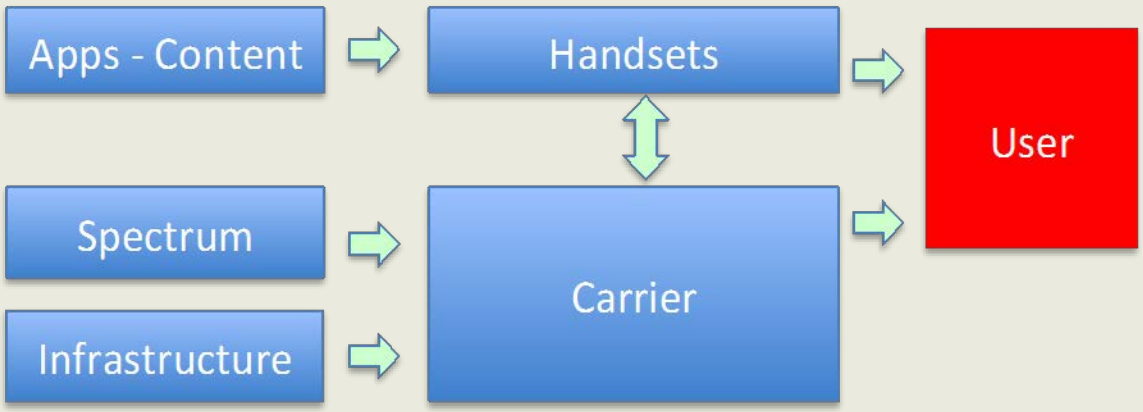


TABLE 1. SELECTED Q RATIOS FOR WIRELESS ECOSYSTEM PLAYERS

Security	2008	1Q2009	2Q2009	Ratio to SP500 (2Q2009)	Enterprise Value ($bil.; 5.4.10)
Sprint	.6	.6	.5	0.68	28.9
Apple	2.6	2.5	3.1	4.25	212.2
RIM	5.0	4.6	6.2	8.49	~38.5
Nokia	1.0	.9	1.2	1.64	~41.5
MOTO	.7	.5	.3	0.41	11.7
QCOM	2.5	2.7	3.2	4.38	50.7
S&P 500	.55	.61	.73	1.0	

Source: Manual of Ideas (Sept. 21, 2009)

2016 Context

Techno-Business Environment Changed since 1986

- Digital convergence
- Internet increasingly pervasive
- Installed base effects and digital platforms ubiquitous
- Multi-invention context more common (100,000+ patents implicated in the iPhone)
- A “grand convergence” may be in process

The “Grand Convergence” is Driven by:

- Digital data and signals, which provide a common (0,1) base for handling diverse types of information, including words, sounds, and images
- Widespread use of common standards, which allows connectivity between diverse information devices
- The advance of enabling technologies, including computers, data storage, batteries, and wireless communications.
- One implication is that access and control of complementary assets may now be more important than installed base/switching cost considerations

New Version of PFI Model

Need more granularity/specificity around:

- Enabling technologies and General Purpose Technologies (GPT)
  - Pervasive
  - High potential
  - Enhance research productivity

GPT's often start out as something less, (e.g. user invented with no initial obvious application)

- Complementarities (Hicks v. Edgeworth v. Hirshleifer, etc.)
- Business Model Design: Depends on "level" in the ecosystem
- Differentiation with respect to standards (standards setting v. standards development)

Enabling Technologies & GP Technologies

Enabling Technologies

An enabling technology is an innovation that can be used to drive radical change in technological capabilities. It allows development of derivative technologies, often in diverse fields. Examples include the printing press, the transistor, and the microprocessor. Enabling technologies were not the focus of PFI, which looked at commercially viable product innovation.

General Purpose Technology* (Bresnahan, Trajtenberg, Lipsey, & Helpman)

Enabling technology is related to general-purpose technology (GPT), a broader category of innovations that have an economy-wide impact. A characteristic of both is that there are large positive spillover effects. Put differently, appropriability is weak for enabling and general-purpose technologies. This implies that society will not produce enough of them, absent government support. Examples include steam engine, the laser, and perhaps the internet itself.

Bresnahan, T., and Trajtenberg, M. 1995. General purpose technologies: 'engines of growth'? *Journal of Econometrics*, 65(1), 83-108.

GPT's Have 3 Characteristics

1. Pervasiveness
2. Potential
3. Enhance Productivity of Complementary Technologies

The salience to PFI of Enabling General Purpose Technologies

- Difficult to design a business model to capture anything but a small sliver of social returns
- Need to engage with partners to develop full potential of the technology (implies rent sacrifice)
- GPT serve to illustrate that business models matter and are inherently limited as value capture structures
- Thomas Edison: usurpation of profits by imitators / pirates are “particularly apt to result in the case of some extraordinary patent”*

*Quote attributed to Edison by his biographer, Remsen Crawford

Heterogeneity with respect to Complements and Complementary Assets

"The time is ripe for a fresh, modern look at the concept of complementarity … the last word has not yet been said on this ancient preoccupation of literary and mathematical economists. The simplest things are often the most complicated to understand fully."

(Samuelson, 1974, p.1255)

Type	Representative Authors	Description
Production	Hicks	A decrease in price of X leads to an increase in the quantity of Y
Consumption	Edgeworth	An increase in the quantity demanded of X leads to increased demand for Y
Asset Price	Hirshleifer	Financial arbitrage opportunities are created by foreknowledge of the probable impact of an innovation.
Input Oligopoly	Cournot	Inputs X and Y will be sold for less if the companies can collude to maximize profits.
Technological	Teece	Unlocking the full value of an innovation requires additional innovation in one or more complements.
Innovational	Bresnahan & Trajtenberg	Improvements in one good increase the productivity of goods in other sectors.

PFI Implications for Each Type of Complement are Different

- Technological complements are critical; Schumpeter saw innovation coming from “new combinations”, and he was right
- Competence destroying and competency enhancing innovation (Tushman) can be understood in part as Hirshleifer type complementarity
- Neither Edgeworth nor Cournot’s complementarity are central to the PFI story.
- The requirement to access multiple complements to commercialize a technology across downstream applications inherently constrains the upstream inventors ability to capture value (this was ignored by both Teece ‘86 and Levin et al ‘87)

Standards & Platforms

Platforms can be defined as:

> "Evolving ... meta-organizations that: (1) federate and coordinate constitutive agents who can innovate and compete; (2) create value by generating and harnessing economies of scope in supply or/and in demand; and (3) entail a modular technological architecture composed of a core and a periphery."

Gawer, A. Bridging differing perspectives on technological platforms: toward an integrative framework". Research Policy, 43(7), p.1240, (2014).

Standards, Complements and Coevolution

Standards: Often necessary for complements to work together

Complements: Significance lies not just with business model dimensions; without the entrepreneur assembling complements, innovation often simply won't happen; and other times complements augment the value of an innovation

Co-evolution: With the introduction of the time element, co-evolution becomes important

More on Standards

	Industrial Economy Notion	Knowledge Economy Notion
	STANDARD SETTING ORGANIZATION (e.g. SAE)	STANDARDS DEVELOPMENT ORGANIZATION (e.g. IEEE/ETSI)
Compatibility Issues Implicated	Yes	Yes
New Technology embedded in Standards	No	Yes

Standard Setting v. Standards Development

	Industrial Economy Notion STANDARD SETTING ORGANIZATION (e.g. SAE)	Knowledge Economy Notion STANDARDS DEVELOPMENT ORGANIZATION (e.g. IEEE/ETSI)
Compatibility Issues Implicated	Yes	Yes
New Technology embedded in Standards	No	Yes

Two Paradigms of Standards Activities

	Standard Setting Organization(SSO) (Model One)	Standard Development Organization (SDO) (Model Two)
Process	Selection amongst known alternatives offered by contributors; choices serendipitous… no clear winner	New technologies developed, often at great expense to contributors. Standard adopted because it's of superior performance
Outcomes	Uniformity, compatibility	Innovation, uniformity, compatibility
Pricing	Usually zero (patents & trade secrets only rarely implicated)	FRAND (fair, reasonable and non-discriminatory)
Examples	Left- v Right-hand drive autos, SAE component; British v American electrical outlets	3G, 4G, LTE; 802.11 wi-fi (IEEE, ETSI)

The Salience of Ecosystems: The Right Unit of Analysis for PFI is the Ecosystem

- For the most part, the same considerations apply at the regional ecosystem and national levels.
- Intellectual property rights, standards, market timing, imitability, and complementary assets are still relevant, although each factor operates somewhat differently. The most interesting observation is that the complementarity of assets and technologies becomes even more salient
- Ecosystem success depends on complementary activities and virtuous circles (for example, digital content, digital rights management, and smartphones);
- Ecosystems can be proprietary or open (e.g., LTE versus Bluetooth)
- Edgeworth complements and Cournot complements are largely irrelevant to the innovation context. Systems integration is one point where information sharing can occur without collusion on price.
- The mobile telephone case show that profits can be earned in different ways and at different levels of the ecosystem.
- Ecosystem health requires that continued development of enabling technology gets supported.
- The social returns to enabling technology in an ecosystem context are likely much greater than the private returns—even more so than for a discrete product.

The Salience of Ecosystems, Cont'd.

- A general theory of PFI needs to grapple with innovation at five levels:
  - individual firm
  - City
  - Regional system of innovation
  - National system of innovation
  - International (global) system of innovation

Implications

- Digital Standards enable the value of complements to be easily tapped through connectivity
- Complementary assets and complementary technologies are more significant than ever in a world of competing and intersecting platforms (Evans and Gawer, 2016)
- Complementary asset ownership/control generally more important than installed base effects
- Multi-invention contexts, in which individual products draw on multiple internal and external sources of technology (patented and unpatented), are pervasive (Somaya, Teece, and Wakeman, 2011) and a further testament to the importance of complements
- Business model choices for a new innovation, even with reference just to appropriability, are more complex than the original "licensing versus in-house production" appropriability model (Teece, 2010; Zott et al., 2011).
- Enabling and GPT technology goes under-rewarded because of inherent limitations in licensing as a business model
- Business ecosystems are increasingly the relevant competitive units and drive firm-level profits;

Conclusions

- Enabling technology/GPT raise very challenging PFI/Appropriability issues
- SSO's/SDO's play critical roles in innovation and raise PFI/Appropriability issues
- Ecosystem success requires managing both standards and complements
- Profiting from innovation is challenging: public policy should facilitate it, and do so most aggressively for enabling technologies/GPTS