Technology Commercialization: Cooperative versus Competitive Strategies

Chapter 8 Teaching Note

This chapter presents a framework for evaluating commercialization strategies available to start-up innovators operating in high technology industries. The authors draw on a stream of research by Gans, Hsu, and Stern, which shows that whether firms commercialize their inventions by entering existing product markets in competition with incumbent firms or take what is called a cooperative approach, forming some type of alliance varies significantly across industries and inventions (Gans et al 2002; Gans and Stern 2003).

The chapter first describes the options available to an innovator and explains how the attractiveness of alliances versus competition is affected by three factors: intellectual property rights’ (IPR) strength; requisite complementary assets; and licensing/alliance transaction costs. As explained, the attractiveness of alliances as compared to product market competition increases both with the strength of the innovator’s IPR position and the cost of acquiring the needed complementary assets. The four distinct commercialization environments defined by these factors are related to the likelihood an innovator will commercialize an invention through cooperation or competition. The chapter then applies the framework to five case studies of start-up innovators in Georgia Tech’s business incubator.

Teaching Purposes
The chapter was designed as part of the strategy module of the first year TI:GER® curriculum, but it can also serve as a stand-alone chapter for use in any technology entrepreneurship course. It also works well as background reading for executive style classes for either entrepreneurs interested in commercializing their inventions or managers of high tech startup companies.

As with all of the chapters in the TI:GER volume, the purpose is to distill results from recent research on technology entrepreneurship in a way that is accessible to different audiences, including students from various scientific and engineering disciplines, as well as law and business students. The chapter has two main teaching objectives focused on alliances versus competition as commercialization choices, how IPR and needed complementary assets affect this choice, as well as how this varies across industry sectors and over time. The material can be covered either in two classes or a single 150 minute session (which includes a 10 minute break).

Objective 1: How does a firm that has an invention with commercial potential decide the best route to commercialization? The firm can choose to develop, manufacture, and market a product based on the invention, or it can choose to form some type of alliance (such as a license or joint venture) with an incumbent firm. The chapter explains why the

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attractiveness of alliances, as compared to product market competition, depends on the
strength of the firm’s IPR position, the cost of acquiring complementary assets, and the
cost of negotiating an alliance. These factors define four distinct commercialization
environments described in the chapter.

**Objective 2:** *The nature of competition in markets for new technologies is dynamic,*
*varying significantly by industry and over time.* It is quite common to see the use of
alliances in commercial development of biotechnology inventions but direct market
competition of new and incumbent firms in the information technology (IT) sector is
common. The chapter explores the reasons for this in terms of the effectiveness of legal
versus business strategies to protect IPR across these industries. The dynamic nature of
competition in all industries is driven home by the discussion of five startup case studies
of firms in the Georgia Tech incubator. These cases illustrate the point that appropriate
strategy changes over time.

**Recommended Student Readings**
This chapter can be successfully used without any additional reading. If, however, you
want to provide students with more in-depth material, the following papers should be
considered. Gans and Stern (2003a) provides a nontechnical explanation of the four
commercialization environments, while the other two papers provide more advanced
material. Gans *et al.* (2002) presents empirical evidence on the extent to which startup
innovators employ different strategies and Hsu (2006) explores the implications for
venture capital funding.

Commercialization Strategies for Technology Entrepreneurs. *Research Policy* 32, 333-
350.

working paper (NBER Working Paper 7851) reports results in more detail.


When the chapter is used for a stand-alone class on technology entrepreneurship, it would
be useful to assign one or both of the following papers. Cohen *et al.* (2000) provides the
needed background for students to understand that simply counting patents does not
properly reflect the strength of IPR. However, I do not assign the article since it was
required reading during the prior semester in TI:GER. Dechenaux *et al.* (2008) provides a
rich background for understanding different mechanisms for appropriating returns in the
context of university inventions.

Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not).*
Unpublished manuscript.

**Recommended Assignment Questions:**
1) What are the three major considerations for commercialization strategies and how does each of these impact your team's commercialization path?
2) Describe the difference between 'Attacker's Advantage' and 'Ideas Factory' and provide examples of industries which would fit into each of these environments. Include an explanation of why your examples apply in those spaces.
3) In which quadrant would you most likely place your team's technology? Discuss why you selected that quadrant. (Refer to Gans & Stern (2003) for a more in depth description of the quadrants).

**Teaching Plan**
I teach this topic in two 60-70 minute segments. The class progresses through 4 main blocks, which loosely reflect the major chapter sections: strategies for technology entrepreneurs, commercialization environments and the likelihood of competition and cooperation in these environments, the variation in strategies by industry, and the dynamic and endogenous nature of commercialization environments.

**Block 1. Strategies for Technology Entrepreneurs (15-20 minutes)**
*Objective:* Provide a framework of evaluating start-up innovator strategies.

This block can be done several different ways. In line with typical business case methods, one could develop this block by asking the students to mention the options that were considered by the companies in the chapter cases. I take a different approach in the TI:GER class in large part because I want the students to come away with a more analytical basis for thinking about strategies.

I start with a lecture-discussion format in which I introduce the ways in which start-up innovators can capture value from their inventions. They can choose to compete with incumbent firms by developing, manufacturing, and marketing a product based on the invention. As considered in some of the chapter cases, if they take this route they may find it desirable to choose a niche market to enter rather than competing with incumbents head to head. Alternatively an innovator can choose to form some type of alliance with an incumbent firm. Alliances can be as simple as a license to the incumbent to manufacture and sell the product, or it could involve a joint venture in which the entrant continues research and development of the invention and the incumbent takes over manufacturing or marketing. All of these choices involve some type of cooperation. Again to draw out discussion, students can be encouraged to give examples from the chapter cases.

I then present Figure 1 from the chapter (Exhibit 1) which is adapted from the Gans et al. (2002) formal model of a start-up innovator’s problem when the desired market has one incumbent firm. One reason to discuss strategy in terms of this model is that later in the finance section of the TI:GER curriculum, the students need to understand decision trees. The three important points to drive home in this block are the affect of IPR strength, transactions cost, and the cost of downstream complementary assets on the merits of
competing versus some form of cooperation. Notice that this framework further refines the framework used in Chapter 1 on appropriating returns to innovation.

One of the first things evident from the Figure is that whether an innovating firm chooses competition or cooperation, it risks imitation by incumbents. If it tries to ally with an incumbent it has to disclose the invention to the potential partner, who may then expropriate the invention. If it tries to compete in the product market it risks imitation if the incumbent successfully reverse engineers the product. This explains one reason that the strength of IPR is important for determining the returns to commercialization. A high probability of successfully enforcing IPR increases the innovating firm’s expected profits regardless of whether the firm competes or cooperates. The important point to drive home, however, is that depending on the form of IPR, stronger rights will have other effects than simply raising the likelihood of successful enforcement in the courts. Clear legal rights to the invention are likely to reduce the transactions costs in negotiating an alliance. In addition, strong IPR reduces the threat of expropriation during the negotiation process since the entrant’s expected profit from competing is higher. This is likely to increase the share of monopoly profits the incumbent is willing to give the entrant in an alliance. Thus, stronger IPR raises the relative returns to cooperation.

The other two points are more straightforward. If the entrant chooses cooperation, it bears transactions costs, which as just noted, may be correlated with the clarity of property rights, but they also reflect uncertainty as to the value of the invention. This is important for most of the technologies considered by the TI:GER teams. Regardless, a decrease in the transactions costs of negotiation increases the attraction of cooperation and has no effect on the expected returns to competition. In contrast, an increase in either the importance of complementary assets or the cost of acquiring these assets increases the expected returns from competition but does not affect the returns to cooperation.

**Block 2. Commercialization Environments and Strategies (15-20 minutes)**

**Objectives:**

(a) Characterize the four commercialization environments defined by IPR and complementary assets.

(b) Compare the likelihood of cooperation and competition in the four environments.

The main contribution of Gans and Stern (2003) is a four quadrant rubric, which defines four distinct commercialization environments represented in Figure 2 (Exhibit 2). These environments are framed in terms of two axes, the strength of IPR and the importance or cost of acquiring complementary assets.

In the lower left hand quadrant, the “Attacker’s Advantage,” IPR and complementary assets are both considered weak. This occurs when legal means for protecting the entrant’s IPR are either unavailable or considered ineffective, and the lack of complementary assets is not an impediment to entry. The name “Attackers Advantage” comes from the fact that in this quadrant technological competition determines competitive advantage and that advantage is often short lived as new entrants continually threaten leadership positions. It is also important to emphasize that in this environment, opportunities for contracting are limited. In addition, the relative benefits to new entrants
from contracting with market leaders are few, and the entrant can gain an advantage by entering niche markets that are currently underserved by the leaders.

This environment is quite different from the upper right-hand quadrant, the “Ideas Factory,” which is defined by both strong IPR and complementary assets that are costly to acquire and essential to product market entry. In this environment, contracting with established firms that control these assets has a substantial benefit. Moreover, formal mechanisms for protecting IPR are relatively effective so that the risk of expropriation discussed earlier is relatively low. In this environment cooperation is the most effective strategy, and the returns to the entrant are determined in large part by its bargaining position.

In these two environments, the message for strategy is clear because the strength of IPR and complementary asset position both indicate the same strategy. The message is less clear in the two remaining environments, in which the strength of IPR and complementary assets by themselves point to different strategies.

“Reputation-Based Ideas Trading” is defined by weak IPR and an environment in which complementary assets determine the ability to succeed in the product market. In this environment, the entrant receives clear benefits from an alliance because complementary assets are important and costly to acquire. Thus, it is difficult for start-ups to overturn incumbent firms’ market position, which of course weakens the incentives for incumbents to form alliances. Finally, “Greenfield Competition” is defined by strong IPR and an environment in which complementary assets do not preclude market entry. Cooperative and competitive strategies both make sense in this environment. The entrant faces a relatively low risk of expropriation in approaching incumbent firms, but it is also feasible for the entrant to acquire the complementary assets needed to enter the product market. Entrants in this environment continually threaten incumbents because turning technological innovations into effective products, rather than competencies per se, largely determine firm performance.

The logic developed in Block 1 combined with this discussion naturally leads to a discussion of the empirical results found in Gans et al.’s (2002) study of 118 start-up companies. For this sample, the probability of cooperation for firms in the Attacker’s Advantage was .143 while it was .56 for firms in the Ideas Factory. Results were much more mixed in the others (around .3). In the discussion it is important to point out that several measures of IPR strength were used in addition to simple patent counts.

Block 3. Variation in Strategies Across Industries (20-30 minutes)

Objectives:
(a) Point out the variation in common strategies across industries.
(b) Highlight differences in the effectiveness of legal IPR protection across industries.

One way to develop this topic is to lead a discussion of the case studies in the chapter. Indeed the reason for covering firms in the biomedical arena as well as those with electronics and software applications was to highlight industry differences, both in the need for downstream complementary assets and effectiveness of formal IPR protection.
However, for the TI:GER students, particularly since the application of the Gans and Stern rubric is fully described in the chapter, it is much more useful to develop this block around the TI:GER team technologies.

We typically ask the students to answer the assigned discussion questions in writing, so they should be prepared to discuss their team’s technology in terms of the four quadrants. Because the students answer these questions individually rather than as a team, I give them 5 minutes to discuss their answer as a team. Then each team is asked to briefly describe the technology, its application, and where they would place it in Figure 2. Depending on the year, we have between 7 and 9 teams in the class so this discussion can be quite lengthy.

As one would expect, the biotechnology teams tend to place their technologies in the “Ideas Factory” or “Greenfield Competition, and the IT related technologies tend to be placed in the “Attackers Advantage” or “Reputation Based Ideas Trading.” Often the technologies can be considered platform technologies, so that the teams will have thought of a variety of potential applications. Depending on the application they discuss, they may place their invention in different quadrants. As well, for applications sold directly to labs or to businesses, they may have relatively low costs of complementary assets as opposed to direct customer applications. The teams also usually bring up questions as to how to evaluate the strength of their IPR. As is the case for the chapter cases, many of our teams are working with inventions that are patentable, and may already have patent applications. All of the companies covered in the chapter cases had one or more patent applications or patents awarded. For those in electronics related industries, however, notice that the IPR strength was considered relatively low. This is in contrast to the two medical related ventures, BioWound and MedJoint.

If this chapter is used for a stand-alone class, this block will take longer than 20-30 minutes because it will be important to first cover the material in Cohen et al. (2000). Figures 3 and 4 of the chapter are useful exhibits if that material is covered in depth. The teaching note for Chapter 1 also provides useful material if more in-depth IPR coverage is needed. For the TI:GER classes, however, we do not review the relative effectiveness of patents, secrecy, lead time, or learning in different industries.

Block 4. The Dynamic and Endogenous Nature of Commercialization Environments (40-60 minutes)
Objectives:
(a) Commercialization environments are dynamic.
(b) IPR and complementary asset positions are not exogenous to the firm.

Section 5 of the chapter develops these two points through the five case studies. Not only do the firms discussed vary by technology types, but these firms also considered different strategies at various points in time. Some of their choices were consistent with the Gans and Stern rubric, while others were not. For example, BioWound and MedJoint were both in situations with a high value for complementary assets, but one originally followed a cooperative strategy and the other competition. SensorTech originally decided to compete but later switched to a more cooperative strategy, selling to OEMs. For all of the cases except MedJoint, the strategy changed as the firm learned from its environment. For
example, BioWound went from wanting to cooperate to competing once it realized market entry in a niche UK market could lower its cost of direct market entry.

As with Block 3, this block could be covered with a discussion on the cases. We append as Exhibit 3 the slides that I have used when taking that approach.

We have found it quite effective to invite one of the principals of the firms covered in the chapter to visit the class. For two years, the CTO of MedJoint has conducted this portion of the class (one of our more popular classes). This case is very interesting because in the chapter, this was the only company that had not changed its strategy over time. The cases were written in December 2006. Since that time, however, MedJoint formed an alliance, as would have been prescribed by the Gans and Stern framework. In addition, as MedJoint hired more personnel with experience in the industry, they became better positioned to compete and within the last year the firm negotiated to dissolve the alliance. Thus, the “live” discussion is ideal for meeting the objectives.
Imitation by disclosure

- Yes
- No

(I -pe)

π coop(pe, c)

"Cooperate"

Imitation by reverse engineering

- Yes
- No

(I -pr)

π comp(pr, θ, K, Δ)

"Compete"

Enforces IPR

Successful

θ

π coop(p_u, θ, c)

Not Successful

1 - θ

π coop(p_u, θ, c, Δ)

Enforces IPR

Successful

θ

π comp(p_r, θ, K)

Not Successful

1 - θ

π comp(p_r, θ, K, Δ)

Start up choice = dark circle
Incumbent choice = hollow circle

Source: Adapted from Gans, Hsu, Stern, *Rand Journal of Economics, 2002*
Figure 2: Commercialization Environments

<table>
<thead>
<tr>
<th>Excludable Technology</th>
<th>Incumbent Complementary Assets Add Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Greenfield Competition</td>
<td>Reputation Based Ideas Trading</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Attacker's Advantage</td>
<td>Yes</td>
</tr>
<tr>
<td>IDEAS Factory</td>
<td></td>
</tr>
</tbody>
</table>

Source: Gans & Stern, Research Policy, 2003
BIOWOUND

- Company formed in 2000
  - CEO background in tissue engineering research and healthcare
  - No full time employees until 2005
  - Raised $6m in seed funds and $5m in series A VC
  - 10 employees in 2006

- Technology
  - Low level electrical impulses in diagnostic and therapeutic chronic wound care
  - Beta trials
  - Closest existing solution a large vacuum pump for hospital use only

BIOWOUND (cont)

- IPR
  - 3 patent applications
  - Prepared by premier firm
  - Only asset so reviewed by their VC backers

- Complementary Assets
  - 12 B$ market worldwide
  - Kinetic Concepts Inc incumbent since 1976
  - Experienced in clinical trial process
  - US market requires 510 (K) approval
BIOWOUND (cont)

- Initial Strategy (business plan)
  - Licensing not possible without proven technology
  - Sell through distributor

- Strategy at the end 2006
  - Direct customer sales in UK
  - Easier regulatory approval outside US
  - Shortens FDA process after UK experience
  - Niche market-600 tissue viability nurses
  - IPR better than China and India

Startup Examples
Changes from Founding

MedJoint (Med) started with a plan to go to market independently with significant VC funding. Now they are actively comparing VC term sheets with some strategic alliance alternatives. The VC funding would yield a compete strategy while the alliances would be cooperating for FDA and marketing with existing firms.

BioWound (Bio) started with a plan to sell through an existing distribution system in a large market. Now they are targeted on tissue viability nurses in the U.K. and can service that space with a direct sales force. They view it as vital to control the message and have sales folks out there with ‘skin in the game’.

SyncUp (Sync) started Biz Plan thinking they could heavily influence nascent market therefore low CAs. But some delays in getting to market and perhaps misread the IT environment, now finding specs are already written for newly established patches, not sure they can still play in this market and thinking of moving technology to a different application

Overview (Over) started business planning to cooperate with big accounting firms but found they needed to establish some beach head customers before they could get attention of the large firms. Today they are independently selling their auditing solution but would still like to partner with a KPMG type firm down the road.
SensorTech (Sen) started with a plan to make sensor products independently and found the distribution channel was a huge (i.e. expensive and captured) hurdle. Now they are integrating their position sensors into OEM products. They are cooperating and have tied into a different stage of the value chain.

**MEDJOINT** (cont)

- **IPR**
  - University with base material patent exclusive license to firm
  - Patent applications for modification for knees and other joints
  - Patents in process for proprietary instrumentation
  - Patent applications for alloy use in ankle

- **Complementary Assets**
  - Medical device industry dominated by big players
  - Orthofix founded in 1980 is dominant in orthopaedics
  - FDA approval and distribution an issue

**MEDJOINT** (cont)

- **Initial Strategy**
  - Attempt to ally with Orthofix not successful

- **Current Strategic Choice**
  - Compete by obtaining VC funds to go through FDA and distribution
  - Ally with other partners for FDA and distribution by selling devices to them
MEDJOINT

• Company formed in 2005
  – Team of 7 (ME faculty, students, MDs, Sr Exec)
  – CEO with bus and sci background
  – 1$m in grants by 2006 and 7 employees
  – Expects FDA process complete in 2-3 yrs

• Technology
  – Shape memory polymer
  – Product for knee surgery—eliminate threaded screws
  – Alloy based produce for soft tissue damage in ankle
    • Maintains elasticity give compression during healing

Startup Examples
Changes from Founding
SENSORTECH

- Company formed in 2004
  - Team of 3 (ME PhD student, 2 MBA students)
  - End of 2006 3 employees

- Technology
  - Position sensing method using a resistive coating on exterior of cylinder to connect to a probe inside the sensor
  - Sensing capability inherent in the cylinder itself

SENSORTECH (cont)

- IPR
  - University patent application for core technology
  - Other patent applications on developments made by the firm
  - Believe they will have a strong IP position

- Complementary Assets
  - MTS, Renishaw, and Kavlico are well established in the fluid power industry where precision sensing is critical for effective automation
  - Four incumbent technologies this technology can be used with

SENSORTECH(cont)

- Initial Strategy (business plan)
  - Compete in the sensor market with own product

- Strategy at the end 2006
  - Producing customized solutions for OEMs
  - Charge for upfront engineering with subsequent sale of the solution to the OEM
  - Core electronics will be manufactured in China
  - For other applications, licensing may be an option
SENSTORTECH (cont)

- **Initial Strategy (business plan)**
  - Compete in the sensor market with own product

- **Strategy at the end 2006**
  - Producing customized solutions for OEMs
  - Charge for upfront engineering with subsequent sale of the solution to the OEM
  - Core electronics will be manufactured in China
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**Startup Examples**

**Changes from Founding**

![Graph showing changes in IPR Appropriability and Downstream Complementary Assets over two years. The graph indicates a shift from a more competitive stance to a more cooperative one over time. Compete is represented by a blue triangle, and Cooperate is represented by a yellow circle.](image-url)
SYNCUP

• Company formed in 2004
  – Team of 2 (ECE faculty and grad student)
  – Business partner in 2005
  – End of 2006 4 employees and 3 contractors
  – $2.5m of funding in 2005

• Technology
  – Novel approach to multi-pathing with use in optimizing wide-area networks (WAN)
  – System has been beta tested of system

SYNCUP (cont)

• IPR
  – 2 university patent applications for core technology
  – Firm has exclusive license
  – 51 claims in basic patent
  – 10 other patent applications by the firm

• Complementary Assets
  – Competition mainly small firms with patches
  – Incumbents have attention of IT community in RFPs for improving network performance piecemeal
  – Problem similar to inertia in markets where standards are important
Startup Examples
Changes from Founding

Startup Examples
(Business Plan)

Startup Examples
(2007 Plan)

Chapter 8 − Marie Thursby