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ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION AND ECONOMIC GROWTH **VOLUME 16**

UNIVERSITY ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER: PROCESS, DESIGN, AND INTELLECTUAL PROPERTY

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GARY D. LIBECAP
The University of Arizona, USA

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prior to distributing these revenues among the innovators and university units. The URC proposes likewise that Carnegie Mellon should set aside a fraction of the university's proceeds from commercialization (after covering legal expenses) to offset the Innovation Network's operating expenses.

ORGANIZATIONAL MODULARITY AND INTRA-UNIVERSITY RELATIONSHIPS BETWEEN ENTREPRENEURSHIP EDUCATION AND TECHNOLOGY TRANSFER

Andrew Nelson and Thomas Byers

ABSTRACT

Both entrepreneurship education and commercialization of university research have witnessed remarkable growth in the past two decades. These activities may be complementary in many respects, as when participation in an entrepreneurship program prepares a student to start a company based on university technology, or when technology transfer personnel provide resources and expertise for an entrepreneurship course. At the same time, however, the activities are distinct along a number of dimensions, including goals and mission, influence of market conditions, time horizon, assessment, and providers and constituency. We argue that this situation presents an organizational dilemma: How should entrepreneurship and technology transfer groups within a university maintain independence in recognition of their differences while still facilitating synergies resulting from overlapping areas of concern? In response to

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this dilemma, we draw on the organizational modularity perspective, which offers the normative prescription that such situations warrant autonomy for individual units, but also require a high degree of cross-unit awareness in order to capture synergies. To illustrate this perspective in an intra-university population of entrepreneurship and technology transfer groups, we present network images and statistics of inter-group relationships at Stanford University, which is widely recognized for its success in both activities. The results highlight that dependence between groups is minimal, such that groups retain autonomy in decision-making and are not dependent on others to complete their goals. Simultaneously, cross-unit awareness is high, such that groups have frequent formal and informal interactions and communication. This awareness facilitates mutually beneficial interactions between groups. As a demonstration of the actual functioning of this system, we present three thumbnail case studies that highlight positive relationships between entrepreneurship education and technology transfer. Ultimately, we argue that to fully realize the synergies between entrepreneurship education and technology transfer, we must also recognize differences between them and ensure the autonomy that such differences warrant.

1. INTRODUCTION

Recognizing the important role that universities play in innovation and in economic growth as a whole, innovation and management scholars have increasingly turned an analytical lens on universities themselves. On one hand, university engagement with external economic interests is nothing new. In *Universities in the Marketplace*, Bok (2003) reminds us that as early as 1915, the Yale University football team earned more than $1 million (in current dollars) for the university. Rosenberg (2002) offers several early examples of state universities' interaction with local industry. Similarly, Lenoir et al. (2004) describe the co-evolution of Stanford University and Silicon Valley over several decades. But, on the other hand, recent decades have witnessed deepening ties between U.S. universities and the marketplace. Indeed, university–firm boundaries in the United States have become a model as other regions and governments attempt to emulate their apparent success (Mowery & Sampat, 2004).

This chapter focuses on two particular changes that concern universities' engagement with external economic interests. First, the past two decades have witnessed a remarkable growth in technology licensing from universities (Association of University Technology Managers (AUTM), 2004; Mowery, Nelson, Sampat, & Ziedonis, 2001). Such activity is indicative of the university's

role in technology transfer activities and of changes in this role. Second, recent years have witnessed an explosion of entrepreneurship education programs, not only within MBA courses, but also serving undergraduates and graduates in a variety of other disciplines (Charney & Libecap, 2000; Vesper & Gartner, 1997). These programs have expanded beyond formal courses to include seminars, business plan competitions, university-facilitated internships, and student organizations.

Our purpose in this chapter is to consider the relationship between these two activities – technology transfer and entrepreneurship education – and to offer normative observations regarding the appropriate organization of these activities within the university. We take as our starting point a survey of programs at Stanford University, which has been identified as particularly successful in both technology transfer and entrepreneurship education. This success lies in Stanford's ability to capture synergies between these activities, while simultaneously recognizing that they are fundamentally different along some dimensions. For example, students' experiences in entrepreneurship education activities may lead them to later transfer technologies from the university. But, technology transfer and entrepreneurship education groups are assessed according to their own criteria and maintain autonomy in their activities and strategies. The Stanford arrangement therefore reflects a "modular" (Brown & Eisenhardt, 1997; Martin & Eisenhardt, 2003) organization in which administrative interdependence and hierarchical structures are minimized, while cross-unit awareness and bottom-up processes are maximized.

We begin by describing trends in both university technology transfer and entrepreneurship education in Section 2. In Section 3, we describe both potential synergies and distinctions between the two activities. In Section 4, we present a network analysis of relations between Stanford groups along a number of dimensions to illustrate the organizational modularity perspective. Section 5 supplements this overall picture with three thumbnail case studies that provide a rich understanding of how relations may play out. Finally, in Section 6 we offer conclusions and discuss limitations and extensions of our study.

2. TRENDS IN UNIVERSITY TECHNOLOGY LICENSING AND ENTREPRENEURSHIP EDUCATION

Over the past two decades, both university technology licensing and entrepreneurship education have experienced remarkable growth. As we will illustrate, these trends are important not only individually, but also for the potential relations between the two activities. For example, increases in technology licensing may provide motivation for growing entrepreneurship programs, the success of which may in turn lead to further increases in licensing. Proper management of this relationship is essential, however, to the health of both activities.

University technology transfer can be defined very broadly to describe "the movement of ideas, tools, and people among institutions of higher learning, the commercial sector and the public" (AUTM, 2004). This movement may take place through a variety of mechanisms, including formal education, such as training provided to students and to current employees via continuing education programs; knowledge sharing, including personnel exchanges and faculty consulting to industry; public dissemination, such as journal articles, books and conferences; research relationships, including sponsored research; and technology licenses. In a similar vein, Cohen, Nelson, and Walsh (2002) list several sources for industry information about university technologies: patents, informal information exchange, publications and reports, public meetings and conferences, recently hired graduates, licenses, joint or cooperative ventures, contract research, consulting, and temporary personnel exchanges.

Certainly, some mechanisms are more important than others. In a survey of 600 U.S. R&D managers, Nelson and Levin (1986) found that three quarters of the most important contributions of academic research to technological development were in the form of uncodified knowledge and skill transfers. Only one quarter were in the form of codified knowledge such as patents and licenses. Thursby and Thursby (2000) found that licensing executives pointed to personal contacts and, less so, publications and presentations as their most important sources for university technologies. Cohen et al. (2002) relay the importance of various mechanisms for each of several industries. Across all industries, publications, public meetings, and conferences were the most important, followed by informal information exchange and consulting.

Nevertheless, one of the most salient measures of university technology transfer may be found in licensing and patenting data. In the past 2 decades, licensing and patenting of university technologies has increased significantly. Mowery et al. (2001) relay data from the United States Patent and Trademark Office (USPTO) that utility patents issued to all U.S. universities and colleges rose from 188 in 1969 to 264 in 1979, and 2,436 in 1997. In fact, according to AUTM, the vast majority of university technology transfer offices were started in the past two decades. AUTM's membership itself swelled from 1,015 in 1993 to 3,155 in 2004.

Since 1993, AUTM has administered an annual survey to track changes in university patenting and licensing. While year-to-year statistics are not strictly comparable due to changing respondent groups, the survey indicates that licenses and options yielding income rose from 2,711 in FY1991 to 10,682 in FY2003 (AUTM, 2004). Even considering only those universities that were consistent respondents from 1994 to 1998, yearly invention disclosures increased by 7.1% per year (Thursby & Thursby, 2002). Moreover, increases are apparent not only in the number of invention disclosures, but also in the percentage of those on which patent applications are filed, rising from 26% in 1991 to 51% in 2003. Much of this licensing (12.9% in FY2003) is to start-ups, meaning companies that were established specifically to develop the licensed technology. A further 52.5% of FY2003 licenses were to existing small companies with less than 500 employees (AUTM, 2004).

Stanford's invention and license data is representative of these national trends. At Stanford, invention disclosures grew from 28 in 1969 to 362 in 2003, while licenses grew from 3 to 127 for those same years. Similarly, annual royalty income grew nearly 1000-fold from 1969 to 2003, rising from $50,000 to $45.4 million. Thus, Stanford's Office of Technology Licensing (OTL) has grown into a relatively large office with seven licensing professionals and 25 total staff members, which consistently ranks among the top 10 offices in annual royalty income.

Many scholars have noted that the rise in university licensing coincided with the passage of the Bayh-Dole Act of 1980 (Henderson, Jaffe, & Trajtenberg, 1998; Mowery et al., 2001; Mowery & Ziedonis, 2002). While some findings indicate that this has coincided with a decline in the "importance" and "generality" of university patents (Henderson et al., 1998), other studies (Mowery et al., 2001; Mowery, Sampat, & Ziedonis, 2002) indicate that such a decline is due to new, less-skilled entrants into academic patenting, rather than declines among existing players. Owen-Smith and Powell (2003) find further evidence for this latter perspective, noting the importance of network ties to industry in enabling institutions to develop higher impact patent portfolios. Thus, in short, there appears to be an important "learning" process among university technology licensing offices.

Learning processes of a different sort characterize a second major trend on university campuses. In recent years, entrepreneurship courses and programs have experienced remarkable growth. Charney and Libecap (2000) note that within a 50-year period, entrepreneurship education has grown from a single course to a wide range of opportunities at more than 1,500 colleges and universities around the world. Vesper and Gartner (1997) estimate that 400 colleges and universities offered entrepreneurship courses in 1995, up from approximately 16 in 1970. Solomon et al. (2002) estimates that this 1995 number tripled to as many as 1,200 in a scant 5-year period. Katz (2003) provides a detailed chronology of entrepreneurship education from 1876. He concludes that since the first university class in 1947, "an American infrastructure has emerged consisting of more than 2,200 courses at over 1,600 schools, 277 endowed positions, 44 English-language refereed academic journals and over 100 centers" (Katz, 2003, p. 284).

As the number of programs has grown, so has the range of offerings. Indeed, our review of various offerings at Stanford indicates that entrepreneurship education may take a variety of formats, including:

- Courses – both full-credit and seminars – on a wide range of subjects, including venture capital, technology/innovation management, new venture creation, and entrepreneurial marketing
- Internships, including both stand-alone internships and work/study internships that are integrated with a course
- Competitions (with accompanying workshops) for new for-profit businesses, new non-profit businesses, and pure technological innovation
- Research by faculty and Ph.D.s
- Student clubs and organizations
- Conferences and outreach to both educators and industry.

Moreover, these activities are organized across a variety of schools, including business, engineering, and medicine (Vesper, 1986; Kauffman, 2001). The prevalence of programs in both engineering and medicine is particularly notable since those same individuals who may create scientific and technological breakthroughs are also being trained to develop these breakthroughs commercially. Stanford's School of Engineering provides an illustrative example of these trends. As late as 1995, the School of Engineering offered a single entrepreneurship course with a maximum enrollment of 65 students. It now offers 13 courses with 1,500 seats available across a variety of entrepreneurship subjects. These, of course, complement offerings in the medical and business schools, the latter offering 20 courses with 1,850 seats.

Given the increases in both university licensing and entrepreneurship education, a natural question concerns the relationship between the two. The entrepreneurship literature offers limited discussion on the role of education. Studies have found that entrepreneurs with a good education tend to be more successful than those without (Vesper, 1990; Robinson & Sexton, 1994). Education also positively influences entrepreneurial intentions

(Autio, Keelyey, Klofsten, & Ulfstedt, 1997; Krueger, 1993; Peterman & Kennedy, 2003). But, little research examines the impact of entrepreneurship courses on entrepreneurial activity itself, particularly as that activity intersects with technology transfer (Honig, 2004; Gorman, Hanlon, & King, 1997; Autio et al., 1997). In an important contribution toward this research gap, Charney and Libecap (2000) find that entrepreneurship education contributes to the formation of new ventures, increases the propensity of graduates to be self-employed, contributes to the growth of small firms, and promotes technology transfer from the university to the private sector.

Our own intention in this chapter is not to provide a quantitative assessment of the impact of entrepreneurship education on technology transfer. Rather, we start with a simple pair of observations: (1) entrepreneurship education and technology transfer share obvious synergies and (2) entrepreneurship education and technology transfer have (somewhat less) obvious differences. To illustrate the first observation, we offer initial results from a survey of groups at Stanford. To expound the second observation, we distinguish between entrepreneurship education and technology transfer along a number of dimensions. The coexistence of both synergies and differences sets the stage for our primary question: How should a university structure relations between entrepreneurship education and technology transfer activities?

3. TECHNOLOGY TRANSFER AND ENTREPRENEURSHIP EDUCATION: SYNERGIES AND DISTINCTIONS

There are two aspects to synergies between technology transfer and entrepreneurship education. First, entrepreneurship education may enhance technology transfer efforts. Second, technology transfer may, in fact, enhance entrepreneurship education. Fig. 1, a network illustration of collaboration in teaching, offers an example of this latter perspective.[1] (The appendix describes the various groups.)

As the figure indicates, Stanford's OTL is not at all disconnected from this activity. In fact, the OTL's eigenvector centrality score places it eighth out of 13 among the groups.[2]

Ties between entrepreneurship and technology transfer groups are multifaceted and may carry a number of benefits. We surveyed each of the Stanford groups involved in these activities about the benefits they have

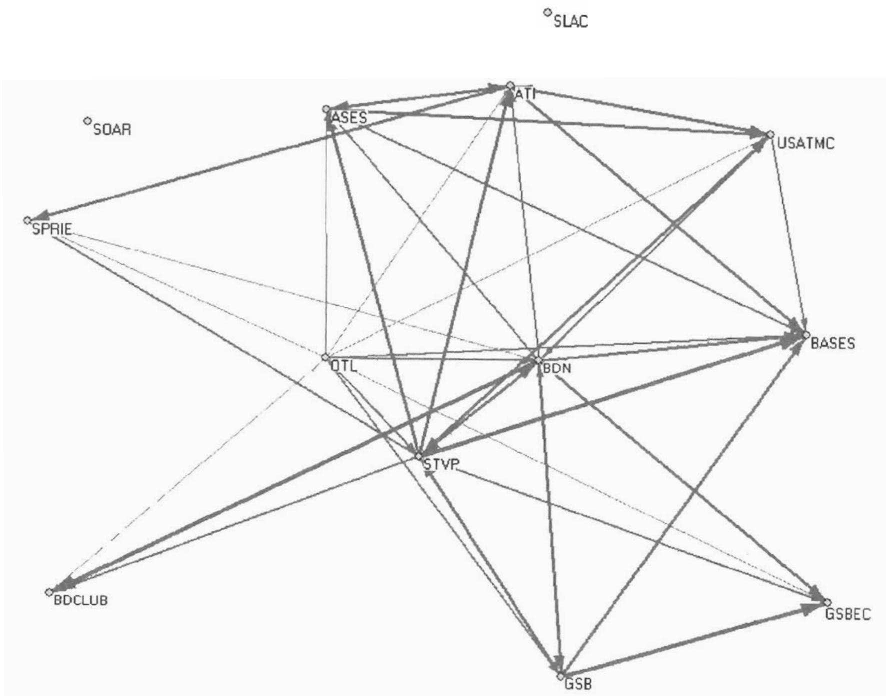

Fig. 1. Responses to the Question "Faculty or Staff from your Group are Involved in Teaching students from:" Thickness of Line Indicates Frequency on a Five-point Scale from "Never" To "Nearly Always."

realized from interacting with other groups in the survey set. The results are relayed in Table 1.

Every group with a technology transfer component responded that interaction with entrepreneurship education groups led to more effective technology transfer. Moreover, entrepreneurship groups pointed to the importance of various types of information and access due to interaction with technology transfer groups. For example, courses have benefited from using Stanford inventions for their class projects and from OTL participation in these courses. Thus, in sum, not only does entrepreneurship education enhance technology transfer, but technology transfer can be an integral part of entrepreneurship education, providing resources and first-hand experience to aid in classroom objectives.

Table 1. Benefits from Interaction with Other Groups.

Information about activities	12
Collaboration on activities	11
Access to other people within the university	9
Access to resources	8
Access to students	8
Access to people outside the university	7
Information about best practices	6
Other information	6
Access to faculty	6
Information about technologies	4
Improved educational opportunities	4
More effective technology transfer	4
Increased stature/prestige	1

The existence of synergies should not, however, obscure differences between technology transfer and entrepreneurship education. Indeed, the activities are distinct along a number of dimensions, including goals and mission, market influence, time horizon, assessment, and providers and constituency. These distinctions are summarized in Table 2.

3.1. Goals and Mission

The mission of the Stanford OTL is to "transfer Stanford technology for society's benefit and to generate royalty income to support research and education" (Stanford OTL, 2005, p. 1). Thus, there is both an economic aspect to the activity along with a desire for social good. Technology transfer is central to both goals. Jensen and Thursby's (2001) survey of technology transfer offices at 62 U.S. research universities reveals that these offices share similar goals. At least 50% of respondents indicated that revenue, inventions commercialized, and licenses executed were "extremely important" outcomes.

By contrast, entrepreneurship education is centered on learning rather than technologies. Solomon, Duffy, and Tarabishy (2002, pp. 1–2) argue that the purpose of entrepreneurship education is to "produce entrepreneurial founders capable of generating real growth and wealth." Charney and Libecap (2000) note that entrepreneurship education may accomplish a variety of goals: integrate various courses and disciplines; provide the foundation for new businesses (economic growth); improve graduates' employment prospects; promote the transfer of university-based technology; forge

Table 2. Distinctions between University Technology Transfer and Entrepreneurship Education.

	Technology Transfer	Entrepreneurship Education
Goals and mission	Commercialize inventions; generate income	Develop leadership skills; integrate courses and disciplines; provide the foundation for new businesses; forge links between academic and business communities; promote university technology transfer
Influence of market conditions	Significant	Less
Time horizon	0–10 years	0–40 years
Assessment	Straightforward: Inventions commercialized; licenses executed; revenue	Difficult: student enrollment and evaluations; correlations with later behavior
Providers and constituency	Administrators and firms (that may involve faculty and/or students)	Faculty and students

links between the business and academic communities; and provide an opportunity to experiment with curriculums. To this exhaustive list, we might add the development of leadership skills.

3.2. Influence of Market Conditions

These differing goals are reflected in the extent to which the market and commercial concerns influence technology transfer and entrepreneurship education, respectively. Since technology transfer typically involves transactions in the marketplace (in the form of technology licenses), market logics influence it extensively. Participants in the process must not only embrace the language and norms of the commercial sector, but also interact with it extensively if their programs are to be successful. A downturn in the economic climate for a particular industry will typically have a direct effect upon licensing efforts in that industry. Conversely, entrepreneurship education is first and foremost a scholarly pursuit. Therefore, it is relatively isolated from market pressures. While entrepreneurship education, too, often embraces the language of the commercial sector, interactions are often based upon theory or historical case studies, which are not directly tied to current market conditions and which therefore permit some degree of separation from this influence.

3.3. Time Horizon

The market orientation of technology transfer offices is reflected in their relatively short time horizon. In a study of Harvard University technology licenses, Elfenbein (2004) found that a new invention's hazard rate of first sale reached a peak approximately 12 months after disclosure and declined steadily from that point. Conversely, entrepreneurship education often has a "career" focus, with payoffs realized over the course of several decades. In fact, there may be significant time lags between participation in an entrepreneurship program and later related behaviors, such as starting a new venture. These lags also make assessment of entrepreneurship programs challenging.

3.4. Assessment

Assessment of technology transfer efforts is straightforward. Indeed, the outputs that Jensen and Thursby (2001) identify – revenue, inventions commercialized, and licenses executed – are easily measured. The AUTM (2004) licensing survey includes a number of additional measures as well, such as patents and start-up activity, which are also amenable to simple tallies.

By contrast, it is difficult to measure the performance of entrepreneurship education activities (Block & Stumpf, 1992; McMullan & Long, 1987). Certain quantitative measures of program elements themselves are available, including enrollment and student evaluations. But, to assess the subsequent impact of these programs is more challenging and studies are therefore limited (Wang & Kleppe, 2000). The issues are twofold. First, the number of observations is relatively small. Since entrepreneurship programs are relatively new, extensive longitudinal data are absent. To the extent that variables of interest – such as technology transfer – exhibit time lags between education and impact, this problem is exacerbated. Similarly, numbers surrounding outcome variables of interest are also small. For example, the most recent AUTM licensing survey (AUTM, 2004) reports that 374 new companies based on an academic discovery were started in FY2003, reported by 190 institutions. Even the most successful institutions such as Stanford average less than a dozen new start-ups per year, including those founded by professors (not only students). Thus, correlations between entrepreneurship education and later behaviors may suffer from small samples.

A second challenge lies in the fact that numbers may be misleading. For example, quantitative analysis of the relationship between entrepreneurship education and technology transfer may fail to capture those cases in which participation in a course, club, or activity led a student *not* to pursue a business idea. While such decisions may be counted as a success from an educational and business perspective, they complicate attempts to compute a simple positive correlation between education and technology transfer or new venture creation. As a result, most assessments of entrepreneurship education rely on qualitative accounts (Wang & Kleppe, 2000).

3.5. Providers and Constituency

University technology transfer offices are typically staffed by professionals with backgrounds in business, law, and/or specific realms of science and technology. These employees are part of the university's administration, not its faculty. They serve a bridging role in the network between faculty and students, who provide the invention disclosures, and industry representatives (including entrepreneurs), who consume them. By contrast, the providers of entrepreneurship education are faculty. These instructors may include both regular tenure-line professors and adjunct faculty in business, engineering, medicine, and law, often with extensive entrepreneurial experience. The consumers of this output are students.

3.6. Discussion

Certainly, the above delineation between technology transfer and entrepreneurship education is not exhaustive and finds its foundation in our observations at Stanford. But regardless of its precise reflection of the specific situation at other universities, the fact remains that technology transfer and entrepreneurship education are different along many dimensions. Moreover, entrepreneurship education programs themselves may vary in specific goals, students, regional emphases and, of course, format. Indeed, the variety in entrepreneurship programs even within a single university is one indication that entrepreneurship education is multifaceted.

It is from the variance across these dimensions that a management dilemma arises: on one hand, there are clear synergies between entrepreneurship education and technology transfer programs; on the other hand, if programs are too tightly coupled, it is impossible to successfully pursue multiple goals and outputs by diverse providers serving varied constituencies and assessed according to different criteria under separate timetables. In other words, units cannot be completely disconnected, such that they miss opportunities for fruitful collaboration. But, they need to interact in a way that is sensitive to their differences.

4. ORGANIZATIONAL STRUCTURE AND PROGRAM NETWORKS

Friedland and Alford (1991) developed the concept of an institutional logic to capture the material practices and symbolic constructions that constitute an institution's organizing principles (see also Scott, Ruef, Mendel, & Carconna, 2000; Thornton, 2004). Thus, differences in goals – and the diverse influence of market conditions, time horizons, assessment standards and participants that these differences entail – may be taken as indicative of different logics associated with technology transfer and entrepreneurship education. These logics may both reinforce and conflict with each other. Where logics are mutually reinforcing, such multiplicity may actually be beneficial to the organization as a whole, as individual participants learn to be "multivocal" in drawing from both (Nelson, 2005). But, when logics conflict and participants vary within a closely linked organization, the outcome is dependent upon individual proponents of each logic and is influenced by the extent to which institutionally specific roles affect the resources available to these proponents (Friedland & Alford, 1991). In such a "battle of logics," the material resources from licensing income and the facile demonstration of relatively immediate and measurable effectiveness would lead technology transfer concerns to dominate educational ones. Thus, a challenge in organizational structure arises in attempting to nurture multiple logics without allowing one to co-opt the other.

In a seminal article, Weick (1976) argues that when an organization is pursuing multiple goals that may conflict, its formal structure may be only "loosely" integrated. As Weick (1976, p. 14) writes, "The imagery is that of numerous clusters of events that are tightly coupled within and loosely coupled between. Those larger loosely coupled units would be what researchers usually call organizations." For our purposes, the larger unit is the university while the smaller subassemblies with their unique goals are individual entrepreneurship education and technology transfer programs. Thus, in this perspective, these programs are only loosely linked. Adkison's (1979) study of a project within the Kansas Public School System found early support for the effectiveness of such an environment. In her study, loose coupling between participants allowed them to define unique roles and responsibilities while avoiding conflict.

The concept of loose coupling has been usefully extended in the literature on organizational modularity, which focuses exclusively on the structures of organizations, rather than on individuals or inter-organizational relationships (Brown & Eisenhardt, 1997; Martin & Eisenhardt, 2003; Hallen & Eisenhardt, 2005). In this view, the autonomy afforded to individual units within a system depends upon both the work undertaken within each unit (Thompson, 1967; Galbraith, 1973) and the potential synergies arising from the leveraging of multiple units (Gupta & Govindarajan, 1986; Larsson & Finkelstein, 1999; Martin & Eisenhardt, 2003). Higher levels of organizational modularity allow individual units to maintain autonomy surrounding goals, actors, measurement, and responsiveness to external pressures. This autonomy facilitates success in multiple activities at the same time. For example, Tushman and O'Reilly (2004) found that companies with high levels of modularity – those that were "ambidextrous" in their view – were able to flourish in very different kinds of businesses simultaneously. A primary function of unit autonomy through modularity is to reduce potentially harmful tendencies to apply a single model or perspective to all subunits of a business. Thus, Gilbert's (2003) study of the newspaper industry highlighted the tendency of less modular newspaper organizations to apply models from print editions to the online world, with unfortunate consequences given these unique environments.

While higher levels of modularity facilitate the simultaneous pursuit of independent goals by individual units, it is still desirable to facilitate synergies between units. For example, Tushman and O'Reilly (2004) point to the benefits from integrated top management teams when units are independent. One of the most important roles that such integration serves is to facilitate and encourage cross-unit awareness. This awareness may take place via direct connections between units, without the necessity of hierarchical oversight. For example, in a study of 12 cross-business synergy initiatives, Martin and Eisenhardt (2003) found that high-performing initiatives originated in the business units, not at the corporate level, and that high-performing initiatives had an "engaged multi-business team decision process," rather than a top-down corporate decision process. Similarly, Tsai's (2002) investigation of a large diversified organization revealed that formal hierarchical structure had a negative effect on knowledge-sharing between units, while informal lateral relations had a positive effect. Hansen (1999) points to the role of "weak ties" in knowledge sharing across organizational subunits. Thus, the organizational prescription is twofold. To the extent that technology transfer and entrepreneurship organizations differ in goals, they should remain autonomous. But, to facilitate synergies, they should have high cross-unit awareness.

4.1. Survey Description and Methodology

To explore this conclusion, we assessed relations between all of Stanford's entrepreneurship education and technology transfer groups along two dimensions: cross-unit dependence and awareness. In sum, we surveyed 13 groups, which are described in the appendix. We pre-tested the survey with four of the groups. Though we had only one respondent for each group, we believe that this still provides an accurate picture of relations between groups since each group is relatively small and members are aware of the type, quality, and extent of relations that their colleagues maintain between groups. We confirmed this perception by presenting survey responses to non-respondents within three groups, who verified the validity of the responses for their groups.

To gauge dependence and awareness, we asked a total of nine questions, measured on a five-point Likert scale. (The survey included additional questions on overlapping activities, experiences with cross-unit collaboration, administrative structure and budgets, as reported in Fig. 1, Table 1, and below.) We performed a factor analysis on the nine questions and found that the dependence and awareness measures loaded on two separate factors, as predicted. One measure, communication between units, was loaded on both factors, though its association with awareness was higher. Given its importance toward capturing non-meeting-based awareness, we retained it as an awareness measure despite this dual loading. The Cronbach alpha for the five dependence measures was 0.88, indicating that the set of questions is a good measure of a single unidimensional latent construct. The Cronbach alpha for the four awareness measures was lower at 0.71, but still above a cutoff value of 0.7 (Nunnally, 1978).

For our network images, we employed the Kamadi–Kawai algorithm for network layout, which is based on the idea of a balanced spring system and energy minimization. The most central actors typically appear in the middle of the image and thickness of lines is indicative of the strength of the tie. For ease of display, we removed the weakest ties, though they were retained for all calculations.

4.2. Dependence

As a first cut at cross-unit dependence, we surveyed whether groups shared a common administrative structure or budget. Predictably, these measures clumped those groups that were in the same department. There were only two instances of shared budgets, both involving student groups connected to larger departmental initiatives. Thus, most positive responses did not represent resource dependence. Moreover, ties did not necessarily indicate administrative dependence. In the organizational modularity literature, modularity is measured by the extent to which individual units within an organization have independence and autonomy. Thus, a simple delineation by department is inadequate since it fails to capture the extent to which units within a department may or may not have autonomy, and the extent to which departments themselves may or may not be dependent upon one another. To develop a more sophisticated measure of cross-unit dependence, we therefore crafted five additional questions based upon the organizational modularity literature: "If you changed *your* core activities, it would impact the following groups:", "If the following groups changed *their* core activities, it would impact you:", "You depend on the following groups to fulfill your mission:", "The output of the following groups serves as a critical input for your group:", and "For your core activity, you need approval from the following groups:".

Owing to space constraints, we present only one example network image of responses to an individual dependence question. Fig. 2 illustrates responses to the question, "The output of the following groups serves as a critical input for your group."

The resulting density of the network is 0.131, indicating that roughly 13% of all potential ties at the strongest level are actually present. (In this diagram, the thickest lines reflect the response "sometimes.") This particular measure had the highest density of all dependence measures, indicating more and/or stronger ties than in other dependence networks. Density measures for all dependence questions are displayed in Table 3.

The extremely low density of the "Need approval" measure indicates that decision-making resides largely at the level of the individual units and that few units are subservient by any degree to other units. In fact, only three groups provided any sort of positive response to the question and each represents, effectively, a subset of another group: the business school's entrepreneurship club (The Entrepreneur Club at the Graduate School of Business (GSBEC)) is the student group portion of The Center for Entrepreneurial Studies at the Graduate School of Business (GSB); Stanford Student Biodesign (BDCLUB) is a group of students who participate in the Stanford Biodesign Network (BDN); and the Stanford Linear Accelerator Center Office of Technology Transfer (SLAC) manages the OTL's efforts surrounding inventions from an electron accelerator research lab. (These disclosures account for a very small percentage of Stanford's total.)

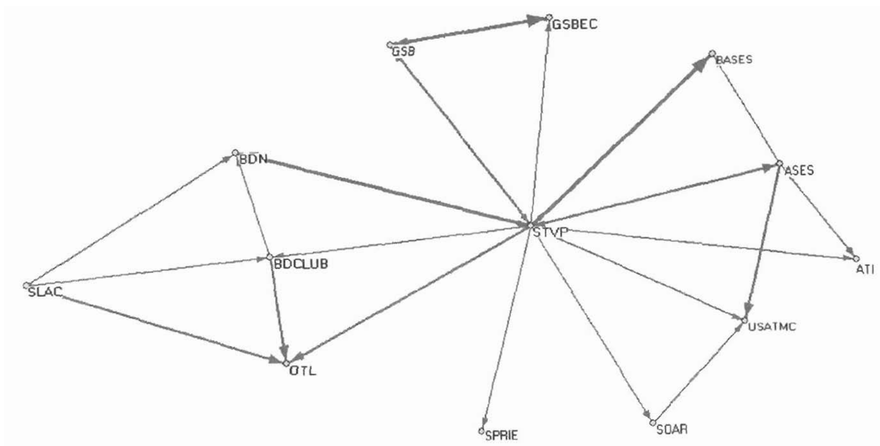

Fig. 2. Responses to "The Output of the Following Groups Serves as a Critical Input for your Group." Arrows Point from the Group that Provides Output to the Group that Relies on this Output.

Table 3. Density Measures for Dependence Network.

If you changed *your* core activities, it would impact the following groups	0.106
If the following groups changed *their* core activities, it would impact you	0.117
You depend on the following groups to fulfill your mission	0.103
The output of the following groups serves as a critical input for your group	0.131
For your core activity, you need approval from	0.013

In sum, the dependence measures indicate that individual entrepreneurship education and technology transfer units have a high degree of autonomy and independence. Fig. 3 collapses the five measures to provide an overall assessment of dependence between units.

This sparse network of dependence (density = 0.0939) indicates that Stanford's entrepreneurship and technology transfer efforts are highly modular. As argued, however, successful modular organizations should employ mechanisms to ensure cross-unit awareness that facilitates potential synergies. In the section that follows, we analyze awareness measures for the Stanford network.

4.3. Awareness

We used four measures to capture the opportunities that units have to exchange information and to become aware of the activities and interests of other units: formal meetings, informal meetings, attendance at Stanford Entrepreneurship Network meetings, and communications such as emails and newsletters. We used a five-point Likert scale to capture the information. For formal meetings, informal meetings and communications, the scale ranged from "Never" to "Once/Week or More." For attendance at SEN meetings, which are held monthly, the scale ranged from "Never" to "Always."

Formal meetings are diagrammed in Fig. 4.

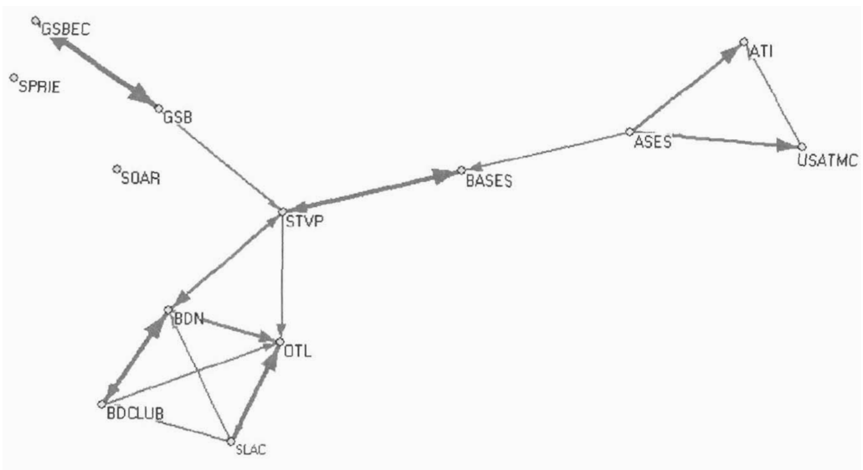

Fig. 3. Network of Dependence – Sum of All Questions.

As the figure indicates, formal meetings (outside of the SEN) are relatively uncommon and typically occur between groups in the same school. For example, the highest values are between the GSBEC and the GSB, and between the engineering school's entrepreneurship program (Stanford Technology Ventures Program (STVP)) and an engineering-based student entrepreneurship group (The Business Association of Stanford Engineering Students (BASES)). Formal meetings also appear common between those groups with overlapping areas of concern. For example, The Asia-Pacific Student Entrepreneurship Society (ASES) and U.S.–Asia Technology Management Center (USATMC) are a student group and an administrative program, respectively, both of which are focused on activities in Asia. Similarly, the OTL and SLAC are both directly engaged in technology transfer.

In contrast to formal meetings, informal interactions between programs are frequent, as indicated in Fig. 5.

In fact, informal interactions capture all network relations that also occur through formal meetings, with the exception of four formal meetings that occur "rarely." Moreover, informal interactions capture several cross-unit (non-shared department) relationships. For example, there are frequent informal interactions between STVP and OTL, between STVP and the medical school's entrepreneurship program (BDN), and between BDN and the GSB. The prevalence of informal interactions compared to formal meetings is reflected in their respective network densities: 0.293 versus 0.151.

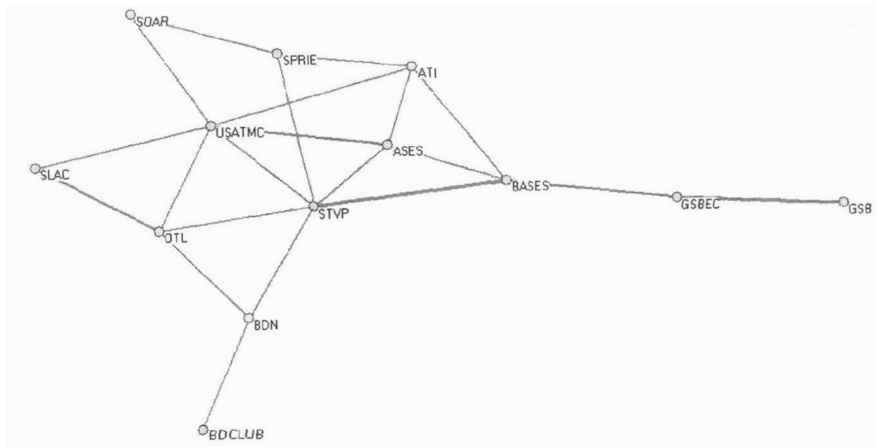

Fig. 4. Formal Meetings between Groups.

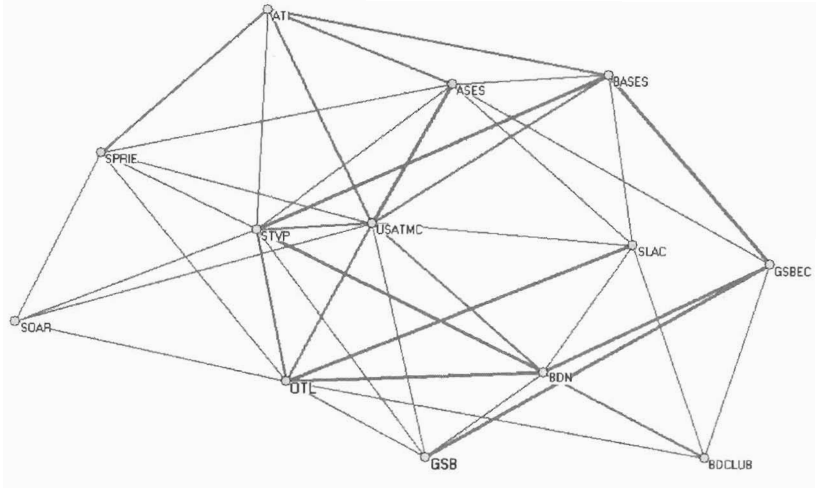

Fig. 5. Informal Interactions between Groups.

The Stanford Entrepreneurship Network (SEN) represents an institutionalized mechanism for encouraging cross-unit awareness. SEN started as a bottom-up effort, led by members of two entrepreneurship education groups and one OTL associate. Participation is optional and there is no formal structure to the group. But, attendance is quite strong, as indicated in Fig. 6.

In fact, the majority of respondents (8 of 13) always attend, and most others (3 of 13) often attend.

A final mechanism for facilitating cross-unit awareness consists of various communications, including emails and newsletters. Fig. 7 illustrates these results.

The most central units here are those that communicate often to other units. For this measure, BASES, a student group that has a weekly email/newsletter with broad circulation, scores highly. By contrast, SLAC, a unit that engages in relatively little communication, is more dependent on other mechanisms for sharing news of its activities and interests.

Fig. 8 illustrates the collapsed network of all four awareness measures.

As the figure indicates, the awareness network is densely interconnected. This result is to be contrasted with Fig. 3, the collapsed image of the dependence network. The comparative network densities are 0.0939 for dependence versus 0.357 for awareness, indicating that the latter is four times as dense as the former; it has more and/or stronger ties.

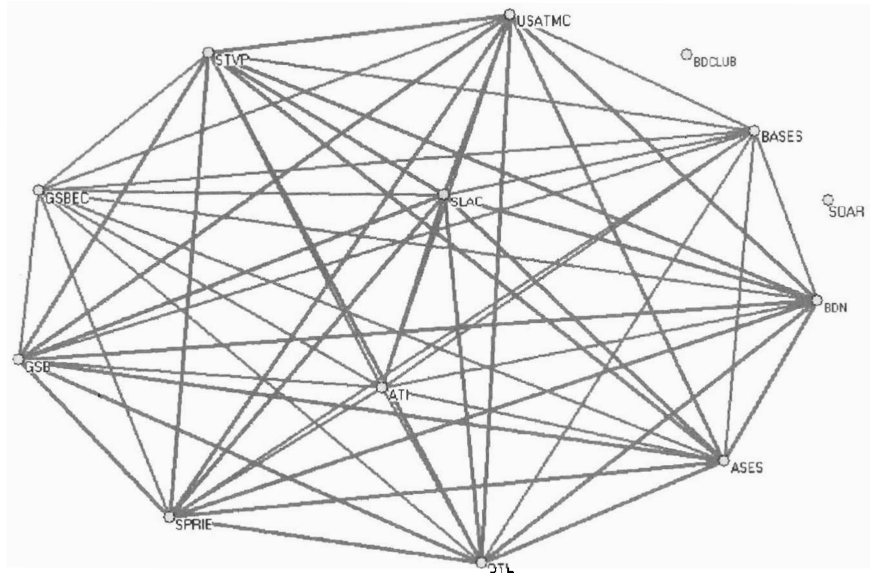

Fig. 6. Interactions via SEN Meetings.

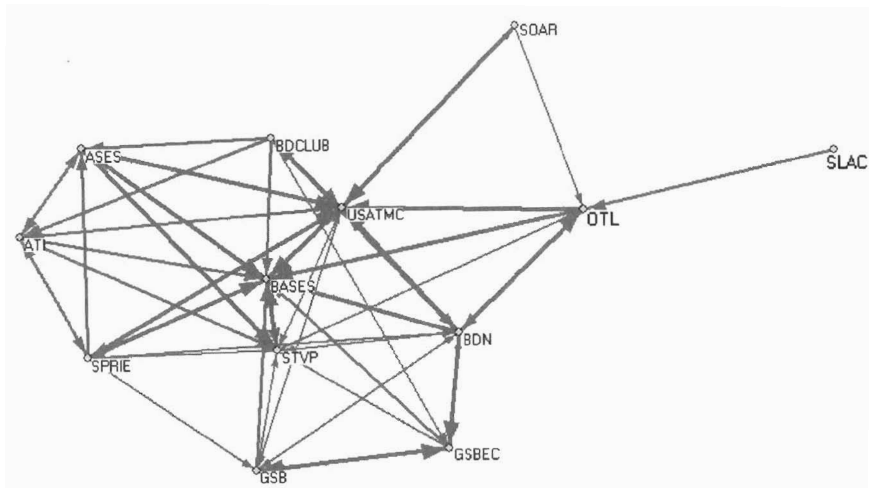

Fig. 7. Awareness Communications between Groups. (Arrows Point to Sender.)

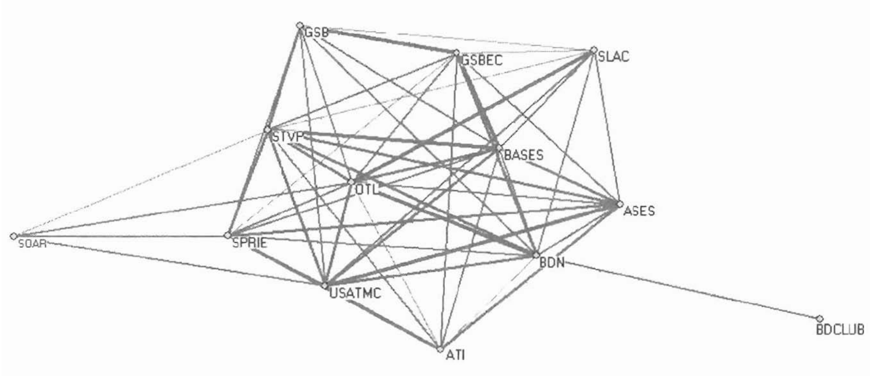

Fig. 8. Network of Awareness – Sum of All Questions.

4.4. Relations between Technology Transfer and Entrepreneurship Groups

These network measures of dependence and awareness can be isolated to consider only ties that cross the two categories: technology transfer and entrepreneurship education. Thus, all ties between the two technology transfer units are removed, as are those between any two entrepreneurship education units. Figs. 9 and 10 illustrate the results for dependence and awareness, respectively. These illustrations allow us to gauge the extent to which technology transfer and entrepreneurship education units interact and how dependence interactions compare to awareness interactions across the two unit types.

The respective density measures provide a further indication of these differences. The dependence density is 0.0189, while the awareness density is 0.0950.[3] These figures indicate that in considering only cross-type ties (only those between technology transfer and entrepreneurship groups), the awareness network is five times as dense as the dependence network, whereas in the network as a whole the awareness network is four times as dense. Thus, even more so than in the network as a whole, technology transfer at Stanford interacts with entrepreneurship education by emphasizing awareness but exhibiting little dependence. This result is consistent with expectations since the activities are in separate spheres.

That said, the OTL occupies a central role in both the awareness and dependence networks. This position indicates that it is taking advantage of synergies and, indeed, relies on these relationships to carry out its mission as effectively as it does. But, again, the large difference between the awareness and dependence density scores indicates that the OTL is primarily capturing

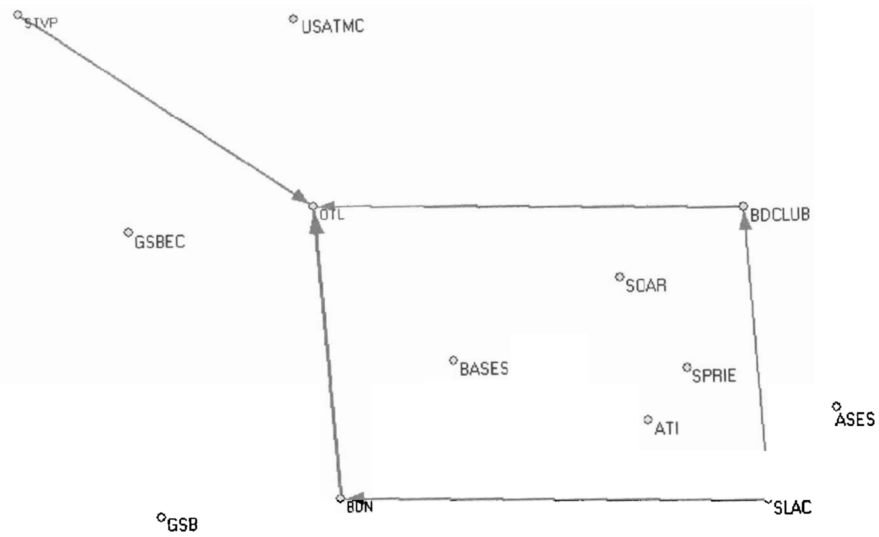

Fig. 9. Dependence Network – Only Cross-Type Ties Retained.

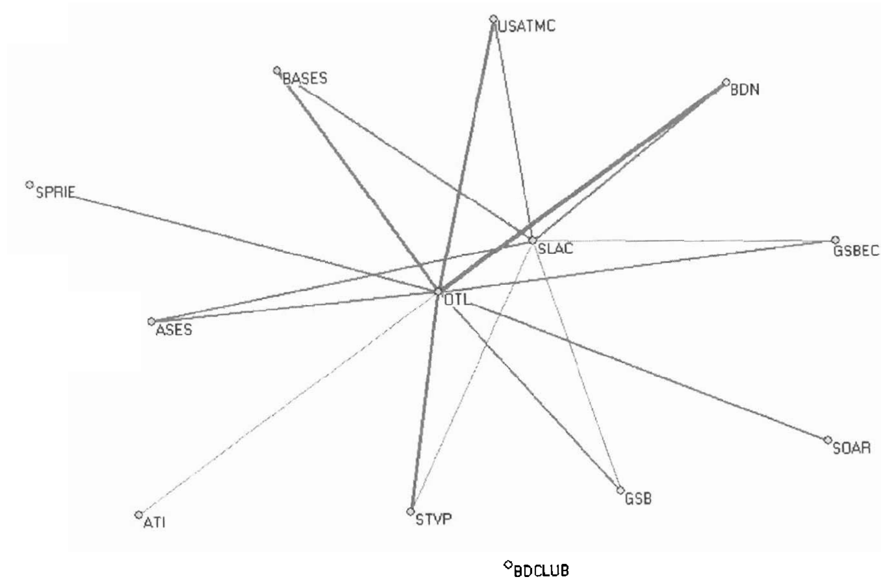

Fig. 10. Awareness Network – Only Cross-Type Ties Retained.

synergies via awareness relationships rather than formal dependence mechanisms.

5. CASE STUDIES

While network images and statistics provide an overall perspective on relations between groups at Stanford, case studies provide a rich understanding of how these relations have actually played out. The following three thumbnail cases differ across a number of dimensions, including entrepreneurship programs, student experience, technologies, departments, and outcomes. Moreover, the nature of the synergy realized varies. In the first case, participation in an entrepreneurship program facilitated the successful founding and growth of a company. In the second case, a company's engagement with technology transfer opened the door for its involvement with entrepreneurship education. In the third case, a feedback loop has emerged in which OTL associates assist in teaching an entrepreneurship course, which has facilitated technology licensing by firms resulting from this course, which in turn encourages further OTL involvement. But despite these different relationships, the three cases are united in illustrating both positive synergies between entrepreneurship education and technology transfer and the maintenance of autonomy for each.

5.1. Voltage Security and BASES

In November 2000, Professor Dan Boneh of Stanford's computer science (CS) department, in collaboration with Professor Matt Franklin at UC Davis, discovered a new way to solve the mathematics behind identity-based encryption (IBE). Months later, two undergraduate CS students, Matt Pauker and Rishi Kacker, met with Boneh to discuss research projects and they subsequently embarked on a study of the practical applications of IBE. In October 2001, Pauker and Kacker joined up with Guido Appenzeller, a Ph.D. candidate also doing research in IBE, to enter the Stanford BASES Entrepreneur's Challenge. BASES is a student group whose goal is to "build the next generation of entrepreneurs" by facilitating networking and discussion of entrepreneurship among undergraduate and graduate students from a variety of disciplines. The Entrepreneur's Challenge is an annual business plan competition run by BASES, which is accompanied by workshops, team building activities, and a mentorship program. Appenzeller had

also taken a global entrepreneurial marketing class, MS&E 271, through the School of Engineering and STVP, which made him sensitive to marketing issues and provided basic tools for identifying target segments. As he later recalled, "271 was maybe the single most valuable class at Stanford. It's this all-inclusive introduction to marketing and business."

In May 2002, the entry by Pauker, Kacker, and Appenzeller won the BASES competition. The success provided visibility and important introductions to many in the venture capital community, which the founders later identified as essential. The next month, in June 2002, the team entered the global business plan competition in Singapore, which it won. That same month, Pauker and Kacker received their undergraduate CS degrees, while Tim Choi, the student president of BASES, completed his Masters in Management Science and Engineering. Choi had been contemplating marketing jobs at large firms, but as president of BASES he had followed the winning team closely. They offered him a position and the team incorporated under the name IdentiCrypt, which later became Voltage Security. The company has since raised two rounds of venture capital financing and has shipped products to customers in the financial services and healthcare sectors.

In reflecting on the role of BASES and entrepreneurship course experience, the founders pointed to both the contacts that it facilitated and the content that allowed them to effectively formulate a strategy for the company, even in the earliest stages. As Appenzeller commented on the role of entrepreneurship course experience in facilitating technology transfer, "It was essential."

5.2. Cooligy and the Mayfield Fellows Program

Brian Biggott was a member of the 2004 class of Mayfield Fellows. The Mayfield Fellows Program (MFP) was founded at Stanford University in 1996 as a 9-month work/study program to develop both a theoretical and a practical understanding of the techniques for growing emerging technology companies. The program combines an intense sequence of courses on the management of technology ventures, a paid summer internship at a start-up company, and ongoing mentoring and networking activities. Enrollment is limited to 12 outstanding Stanford undergraduate engineers and scientists.

The summer internship is an integral part of the program; it provides an opportunity to reflect on the course materials from the spring and it forms the basis of the fall quarter class, in which students develop and teach case studies based on a critical decision that their company faced during the summer. Biggott was a co-terminal student in mechanical engineering (ME). Like most Mayfield Fellows, he sought a summer internship that would bear some relation to his technical background, but would immerse him in the business, rather than purely technical, aspects of a start-up.

In several ME courses, Biggott had heard of Cooligy, a company founded on technology primarily developed by three Stanford ME professors: Tom Kenny, Ken Goodson, and Juan Santiago. The technology consists of a closed-loop active cooling system for computer chips that is small, light, and quiet, and provides excellent thermal performance compared to traditional fans. The company and the technology intrigued Biggott, and he sought to pursue a summer internship. Cooligy, however, had never considered hiring an intern, largely due to concerns with confidentiality. As Biggott recalled, "Bringing someone in and doing valuable work at this stage in the company entailed knowing too much."

That spring, the Mayfield Fund, the entrepreneurship program's namesake venture capital firm and also one of Cooligy's funders, hosted a reception for the Mayfield Fellows. At the reception, one of the partners, Kevin Fong, mentioned Cooligy as an interesting portfolio company; Fong is the Cooligy board member from Mayfield. Biggott subsequently sent an email to the associate at Mayfield who was in charge of liaison contacts, who in turn encouraged him to contact the operations officer that Mayfield had on loan to Cooligy. Subsequently, Fong also sent messages encouraging the company to consider Biggott. These were supplemented by emails from the Mayfield Fellows program director and from Tom Kenny, one of the professors who developed the technology. Biggott was interviewed for the position and was hired. As he later reflected, "There's not a chance I could have been hired coming from another school, and there's a minimal chance I could have been hired outside of this [the Mayfield Fellows] program."

The tight network between the Stanford entrepreneurship program, the venture capital firm and the start-up influenced not only Biggott's hiring, but also his subsequent internship experience. As Biggott recalled, "Even if I was able to get a position, I would have been doing engineering stuff and there's no chance I would have been doing marketing." Instead, he spent most of his summer investigating and picking new markets, and developing marketing pitches. In fact, one of the requirements that MFP places on summer employers is that they provide the Fellow with access to senior management, provide a mentor within the company, host a summer open house for other program participants to explain their business, and generally play an active role in the program; it is not a typical summer job.

In reflecting on the doors opened by the MFP, Biggott remarked, "My exposure and my understanding of what was going on in that company, and more importantly my *point of observation* about what was going on in that company, was made a thousand times more valuable by having that sort of access." Thus, Cooligy's Stanford roots and OTL relationship opened the door for them to become intricately involved in entrepreneurship education. Per data from the OTL, at least a half-dozen MFP internship companies held earlier technology licenses from Stanford.

5.3. Picarro and the Technology Venture Formation Class

As a Ph.D. student at Stanford, Barb Paldus did groundbreaking research on cavity ring-down spectroscopy (CRDS). Due to its insensitivity to fluctuations in laser output and its ability to achieve large pathlengths through the sample, CRDS is the preferred method for ultra-sensitive, quantitative absorption measurements. While there were clear commercial applications for the technology, neither Paldus nor the two professors with whom she worked had ever started a company. Paldus looked through the course catalog and spotted Management Science & Engineering 273, "Technology Venture Formation," which is taught by a team of experienced entrepreneurs and venture capitalists.

As Paldus recalled:

> The course was a major eye-opener. I knew absolutely nothing about business or starting businesses...It was not a career option that I considered at the time. Many of us from EE were thinking of academic careers in the university. And developing technology in a startup was, in a way, a concept that none of us had ever really thought about. Trying to figure out where the market was, and where the market would be. That was something we had never really done either. So they taught us the basics of doing that. It was really neat.

After taking part in the course, Paldus and her professors approached the OTL. As they explored the technology licensing possibility, the course instructors – experts in entrepreneurship – also contacted the OTL to reinforce the opinion that the concept could form the basis of a start-up. When Paldus graduated in 1998, she co-founded Inform Diagnostics, which later became Picarro. The company completed its Series C round in 2004. Significantly, the OTL regularly participates in the MS&E 273 course that opened Paldus' eyes to the world of entrepreneurship by having a licensing associate share information about technologies available for license and by providing an overview of the licensing process. Thus, a feedback loop has emerged in which the OTL assists in entrepreneurship classes, which may result in actual companies that license Stanford technologies, which further encourages OTL involvement.

5.4. Discussion

In each of these cases, entrepreneurship education and technology transfer were closely linked while also being independent. For the Voltage founders, coursework, workshops, and a business plan competition provided both background knowledge and connections that were vital to the company's success. For the MFP, a company's participation in university technology transfer paved the way for its integration into an entrepreneurship education program. For the Picarro co-founder, initial engagement with an entrepreneurship course facilitated the successful launch and growth of the company.

In each of these cases, the technologies were developed at Stanford and the companies have licenses from the OTL. But, the OTL's licensing decisions were very much independent of entrepreneurship education and the office did not give preferential treatment to potential licensees with Stanford connections, including those involved in entrepreneurship programs. Rather, the OTL "markets" all inventions, meaning that they are shown to others who may have an interest in commercializing them. From a technology transfer perspective, the firm with an entrepreneur committed to developing a particular technology may be the best licensee, but that firm must offer a viable plan to commercialize an invention in order to receive a license. Entrepreneurship education, such as that highlighted in the Voltage and Picarro cases, helped the inventors create the viable business plan that was presented to the OTL.

For other groups, too, the disconnect between technology transfer and entrepreneurship education is clear. BASES, for example, provides resources for potential companies. But, its success as an organization is not tied to the success (or lack thereof) of these companies. As Tim Choi, the former BASES president who joined Voltage, commented, "BASES, at the end of the day, is about education." Similarly, OTL portfolio companies are not required to take part in the MFP and, conversely, the program is not tied to the performance of these companies. In each case, awareness relations between technology transfer and entrepreneurship education groups led to synergies that were exploited, in these cases, to the benefit of technology

transfer, entrepreneurship education, or both. Dependence ties were absent – and, indeed, unnecessary.

6. DISCUSSION AND CONCLUSION

Several observers have identified universities as an important source of commercial innovation (Jaffe, 2000; Nelson & Levin, 1986; Rosenberg, 2002). Similarly, support for entrepreneurship marks a vital element of both regional and national economies (Schramm, 2004; Byers, Keeley, Leone, Parker, & Autio, 2000). Our purpose in this chapter has been to describe the intra-organizational relationships between a university's technology transfer and entrepreneurship education units. Reporting survey data, we highlighted some synergies between entrepreneurship education and technology transfer activities. We then delineated several dimensions that distinguish these activities and therefore encourage independence of units. The co-existence of such synergies and differences led to a prescription for a modular organization design. In this arrangement, individual units retain independence and autonomy. But, the units themselves develop mechanisms to facilitate cross-unit awareness. Thus, units are able to learn about and act upon potentially fruitful opportunities for collaboration. The network analysis of the Stanford model along various dimensions of dependence and awareness provided an overall illustration of the modular arrangement, while three thumbnail case studies provided descriptions of actual synergies realized.

Network analyses also offer universities the opportunity to perform an internal assessment. For example, groups that appear on the periphery of the awareness network may wish to engage with others more. Groups that score high on dependence measures may wish to assess if this dependence is mutual and to consider its implications. Network data over time could provide compelling insights into the evolution of a university's efforts and could point to further areas for improvement.

There are, of course, limitations to our observations. First, we acknowledge that there is no "one size fits all" and that approaches to these relationships are context-dependent. Indeed, even within Stanford, entrepreneurship education programs differ along many dimensions that influence their interaction with both other entrepreneurship programs and technology transfer. We contend that the degree of modularity is proportional to the extent to which groups differ. That is, increased modularity is more appropriate as groups increasingly differ.

The organizational modularity literature also suggests that the dynamic nature of an environment influences the appropriate degree of loose coupling (Gupta & Govindarajan, 1986; Tushman & O'Reilly, 1996; Brown & Eisenhardt, 1997; Martin & Eisenhardt, 2004). Thus, a challenge moving forward is to consider the degree of modularity in relation to a (potentially) changing environment. It may be that universities are experiencing a particularly turbulent time and that as trends in both technology transfer and entrepreneurship education stabilize, tighter coupling will be more appropriate.

Second, the study raises the question of how we should measure the success of organizational practices. This determination is, of course, dependent upon the goals, which vary across programs. Even with a clear goal, such as determination of the socioeconomic impact of entrepreneurship programs, measurement is very difficult (Block & Stumpf, 1992; McMullan & Long, 1987). In their detailed longitudinal study of an entrepreneurship program at the University of Arizona, Charney and Libecap (2000) accomplish this to some extent. More studies along this line are certainly in order. A primary challenge to impact measurement of this sort stems from the fact that most entrepreneurship education programs may be too new to exhibit significant impact. But, while it may be difficult to measure outcomes, we can still ascertain the conditions for growth; while the garden may not yet yield produce, we can judge the quality of the soil, sun, and water.

Finally, an obvious extension would consider other universities' experiences. At Stanford, all entrepreneurship and technology transfer programs are in agreement that the modular organization works very well. But, the single case study has two limitations. First, samples from other universities, both where relations are perceived to work well and not, are essential to determine the generality of our findings. Second, it may be that regardless of organizational structure, awareness networks are always more dense than dependence networks. With data from multiple universities, we could test how different degrees of dependence are related to different degrees of awareness, and could regress this against measures of individual universities' strength at both technology transfer and entrepreneurship education. Such a diverse sample could also compare those universities, like Stanford, where entrepreneurship has close ties to the engineering school, to those that rely wholly or primarily upon initiatives in business schools.

Beyond the specifics of technology transfer and entrepreneurship education programs, it is also important to recognize the role of a university's overall culture. As Lenoir et al. (2004) point out with respect to Stanford, the university has long had an "entrepreneurial attitude." This facilitates experimentation with new curricula and the formation of novel ties between groups. Consistent with the literature on modular organizations, these ties are most effective when they emerge from lateral relations between groups acting in an entrepreneurial fashion, rather than from a "top-down" administrative directive. Indeed, ultimately we need to be entrepreneurial in our entrepreneurship education and technology transfer programs themselves. Those same tools developed to advise entrepreneurial businesses should be applied within the university to the novel relationships between entrepreneurship education and technology transfer programs at this early stage in their co-evolution.

NOTES

1. Section 4.1 describes our network analysis methodology.
2. We employ eigenvector centrality in our analyses. Unlike betweenness or *n*-degree centrality, eigenvector centrality weights scores according to the value of ties and the centrality of those to whom the focal actor is tied.
3. Technically, these are incomplete density measures since density is the ratio of ties that are actually present to those that could potentially be present. In these calculations, we have explicitly removed non-cross-type ties so the number of possible ties is overstated. But, the error in the denominator applies equally to both networks and therefore does not affect a comparison.

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APPENDIX. DESCRIPTION OF GROUPS IN THE STUDY

ASES – The Asia-Pacific Student Entrepreneurship Society. The Asia-Pacific Student Entrepreneurship Society at Stanford is affiliated with ASES International. The Stanford group hosts two major annual summits that explore transpacific business and leadership issues, and sponsors several

small events throughout the year that are focused on entrepreneurship in Asia.

ATI – Asia Technology Initiative. The Stanford Asia Technology Initiative seeks to cultivate entrepreneurship through hands-on entrepreneurial experience and by promoting links between Stanford and technology clusters throughout Asia. Each summer, a number of Stanford students are selected to go to different hotspots within Asia for a 10-week internship and a capstone conference.

BASES – The Business Association of Stanford Engineering Students. BASES is a student group whose goal is to build the next generation of entrepreneurs by facilitating networking and discussion of entrepreneurship among undergraduate and graduate students from a variety of disciplines. The group organizes a weekly Entrepreneurial Thought Leaders seminar, hosts three annual business plan competitions and sponsors several workshops and lectures throughout the year.

BDCLUB – Stanford Student Biodesign. Stanford Student Biodesign is a student group that aims to prepare students for careers in biotechnology, biomedical technology, bioengineering, and other fields at the intersection of life sciences and engineering. The group offers career seminars, lectures, dinners with industry and faculty, community service opportunities, and hands-on innovation experience. It is affiliated with Stanford Biodesign.

BDN – Stanford Biodesign Network. The Biodesign Network focuses on technology transfer, providing education, advocacy and mentoring to students and faculty who wish to bring their innovations forward through the university to be developed into commercialized healthcare products. BDN also provides connections to the professional communities that specialize in biomedical technology, such as investors, medical technology equipment manufacturers, and attorneys.

GSB – The Center for Entrepreneurial Studies at the Graduate School of Business. The Center for Entrepreneurial Studies was founded to address the need for greater understanding of the issues faced by entrepreneurial individuals and companies. The Center focuses on case development, research, curriculum development and student programs in the areas of entrepreneurship and venture capital, and also supports alumni and students engaged in entrepreneurial pursuits.

GSBEC – The Entrepreneur Club at the Graduate School of Business. The Entrepreneur Club at the Graduate School of Business is a student group with the goal of stimulating interest in entrepreneurship among GSB students and other members of the Stanford community. The group hosts frequent events and workshops to raise awareness about both traditional start-up paths and entrepreneurial "start-up" opportunities within existing organizations.

OTL – Stanford Office of Technology Licensing. The Stanford Office of Technology Licensing is responsible for managing the intellectual property assets of Stanford University. OTL receives invention disclosures from Stanford faculty, staff and students, evaluates these disclosures for their commercial possibilities, and when possible licenses them to industry. OTL has the responsibility to identify the best source or sources for commercialization, including large corporations, medium-sized companies and start-ups. Royalties collected by OTL provide funding to the inventors' departments and schools, as well as personal shares for the inventors themselves.

SLAC – Office of Technology Transfer at the Stanford Linear Accelerator Center. The Stanford Linear Accelerator Center is one of the world's leading research laboratories. Their mission is to design, construct, and operate state-of-the-art electron accelerators and related experimental facilities for use in high-energy physics and synchrotron radiation research. The Office of Technology Transfer at SLAC is responsible for managing the intellectual property assets at SLAC and oversees technology licensing for the Center.

SOAR – Stanford Office of Asian Relations. The mission of the Stanford Office of Asian Relations is to: (1) raise funds from Asia to support the university; (2) strengthen Stanford's relationship with alumni, parents, friends, and organizations in Asia and assist them with their Stanford interests; (3) work with schools, departments, institutes and centers at Stanford to promote their interests in the region.

SPRIE – Stanford Project on Regions of Innovation and Entrepreneurship. The mission of the Stanford Project on Regions of Innovation and Entrepreneurship is to contribute to the understanding and practice of innovation and entrepreneurship. Located within Stanford University's Asia/Pacific Research Center in the Institute for International Studies, SPRIE investigates a number of questions surrounding models and networks of innovation and entrepreneurship.

STVP – Stanford Technology Ventures Program. Stanford Technology Ventures Program is the entrepreneurship education center located within Stanford University's School of Engineering. STVP supports academic research on high-technology entrepreneurship and teaches a wide range of courses to scientists and engineers on campus. STVP has a strong outreach effort that includes hosting four international conferences on teaching entrepreneurship and extensive online resources open to all educators.

USATMC – U.S.–Asia Technology Management Center. The U.S.–Asia Technology Management Center is an education and research center located within the Stanford University School of Engineering. U.S.–ATMC programs aim at integrating practical perspectives into international strategic technology management along with analysis of research trends in selected areas of leading-edge electronics and information technology. U.S.–ATMC activities include public lecture series and seminars, sponsorship of faculty research projects, development and delivery of new university courses, and major Internet web site projects.