# Private Benefit from Public Good? Startup Strategies for Participation in an Open Standards Community

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**Abstract:**

Despite a vast economics literature on standards and a growing literature on open innovation communities, there exists little research on how firms should participate in open standards communities. In this study we examine U.S. based information technology startups that participate in the Internet Engineering Task Force, a volunteer organization that creates and approves internet standards. We compare the hazard of a liquidity event (an Initial Public Offering or Acquisition) for the startups who participate in the IETF community with those that do not. We identify and operationalize three types of open standards community participation: passive monitoring, technical contribution, and community leadership. IETF participation of any sort generally correlates with decreased time to IPO or acquisition, unless the startup possesses strong intellectual property protection. These benefits are retained regardless of the whether the startup enters the IETF space by recruiting engineers with pre-existing ties to the IETF community, or by developing its own talent.

## Introduction

Do firms that participate in the provision of open technology standards retain some private benefit? If yes, what forms of participation provide the greatest benefit? Should they always participate? Despite the dramatic rise of open innovation communities and their increasing influence on innovation, standards, and business strategy, these issues remain surprisingly unexplored (von Hippel and von Krogh 2003). The motivation for firms to understand and influence standards outcomes is obvious and large; firms that control or most rapidly implement emerging standards usually earn higher profits and greater market share. While much research has considered why standards emerge and how firms should compete for standards within a market context (Farrell and Saloner 1985, Farrell and Saloner 1988, David and Greenstein 1990, Garud and Kumaraswamy 1993, Bessen and Farrell 1994, Garud and Kumaraswamy 2002, West 2003), the work does not consider how a firm should strategize within an open standards community. Only recently has any research studied standards processes within open innovation communities (Mowery and Simcoe 2002, Simcoe 2004a, 2004b, Fleming and Waguespack 2004).

The question of how (or if) firms should participate in open standards communities is part of the larger question of why and how individuals and firms should participate in open source communities. A flurry of recent work has established the private benefits for individuals who contribute to open innovation communities. Such benefits include personal skill improvement, job mobility (Lerner and Tirole 2001), higher wages (Hahn et al. 2002), solution of a local technical problem (von Hippel 2001), communal

acceptance, and intrinsically satisfying creative opportunities (Lakhani and Wolf 2005). These results and their focus remain important, but ignore the fact that most of these contributors work for firms that must support – or at best tolerate – these individuals' investment of time and most often, use of corporate resources. The investments can be quite large, mostly in programming time (Lakhani and Wolf 2005), in addition to travel expenses and use of the firm's assets and R&D infrastructure (David and Greenstein 1990). Recent work on the motivation for firms' participation include improving reputation, economizing on innovation resources, acquiring functionality or expertise not available inside the firm, or identifying talented individuals for future employment (Henkel and Tins 2004). Other more strategic reasons include emancipation from proprietary platforms (Bonaccorsi and Rossi 2004) and the opportunity to threaten rivals (Rossi 2004).

Our research question therefore lies at the unexplored nexus of these two more mature literatures on standards and open source participation. This nexus highlights the question: how should firms participate in open standards communities? Firms and their employees have a number of possibilities with respect to this question. Since membership is open to all within an open standards community, firms can simply monitor the developments. Monitoring keeps managers abreast of the general direction of the technology's evolution and enables them to ignore, incorporate, compete with, or buy the emerging standard or its owner. More expensive strategies include attempting to directly influence the technological direction of the community through the sponsorship of engineers and technical expertise. Even more expensive participation includes providing

leaders to the communities, which often constitutes a full time job for the involved individual. The question is particularly crucial for startups due to their limited personnel and financial resources. Since high technology startups tend to rely on a few individuals and typically lack a staff of established "standards" professionals, participation can be quite costly if key individuals are distracted from work that directly benefits the firm. Hence, it becomes important to understand which participation strategies provide the largest benefit, and how those strategies fit into the startup's overall strategic plans.

This paper investigates the question of the private benefits to participation in an open standards community by first elaborating on the processes and outcomes of the Internet Engineering Task Force (IETF), an open innovation community that has directed the evolution of internet standards since the technology's inception. From there we propose hypotheses related to discrete types of firm participation in open communities, and then test these hypotheses using a sample of 9516 US based information technology and venture funded startup companies. The major finding is that startups directly interacting with the IETF experience a benefit in the form of decreased time to an Initial Public Offering (IPO) or acquisition event. Surprisingly, technical contribution provides little benefit to startups, relative to simple monitoring or active leadership. While firms with patents experience an IPO or acquisition event faster, the marginal benefit from patenting decreases if the firm simultaneously pursues an open community technical contribution or leadership strategy. The effectiveness of participation remains whether the startup enters the IETF community via recruitment of existing members or development of its own talent.

## The IETF, An Archetype Open Standards and Innovation Community

While the IETF is an open standards community rather than an open source community, it shares the critical "open community" features in that any individual can participate, most of the participants think of themselves as software developers (Simcoe 2004b), proceedings are transparent, and all resulting technology is freely available (Bradner 1999). The IETF is also the most long lived of the well-known open innovation communities and arguably the group with the greatest social and economic impact because of its association with the Internet. According to Scott Bradner, a long time IETF member:

> The IETF and its standards have succeeded for the same sorts of reasons that the Open Source community is taking off. IETF standards are developed in an open, all-inclusive process in which any interested individual can participate. All IETF documents are freely available over the Internet and can be reproduced at will. In fact the IETF's open document process is a case study in the potential of the Open Source movement...The IETF supported the concept of open sources long before the Open Source movement was formed. (Bradner 1999 pgs. 47 and 52)

The IETF formed in 1986 from an amalgam of ad hoc technical committees advising the Defense Advanced Research Projects Administration (DARPA) on the original ARPANET Internet backbone, and coalesced as commercial Internet service providers began to emerge and replace both networks. The IETF has no official mandate for governing Internet technology, and although the group has been challenged by more traditional standards-developing organizations and even government bodies, it has nonetheless emerged as the *de facto* standards developing organization for the Internet (Abbate 1999, Mowery and Simcoe 2002; see also Harris 2001, Bradner 1996, Bradner 1998, and Hoffman and Bradner 2002 for insiders' descriptions of the IETF).

The IETF develops and maintains the core Internet standard, TCP/IP, and a large variety of other standards that are largely invisible to typical users but are pervasive in modern computing and networking. While much of the communication and work of the task force occurs over electronic media, the organization members meet physically three times each year, a tradition started with the first meeting of 21 "IETFers" in San Diego in January 1986. Membership is open to all comers and persons participating in the IETF do so at least nominally as individuals (Bradner 1999). They are usually employed, however, by firms, universities, or governments. There are no dues or membership lists, so in principle any person with an Internet connection or in attendance of one of the meetings can "join" the IETF.

The IETF accomplishes most of its work within aptly named Working Groups (WG), each of which is organized under a larger functional area. Individuals can freely associate with any of the extant technical working groups through virtual or physical participation. The groups receive a time and domain limited charter over specific technical problems. For example, the Secure Shell Group updates and standardizes the popular SSH protocol for secure remote login to a server (i.e. a secure alternative to telnet) (Secure Shell secsh 2003). Each working group has a chair(s), as well as individuals or design teams from within the group that produce documents detailing proposed standards. Following the emergence of rough consensus and demonstration of working prototypes, the Working Group Chair forwards the proposed solution or standard

to the Area Director (AD) for final acceptance. The Area Directors screen all WG standard proposals and appoint Working Group Chairs.

New working groups emerge mainly from grass roots interest in a emerging problem or promising new technology, and are typically preceded by a "Birds of a Feather" (BOF) meeting during a conference. IETF members organize BOFs by soliciting participants through an electronic invitation on the IETF mailing list. With favorable sign-up response, the organizer is given physical meeting space at the next IETF conference. If the meeting is well attended and generates broad interest, an Area Director will then develop the group's charter and usually appoint the BOF organizer as the Working Group Chair. Hence, appointment can be thought of as a confirmation of successful, yet informal, open community leadership. Even though many individuals participate online and physically attend conferences, very few advance to these leadership roles in the organization. For instance, of the 955 unique individuals first attending an IETF meeting in 1995, only 34 have become WG chairs.[1]

**How participation in an open standards community benefits a startup firm** [2]

The most common and cheapest method of participation in the IETF is to simply monitor the community's activities. This occurs with on-line monitoring of standards, via emails or perusal of proceedings or standards. The IETF, like many open innovation communities (Raymond 2000), also relies upon physical interaction, however, and much

[1] Much of this basic description of the IETF builds upon Fleming and Waguespack (2004).
[2] To understand how startups participate in the IETF and how that participation might benefit them, we researched the online archives of the IETF and interviewed Scott Bradner, an IETF founder who has

of the real consensus building and innovation happens at the triennial conferences. Physical attendance provides superior monitoring because much information is disclosed and discussed both formally and informally at conferences. Furthermore, a large amount of the emergent standards knowledge is changing and tacit and this knowledge is more easily transferred in person (Rosenkopf et al. 2001). Monitoring is a relatively passive strategy, but still allows the firm to hear about, and before a standard is finalized, how a crucial technology is evolving.[3] Startups that monitor effectively can incorporate this knowledge more quickly into their products and hence bring products to market faster (Yli-Renko et al. 2001). This product advantage makes them more ready for IPO and more attractive for acquisition. Monitoring and attendance also enables a startup, "to place itself on the radar screens of other, more established organizations." (Rosenkopf et al. 2001). Potential buyers will be especially important for firms looking to be acquired. Therefore, we expect that monitoring decreases a startup's time to a liquidity event.

H1: S*tartups that monitor an open standards community are more likely to experience an IPO or acquisition.*

A more proactive strategy for firms is to actively influence the community's innovation and technological direction. Startups with a lead in what becomes a community standard are extremely well positioned. Quite often they will have the first product on the market. Furthermore, and regardless of whether the standard endorses the firm's technology, the firm's engineers will benefit from active participation in the process. As Sirbu and Hughes describe the evolution of Local Area Network standards (cited in David and

advised multiple technology startups, serves on the board of U.S. Venture Partners, and has founded a firm himself (Bradner 2004).

[3] Indeed, many established firms adopt the strategy of monitoring startups, and then simply buying those startup with the most promising technology (Bradner 2004).

Greenstein 1990), "…firms that invested resources in mastering the process influenced it in directions favorable to their interests. Mastering the technical aspects was especially significant when standards evolved, and the relevant committees were obliged to consider additions, variations, and new options." Because a firm's engineers actively build and test the standard, they will be very close to the technology and able to immediately incorporate the latest innovation within the firm's product. Being part of the innovating team will give the engineers a much deeper understanding than a passive monitoring strategy. As a result, firms whose employees co-author standards are much more likely to be the first to implement the standard (Bradner 2004).

Standards authors will also learn from engineers at other organizations and possibly be able to leverage other organizations' resources in building and testing technology. This is particularly important for small and entrepreneurial organizations without private access to physical resources and large engineering staffs (David and Greenstein 1990). Based on these arguments, we would expect to observe that direct technical involvement and contribution would decrease a startup's time to a liquidity event.

*H2: Startups that contribute technically to an open standards community are more likely to experience an IPO or acquisition.*

Purely technical contribution provides a firm the opportunity to directly influence the evolution of technical and community standards. Individual contributors must work with other individuals as peers, however, and can only rely on personal argument and contribution to influence the standards outcome. Nonetheless these communities do recognize informal leaders, and these leaders have various means, both procedural, and

personal, with which they can influence the standards process. First of all, they can call attention to needed innovations and standards. In the IETF, this occurs when an individual proposes a Birds of a Feather session. Many other communities accomplish this step through purely electronic means. Second, informal leaders can broker between competing factions (Fleming and Waguespack 2004). This enables them to manipulate information flow and direct the conversation and resolution of controversies (Burt 1992). Brokers also gain insight across the community at a higher and deeper level than simple technical contributors. Becoming a leader in these communities requires a large commitment of resources for a firm, because leaders must attend conferences until the standard is adopted, plan, manage, and review all the work within their groups, and liaison with other groups. Leaders must invest many hours outside of conference time and it is likely that these hours would detract from their job performance. This investment should provide greater benefit, however, than simple monitoring and even technical contribution, because the leader understands broader technical issues and has greater informal power to shape the direction of standards evolution. Based on these arguments, we would anticipate that direct technical involvement and contribution would decrease a startup's time to a liquidity event.

*H3: Startups that provide leaders to an open standards community are more likely to experience an IPO or acquisition.*

Given the cost of participation and the typical resource poor position of most startups, should a firm always support participation of its employees? In particular, when should they attempt the costlier strategies of technical contribution and leadership? We propose that startups with strong intellectual property position should avoid more active

participation, for four reasons. First, firms whose employees participate in open standards communities always risk losing their proprietary advantage (Rosenkopf et al. 2001). Engineers typically communicate a great deal of information across firm boundaries (Allen 1977, von Hippel 1988, Fleming et al. 2004), and given that open innovation communities profess strong norms of open information flow (Fleming and Waguespack 2004), it is unlikely that a proprietary secret would be kept long in such a context. Although patents may seemingly protect a firm and allow them to participate without risk, much of the effort in open innovation communities goes to innovating around patents (Brim 2004). It would be difficult to actively contribute as an engineer without facilitating such a process. Second, open innovation communities tend to distrust and dislike firms with patents, unless the owner can reassure community members that they will license the patent widely and support efforts to incorporate and understand the technology (Brim 2004). This distrust will require the startup to invest additional resources to overcome resistance to the firm's goals. Third, firms with previously working technology run the risk of making their products worse, if they are forced to build in capabilities for additional standards. Finally, startups are ill-equipped to lose vital technical personnel just prior to their IPO or acquisition. Resources spent in a community effort could be better used developing proprietary technology. Based on these arguments, we would expect to observe that the marginal benefits of active participation (technical contribution and leadership) would decrease for a firm with strong intellectual property protection. Firms with IP protection should not actively participate in a lengthy, expensive, and tedious open standards process.

*H4: Startups with strong intellectual property protection are less likely to experience an IPO or acquisition if they actively participate in an open standards community.*

## Empirical Context: Venture Funded Startups and the IETF

We assess the question of whether public goods providers retain private benefits from open standards community participation in the Venture Capital (VC) arena. VC firms, typically composed of principals who are former entrepreneurs and technology leaders, pool investment capital from third parties, and then take investing stakes in a portfolio of private companies. These private startups are generally small, have few tangible assets, and operate in very uncertain markets (Gompers and Lerner 2001). The VC firm only realizes a return on its investment when the startup "exits" via an initial public offering or acquisition by another company.

Figures 1 and 2 provide a snapshot of the information technology sector of venture funded startups for 1988 to 2000. Figure 1 shows the number of new companies by entry year, with entry year determined by the date of the first round of venture capital investment, and by whether or not these companies participate in the IETF in any form. Figure 2 shows eventual exit rates, with exit data running through the first quarter of 2002, for IETF related and non-IETF related startups. Several implications are readily observable in these figures. First, the number of venture funded companies has grown dramatically over time, with over a 10-fold increase in new companies from 1988 to 2000. Were this data series to extend into the current millennium, this trend would show a slight decline but still indicate that the venture funding industry has grown substantially. Second, venture investing is a risky proposition. Overall exit rates in figure 2 at best hover slightly above 50%. Third, time to exit is a critical component for the researcher in modeling the exit outcome. Although exit is a binary outcome, if

history is a guide then it is clear that startups entering in later years have a censored outcome, and may simply be too immature to have a successful exit by the end of the study period. Finally, the ratio of new entrants participating in the IETF (with participation occurring prior to any exit) over time has remained relatively stable and these startups have been particularly successful. Overall, 521 unique VC funded IT startups contributed to the IETF and of these 175 (33.6%) have a successful exit, compared with an overall exit rate of 18.9% for the 8995 companies with no IETF involvement. Figure 2 shows the exit rate for both groups of startups converging with the 1998 cohort, which assuming it typically takes at least two to three years from entry to the first possibility of exit, is roughly the point at which the Internet Bubble collapse starkly diminishes the prospects for small companies and at which data truncation comes into play. Prior to the 1998 cohort, however, IETF participant companies appear to enjoy a large premium on exit.

Two examples help to illustrate the path from IETF participation to exit. ValiCert is a Mountain View California based company that develops digital certification technology. It received its first round of venture capital in May 1998 from high profile VC firms such as U.S. Venture Partners and Draper, Fisher, Jurvetson. Ultimately raising more than $29 million, ValiCert completed an IPO on July 28 2000. Prior to receiving its IPO or even its first venture investment, Valicert had a significant presence at the IETF, sending as many as 3 employees to each IETF meeting and publishing two technical standards with firm employees as co-authors. Subsequent to the IPO Valicert has maintained its presence at IETF meetings. Valicert was merged into Tumbleweed Communications in

April 2003. In a second example, Longitude Systems was a Washington D.C. Metroplex based company that developed support software for communications service providers. The company received its first VC investment in October 1997, and overall raised approximately $10 million, again from such prominent investors as Draper, Fisher, Jurvetson, and Redpoint Ventures. Longitude Systems was acquired in November 2001 by Vibrant Solutions, Inc. Longitude Systems was founded by IETF veterans Stephen Crocker and Joel Halpern, and its employees appear in IETF records at conferences and as working group chairs prior to its sale.

While the two examples present anecdotal evidence that companies participating in open communities retain private benefits, we believe the VC funded startup domain in general presents an excellent opportunity for rigorously testing hypotheses about the private benefits to companies developing traditional intellectual property and participating in open technological communities. The population of VC funded startups is quite large and well defined, which allows the researcher to construct well controlled empirical models and avoid the problem of selection bias that plagues much extant empirical literature on open innovation. In other words, failed companies and failed efforts to engage an open community are readily observable when the sample is defined as the population potentially interested in open communities, rather than the sample that *successfully participates* in such communities. Furthermore, one can make realistic assumptions about the strategic intent of these startups. The goal of the investor, the venture capitalist, is to recoup her investment through an initial public offering or acquisition (Gompers and Lerner 2001), and not simply to maintain a small private

company or consulting shop. Likewise, the presence of the venture capitalist presumably means that the resource allocation decisions of these small and cash-constrained companies are scrutinized very closely by dispassionate investors. Participation in open communities is costly for small companies, both in terms of employee hours devoted to public goods provision and in terms of lost opportunities to develop proprietary products. While large public firms may have the slack to broadly scan the technology landscape or engage in vaguely defined research and development efforts, and closely held private companies may have the flexibility to indulge activities that do not contribute the bottom line, we assume that the decision to participate in open innovation by VC funded startups is strictly driven by the belief that such efforts will increase the probability of a successful IPO or sale.

**Data**

Our primary data source is the Thomson Financial's Venture Economics (2002) database of venture funded startups. Venture Economics provides basic information on a large sample of privately funded companies, in excess of 44000 operating in the past four decades. This information includes the company's location, dates and amounts of funding, industrial classifications, and the company's ultimate status. We extended this data by linking each startup company to United States patents assignees, and to the companies participating in the IETF.

For statistical analysis we selected venture funded companies in the broadly defined information technology (IT) industry that were based in the United States and received an

initial venture capital investment between 1988 and 2000. While Venture Economics covers a broad range of industries, we excluded health-related and non-high technology industries upon the assumption that internetworking technology was marginally important to these companies and upon the observation that fewer than 10 of these 23000 companies appear anywhere in the IETF archives. On the other hand, within the sub-industries of information technology as defined by Venture Economics there is surprisingly broad participation in the IETF, including such seemingly unrelated industries as Fiber Optics and Medical Software Services. Rather than limit industry selection in an ad hoc manner, we instead include a wide array of industry controls in statistical models. We excluded foreign based firms because in practice the IETF is predominantly a US phenomenon. By convention two of the three annual IETF meetings are held in North America, and the majority of individuals participating reside in the United States. Foreign based startups in Venture Economics also have much lower exit rates than their US based counterparts as well lower rates of IETF participation, so our expectation is that this exclusion will in balance result in more stringent hypotheses tests. Finally, the IETF initiated its current working group structure in 1989, which is also roughly the first point at which commercial entities become involved in the Internet.

The above selection procedures net 9516 private companies. We construct multiple observations for each company, tracking each through 4 month observation periods from entry at the time of the first venture capital investment to exit via an IPO or sale, or censoring at the end of the study in the first trimester of 2002. The four month interval was selected to match the activities of the IETF, which holds meetings on a four month

cycle. The four month interval setup also allows controls for environmental conditions, such as the state of the IPO market, that affect existing populations of startups (Stuart et al. 1999).

Table 1 provides descriptive statistics at the company/period unit of analysis, and Table 2 reports bi-variate correlations for the independent variables of interest. The dependent variable *Exit* is a simple dummy variable with a value of one if the company exits via an IPO or an acquisition in the *next time period*. We chose the one period lead on the dependent variable as it is very common in practice for newly exited and better capitalized to begin participation in the IETF at this point. For supplemental analysis, the dependent variable is also broken into its components, *Acquisition* and *IPO*, which have the same coding and lead time as the main dependent variable. Over the course of the study 870 startups experience an IPO and 1010 are acquired.

The independent variable *Patent Stock* is the natural log of the cumulative count of granted patents held by the company. *Conference Attendance* is the count of company employees attending IETF meetings, and not concurrently holding an appointment as an IETF working group chair, in the prior 12 months inclusive. *Standards Publications* is the count of technical standards ("standards RFCs" in IETF jargon) published in the prior 12 months inclusive on which company employees appear as authors. *Information/Experimental Publications* counts the number of information documents ("non-standards RFCs" in IETF jargon) published by firm employees in the prior 12 months inclusive. The standards and informational/experimental track documents differ

primarily in the way the sponsoring authors must approach the IETF. Standards documents must go through revision within a working group prior to submission to IETF oversight committees, and additionally imply that the authors will follow-up to assist with interoperability. Informational/Experimental documents by contrast can come from individuals otherwise unaffiliated with the IETF and imply no additional obligations. *Working Group Chairs* is the count of working group chair positions held by the startup's employees in the prior 12 months inclusive. *IETF Technology* is a composite dummy variable, equaling one if the company has either held working group chair positions or published technical standards in the prior 12 months. Either of these activities indicate that the firm is actively participating in collaborative technology development via the IETF's working group process.

Finally, as the IETF data consists of observations on individuals and not just their employers, we are able to split the startup's IETF activities into two separate components based on what kind of prior relationship any given employee has with the IETF community. These two components are "recruited" talent, those people who have participated in the IETF in the past for a company other than the startup currently employing them, and "newcomer" talent, those individuals whose prior IETF experience is only with the startup currently employing them. The *Newcomer* prefix variables are counts as the other IETF variables above, with the exception that scores associated with "recruited" individuals are subtracted.

The independent variables of interest are tested against a broad set of controls. *Boston* and *Silicon Valley* are dummy variables indicating the company is located in one of those regions. *Total Invested* is the natural log of total venture capital invested to date, expressed in 1990 million dollar units using the US Federal Reserve GDP Chain-Type deflator. This controls for better funded firms being more able to participate in the IETF. *VC Syndicate Size* indicates the cumulative number of unique VC firms taking a stake in the startup. *Startup Cohort Size* captures startup crowding by recording the number of new companies entering in the focal startup's cohort year. *Market Heat* is a gauge of the state of the external market, and measures the number of companies successfully exiting in the prior trimester. Each model also includes 27 *Industry Dummies* based on the Venture Economics classification scheme.

**Results**

In Table 3 we report hazard model coefficient for the duration T from entry at first VC investment to an IPO or acquisition. Although exit is a binary outcome, we employ a hazard rate model to allow for censored observations. We estimated semi-parametric Cox models, in order to avoid making parametric assumptions about the form of duration dependence in the underlying hazard rate (Cox 1972). The model's hazard rate is the product of an unspecified baseline rate, $h(t)$, and an exponential term that includes covariates $X$. Taking the anti-log of any coefficient gives the increase in the odds of exit over the baseline hazard rate at any given t, holding all else constant. All analyses were done in Stata.

Table 3 provides evidence to support all except the second hypothesis. Considering the control variables first in Model 1, it appears that location in Boston and Silicon Valley has no effect on time to a liquidity event. As would be expected, total investment, the size of the VC syndicate, and market conditions all in increase the probability of an event at any given point in time. Members of large founding cohorts, however, take longer to experience a liquidity event. Models 2, 3, and 4 include individual measures of scanning (conference attendance), contribution (publication of drafts), and leadership (serving as a working group leader). Each term individually has a positive influence, as expected. When these measures are included together, however, the influence of drafts becomes insignificant. Conference attendance remains significant, however, and demonstrates an 8.5% increase with each attendee in the full model 5 (a one standard deviation increase in the variable corresponds to a 9.4% increase). Working group leadership demonstrates a 21.5% increase with each additional leader and a 5.3% increase with a one standard deviation increase of the variable. Despite the fact that Conference attendance and Working Group leadership are individually and jointly significantly different from zero, in likelihood ratio tests the coefficients are not significantly different from one another.

Model 6 provides support for hypothesis 4, that firms with strong intellectual property protection will experience a negative marginal effect from active participation. Patents (*Patent Stock*) decreases the time to an event by 10.1% and active participation (*IETF Tech.*) strategies decrease the time by 8.8%. The interaction (*Patent Stock * IETF Tech.*), however, increases the time to an event by 9.7%. Given the similarity in the magnitudes of the coefficients, a firm will see little overall impact from participation. Nonetheless

the results suggest that small resource constrained firms that simultaneously develop proprietary intellectual property and assist in developing open technology will negate the positive effects of either strategy.

Table 4 presents selected supplemental results. The well-established finding in the open source literature that individual contributors to open technology benefit through enhanced job mobility begs the question of whether startups deliberately choose to enter the IETF space, or whether in fact they do so accidentally and solely as a consequence of recruiting talented software engineers who compel their new employers to fund their extra-curricular activities. IETFers, like members of other open communities, profess strong allegiances to the community and are highly mobile. For instance, of the roughly five thousand IETFers who attend 3 or more conferences between 1986 and 2002, over 60% change affiliations at least once. Thus it may be that the positive effects of IETF participation seen in Table 4 are associated with recruiting and the startup's technology strategy. Model 7 in Table 5 assesses this by restricting counts on IETF participation to "newcomer" talent, those individuals who have no prior IETF appearances with a different employer. The results in model 7 are quite similar to those in model 5. In unreported results we also found a similar effect when counts are recruited talent, indicating that the manner in which a startup enters the IETF is largely irrelevant.

Models 8-11 check whether the results are robust for each type of exit event. In models 8 and 9, the exit is an IPO, and firms with an acquisition are treated as censored. In models 10 and 11 the exit is an acquisition, and firms with an IPO are treated as censored. The

results are similar to those specifications with two exceptions. First, the positive coefficient on WG Chair (model 8) for IPOs is significantly larger than the positive coefficient on conference attendance, meaning the startup gets greater benefit from a leadership position than simple monitoring. Second, the WG Chair (model 10) is not significant to an acquisition. Our interpretation of this finding, consistent with reports from our IETF fieldwork and with manual checks of the data, is that startups initiating a new working group via the BOF process become attractive acquisition targets prior to the startup's employees actually assuming the WG chair position. Thus the startup wins a new WG chair appointment, but is bought before actually assuming the position and hence will not appear in the archival records. The consistent influence of monitoring provides support for the radar screen argument, that startups use physical attendance to engage potential buyers.

An alternative explanation of the results in Table 4 is that this was a situation where the overall growth and success of the Internet simply carried along those startups that were fortunate enough to be involved with the IETF. We expect that the control variables on market conditions, the heat of the liquidity market and the crowding of new entrants, control for this possibility. In unreported results we also re-ran model 5, restricting analysis to the mid 1999 and later post Internet bubble period. The results for the post-bubble analysis subset are similar to model 5, with significant positive coefficients on working group chair and conference attendance (one-tailed; $p < .05$), and insignificant coefficients on other IETF actions.

## Discussion

Despite the significant results, further work will be necessary to fully understand the mechanisms of how firms participate most effectively in open standards communities. Causality, for example, remains problematic. Do IETF participants decrease their firm's time to an event because they participate, or do they participate and decrease the time because they are outstanding technical contributors and leaders? Case studies of elite technical leaders and measures of their human and social capital stock would give us a better handle on the direction of causality. Omitted variable bias poses another problem. For example, some firms in the sample have more to gain from IETF participation than others. One approach to solving this problem would be to instrument actual participation with the cost of participation (Fleming and Waguespack 2004). The interaction of intellectual property protection and open standards communities remains understudied, both qualitatively and quantitatively. Field work should interview the active participants from firms with strong IP protection and additional measures, such as the IETF's IP disclosures (patents, some of which are promised to be widely licensed), should be gathered.

Strategic implications for firms can still be drawn from the current research, however. Each of the strategies – monitoring, technical contribution, and community leadership – must be accomplished by a member of the IETF. Given the openness of the organization, however, members can be newly arrived, or recruited from existing members. Depending on a firm's goals, it will be better under some circumstances to recruit and in others, to sponsor new members of the community. With whom a firm implements its

strategies matters. We see this in the supplemental models that split out the effects from individuals with a prior affiliation that differs from their current employer. Firms that desired to be acquired are most interested in gaining visibility (Rosenkopf et al. 2001), network connections, and opportunities for being purchased. Although developing a working product would still be important, it would be less important than for a firm that was attempting an IPO. Floating an IPO would be more difficult and require greater evidence of viability. For example, while acquiring firms could appreciate immature technologies, investors would probably demand to see a working product and satisfied customers. This argument would imply a greater value to the more intensive strategies, such as technical contribution and leadership.

While this paper considered how startups should engage an open standards community, established firms should carefully consider the strategic implications of these results and the larger literature on open innovation communities. Perhaps the first realization is that established firms cannot treat an open standards community with predatory intent, particularly if the established firm intends to remain in a fast moving technological area. Unlike most models of market competition for standards, winners in open standards communities must work with the losers to develop future standards. Established firms that gain a bad reputation will be shunned in future efforts, despite their having legal access to an open community. Enlightened firms will consider the vitality and health of the community eco-system before adopting predatory practices (Iansiti and Levien 2004). Given that startups provide very effective means of experimentation, large firms would do well to ensure the creation and success of startups, as future customers and potential

acquisition targets. Established firms can also uphold norms of cooperation and focus on technical solutions, make judicious investments of physical, personnel, and status resources, and broker relationships between competitive startups. Given the multitude of strategic nuances, the challenge for established firm participation is not trivial. Standards are crucially important and firms must adjust quickly to subtle market, political, and technical challenges. This implies that established firms should invest respected people in participation and not simply assign "standards" professionals to the community. The firm's community gatekeepers should have access to senior decision makers, so that the firm can react quickly to competitive, cooperative, or acquisition opportunities. The topic strikes us as an important area for future strategy research.

Finally, and consistent with the ideals of a healthy eco-system, the results highlight the strategic importance of leadership in open innovation communities. While the importance of leadership has been widely acknowledged within the communities themselves (DiBona, Ockman, and Stone 1999, Raymond 2000) and by social scientists (Kogut and Metiu 2001, Lee and Cole 2003, Fleming and Waguespack 2004), we believe this is the first research that demonstrates the advantages to firms that employ open innovation community leaders. Open innovation communities need leaders and firms benefit by sponsoring them.

## Conclusion

This research sought to answer how a firm, and in particular, a startup, should participate within an open standards community. It described three strategies that a firm can use to

participate within a community: passive monitoring and more active technical contribution and leadership. All three strategies decreased the time to a liquidity event for U.S. startups, though technical contribution was not always significant, and leadership had a greater impact upon IPO than acquisition. Firms with patent portfolios saw a marginal increase in their time to an event if they participated actively, with either technical contribution or leadership. Results were broadly similar if the firm recruited existing community members or sponsored a newcomer.

Open standards communities represent a unique opportunity to study the changing landscape of innovation and innovation-based competition. Unlike open source communities, where motives for firms remain murky without deeper consideration and research, it is extremely clear why a firm cares about open standards communities. Standards, whether de facto, de jure, or community developed, have a huge impact on a firm's success, and firms ignore them at their peril, regardless of their source. This context, simultaneously important to firm strategy and hacker gifting, makes open standards communities an outstanding opportunity for furthering our understanding of the new "private-collective" model of innovation (von Hippel and von Krogh 2003).

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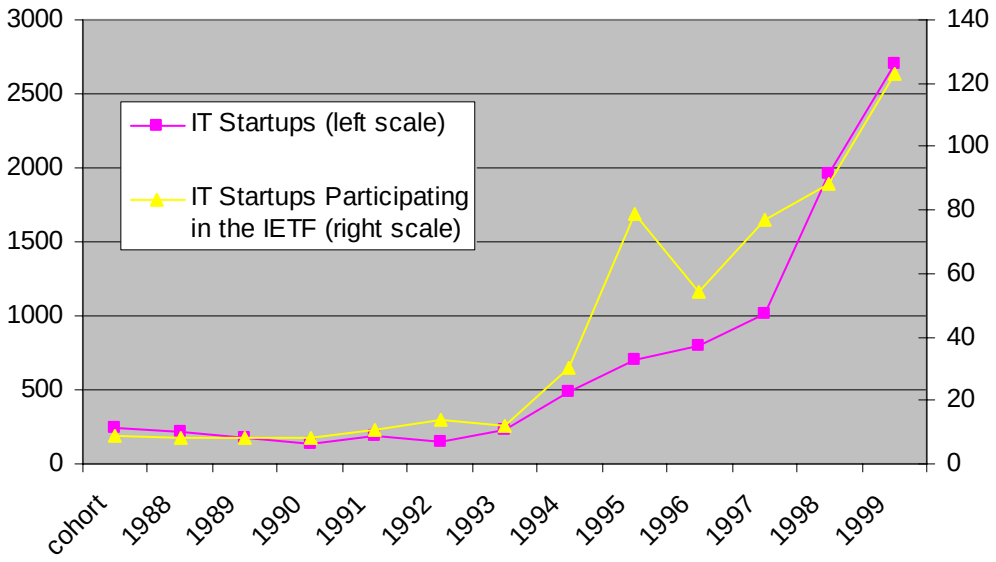
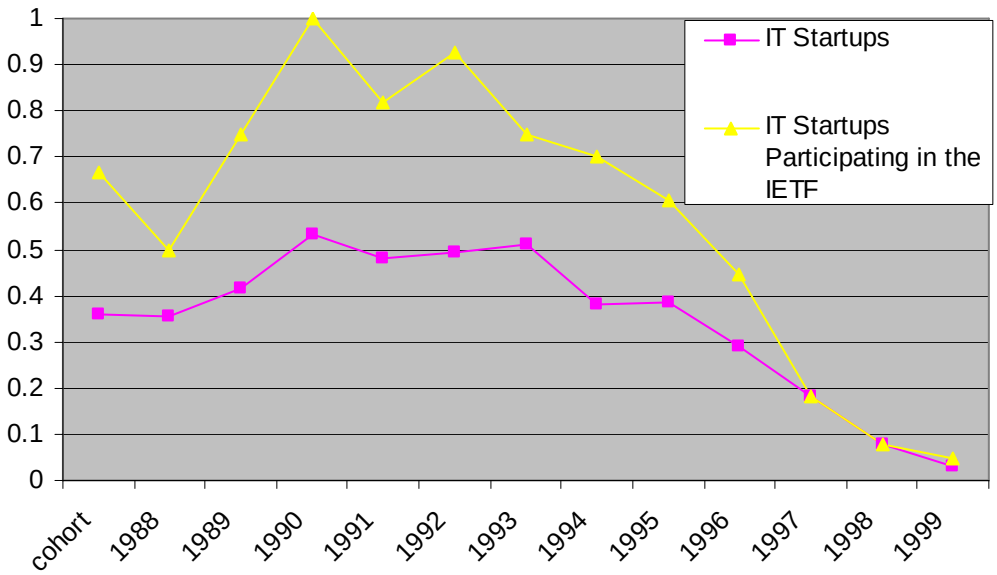
## Figure 1: New IT Startups by Entry Year (First VC Investment)




## Figure 2: Exit Rates for IT Startups by Entry Year (First VC Investment)



| Variable | N | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|---|
| Exit | 110500 | 0.017 | 0.129 | 0.000 | 1.000 |
| Acquisition | 110500 | 0.009 | 0.095 | 0.000 | 1.000 |
| IPO | 110500 | 0.008 | 0.088 | 0.000 | 1.000 |
| Boston | 110500 | 0.102 | 0.303 | 0.000 | 1.000 |
| Silicon Valley | 110500 | 0.305 | 0.460 | 0.000 | 1.000 |
| Total Invested (1990 $ ) | 110500 | 0.116 | 0.177 | 0.000 | 3.190 |
| VC Syndicate Size | 110500 | 3.093 | 2.952 | 0.000 | 31.000 |
| Startup Cohort Size (100s) | 110500 | 11.284 | 9.368 | 1.410 | 28.200 |
| Market Heat (100s) | 110500 | 0.793 | 0.558 | 0.000 | 1.920 |
| Patent stock (ln) | 110500 | 0.144 | 0.483 | 0.000 | 5.263 |
| Conf. Attendance | 110500 | 0.062 | 0.606 | 0.000 | 35.000 |
| Standards Pubs | 110500 | 0.003 | 0.091 | 0.000 | 7.000 |
| Info./Exp. Pubs | 110500 | 0.003 | 0.074 | 0.000 | 6.000 |
| WG Chairs | 110500 | 0.006 | 0.141 | 0.000 | 8.000 |
| IETF Tech. (WG Chair or Standard) | 110500 | 0.004 | 0.061 | 0.000 | 1.000 |
| Newcomer Conf. Attendance | 110500 | 0.031 | 0.377 | 0.000 | 23.000 |
| Newcomer Standards Pubs | 110500 | 0.002 | 0.063 | 0.000 | 5.000 |
| Newcomer Info./Exp. Pubs | 110500 | 0.002 | 0.048 | 0.000 | 4.000 |
| Newcomer WG Chairs | 110500 | 0.001 | 0.059 | 0.000 | 4.000 |

Table 1: Company/period descriptive statistics.

| | Patent stock (ln) | Conf. Attendance | Standards Pubs | Info./Exp. Pubs | WG Chairs |
|---|---|---|---|---|---|
| Patent stock (ln) | 1 | | | | |
| Conf. Attendance | 0.0244 | 1 | | | |
| Standards Pubs | 0.0271 | 0.2491 | 1 | | |
| Info./Exp. Pubs | 0.0319 | 0.2486 | 0.2678 | 1 | |
| WG Chairs | 0.0219 | 0.2482 | 0.2122 | 0.443 | 1 |

Table 2: Bi-Variate Correlation Matrix for the Main Independent Variables..

Table 3: Cox Proportional Hazard Models estimates for Startup Company Exit.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Exit (IPO or Acquisition) at t | | | | | |
| Boston | 0.039 | 0.027 | 0.032 | 0.035 | 0.020 | 0.017 |
| | (0.076) | (0.076) | (0.076) | (0.076) | (0.076) | (0.076) |
| Silicon Valley | -0.048 | -0.053 | -0.049 | -0.052 | -0.055 | -0.059 |
| | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) |
| Total Invested | 0.450 | 0.426 | 0.439 | 0.438 | 0.423 | 0.424 |
| | (0.142)** | (0.142)** | (0.142)** | (0.143)** | (0.143)** | (0.144)** |
| VC Syndicate size | 0.110 | 0.109 | 0.110 | 0.111 | 0.110 | 0.109 |
| | (0.008)** | (0.008)** | (0.008)** | (0.008)** | (0.008)** | (0.008)** |
| Startup Cohort Size | -0.093 | -0.092 | -0.092 | -0.093 | -0.092 | -0.092 |
| | (0.005)** | (0.005)** | (0.005)** | (0.005)** | (0.005)** | (0.005)** |
| Market Heat | 0.513 | 0.512 | 0.511 | 0.513 | 0.512 | 0.512 |
| | (0.040)** | (0.040)** | (0.040)** | (0.040)** | (0.040)** | (0.040)** |
| Industry Dummies | (27,**) | (27,*) | (27,*) | (27,*) | (27,*) | (27,*) |
| | | | | | | |
| Patent stock | 0.201 | 0.191 | 0.193 | 0.196 | 0.190 | 0.210 |
| | (0.045)** | (0.046)** | (0.045)** | (0.045)** | (0.046)** | (0.045)** |
| Conf. Attendance | | 0.095 | | | 0.082 | 0.073 |
| | | (0.017)** | | | (0.018)** | (0.020)** |
| Standards Pubs | | | 0.248 | | 0.145 | |
| | | | (0.093)** | | (0.108) | |
| Info./Exp. Pubs | | | 0.239 | | -0.083 | 0.035 |
| | | | (0.128)+ | | (0.131) | (0.138) |
| WG Chairs | | | | 0.286 | 0.195 | |
| | | | | (0.056)** | (0.068)** | |
| IETF Tech. (WG/Stand) | | | | | | 0.808 |
| | | | | | | (0.227)** |
| Patent * IETF Tech. | | | | | | -0.735 |
| | | | | | | (0.287)* |
| Observations | 110500 | 110500 | 110500 | 110500 | 110500 | 110500 |
| Log Likelihood | -15391.72 | -15378.66 | -15386.52 | -15384.56 | -15374.61 | -15371.08 |

Robust standard errors in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 4: Cox Proportional Hazard Models estimates for Startup Company Exit.

| | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|
| | Exit (IPO or Acquisition) at t | IPO at t | | Acquisition at t | |
| Boston | 0.030 | -0.317 | -0.293 | 0.250 | 0.254 |
| | (0.076) | (0.128)* | (0.127)* | (0.097)** | (0.097)** |
| Silicon Valley | -0.047 | -0.087 | -0.073 | -0.025 | -0.019 |
| | (0.053) | (0.077) | (0.077) | (0.073) | (0.073) |
| Total Invested (ln 1990 ) | 0.445 | 1.286 | 1.293 | -1.077 | -1.042 |
| | (0.142)** | (0.157)** | (0.158)** | (0.300)** | (0.297)** |
| VC Syndicate size | 0.110 | 0.105 | 0.106 | 0.136 | 0.136 |
| | (0.008)** | (0.010)** | (0.010)** | (0.013)** | (0.013)** |
| Startup Cohort Size | -0.093 | -0.206 | -0.207 | -0.034 | -0.034 |
| | (0.005)** | (0.010)** | (0.010)** | (0.005)** | (0.005)** |
| Market Heat | 0.514 | 0.794 | 0.797 | 0.424 | 0.425 |
| | (0.040)** | (0.061)** | (0.061)** | (0.055)** | (0.055)** |
| Industry Dummies | (27,*) | (27,**) | (27,**) | (23,*) | (23,*) |
| | | | | | |
| Patent stock (ln) | 0.182 | 0.203 | 0.188 | 0.160 | 0.158 |
| | (0.046)** | (0.068)** | (0.070)** | (0.060)** | (0.061)** |
| Newcomer Conf. Attendance | 0.097 | | 0.092 | | 0.112 |
| | (0.029)** | | (0.034)** | | (0.037)** |
| Newcomer Standards Pubs | 0.113 | | -0.224 | | 0.319 |
| | (0.175) | | (0.299) | | (0.192)+ |
| Newcomer Info./Exp. Pubs | -0.034 | | -0.090 | | -0.221 |
| | (0.229) | | (0.270) | | (0.434) |
| Newcomer WG Chairs | 0.397 | | 0.626 | | -0.117 |
| | (0.161)* | | (0.200)** | | (0.486) |
| Conf. Attendance | | 0.078 | | 0.088 | |
| | | (0.022)** | | (0.023)** | |
| Standards Pubs | | 0.221 | | 0.049 | |
| | | (0.137) | | (0.151) | |
| Info./Exp. Pubs | | -0.085 | | -0.108 | |
| | | (0.139) | | (0.243) | |
| WG Chairs | | 0.252 | | 0.122 | |
| | | (0.080)** | | (0.139) | |
| Observations | 110500 | 110500 | 110500 | 110500 | 110500 |
| Log Likelihood | -15383.57 | -6784.31 | -6790.41 | -8396.78 | -8398.48 |

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%