

## ***An Entrepreneurial System View of New Venture Creation\****

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*This paper reports the results of a two-phase study that explores new venture creation within the context of an entrepreneurial system. First, a genealogy of high-technology companies is presented depicting a high spin-off rate resulting from the presence of seven incubator organizations. Second, semantic structure analysis (Spradley 1980) based on semi-structured interviews with founders is used to develop a taxonomy. This taxonomy depicts the relationship among components in one entrepreneurial system, Boulder County, Colorado, that encourages, supports, and enhances regional entrepreneurial activity. Findings indicate that incubator organizations, spin-offs, informal and formal networks, the physical infrastructure, and the culture of the region are related uniquely and interact to form a system conducive for dense high-technology entrepreneurial activity. Additionally, greater rates of new venture formation were found following critical moments in the life of incubator organizations.*

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\*A previous version of this paper was presented at the 1999 Babson-Kauffman Entrepreneurship Research Conference, Columbia, South Carolina. Funding for this study was provided by University of Colorado's Center for Entrepreneurship and the Price Institute for Entrepreneurial Studies.

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## ***Introduction***

This paper explores new venture creation within the context of an entrepreneurial system. Silicon Valley, arguably the most famous and successful entrepreneurial system, has been the envy of regional economic developers and the living laboratory for many academic researchers trying to ascertain how such communities have come to exist and to thrive. Furthermore, the goal of these Silicon Valley observers has been not only description but also replication. The wealth and job creation found in areas such as Silicon Valley, Boston's Route 128, and North Carolina's Research Triangle can be a region's answer to floundering local economies. Unfortunately, many of the models presented in the literature (Leslie and Kargon 1996; Miller and Cote 1987; Hall and Markusen 1985; Rogers and Larsen 1984) fail to prove successful when replication is attempted.

Previous research has shown the importance that different, single elements of an entrepreneurial system may have on the overall macroeconomic development of a region. Spilling (1996) focused on the effect of a mega-event; Stough, Haynes, and Campbell (1998) examined the effect of clusters of high-technology firms; Shepherd (1987) examined government interaction; and Florida and Kenney (1988) measured the impact of venture capitalists. Here, this study broadens the focus to investigate the interaction of many different elements of an entrepreneurial system, while also examining what impact this interaction can have on the macroeconomic development of a region. Before modeling with a goal toward replication can begin, first a deeper understanding underlying the phenomenon of extreme regional entrepreneurial activity must be acquired.

This paper reports the findings of a study that analyzes a system of dense high-technology entrepreneurial activity

in Boulder County, Colorado. First, a genealogy of high-technology companies is presented, depicting a high spin-off ratio resulting from the presence of a small number of incubator organizations (Phase I). Second, semantic structure analysis (Spradley 1980) of semi-structured interviews is used to develop a taxonomy (Phase II) that depicts the incubator-spin-off relationship and that describes the other core components of a high-technology entrepreneurial system.

The discussion of new venture creation is framed within the context of *entrepreneurial systems*, which Spilling (1996) defines as the interaction of actors, roles, and the environment that determine the entrepreneurial performance of a region. Through this study's examination, it can be seen that Boulder County comprises the elements of an entrepreneurial system, while being part of a larger, open system of economic exchange. This foundation of an entrepreneurial system is used for two reasons. First, the genealogy of high-technology firms in Boulder County is contained within this entrepreneurial system; the system contains and supports entrepreneurial activity. Second, the entrepreneurial activity results from an evolution of components over time that interact to form a dynamic system that fuels new venture creation (Van de Ven 1993).

## ***Entrepreneurial Systems and New Venture Creation***

Regions of high entrepreneurial activity are important for research, but the many forces and actors fueling the activity cannot be studied independently. According to Malecki (1997), "entrepreneurship is a process as well as a phenomena" (p. 58); therefore, it seems plausible to view a region of high entrepreneurial activity as a system in addition to the previous research that examined the actions of individual

actors, events, or organizations alone. The process of entrepreneurship—as one of identifying an opportunity, creating a team, marshalling resources, and starting the venture (Morris 1998; Timmons 1999)—and the system in which it occurs feed off each other. Van de Ven (1993) best explains the importance of an entrepreneurial system and the codependence of the individual, the process, and the system. “This infrastructure does not emerge through a few discrete events or by the actions of one or even a few key entrepreneurs . . . Entrepreneurship consists of an accretion of numerous institutional, resource, and proprietary events involving many actors who transcend boundaries of many public and private sector organizations” (p. 218).

Van de Ven (1993), citing supporting studies (Usher 1954; Jewkes, Sawers, and Stillerman 1958; Constant 1980; Rosenberg 1983), argues that researchers focusing on individual entrepreneurs have ignored the historical evolution and actions of multiple actors that create the infrastructure for entrepreneurship. As the infrastructure develops and as the entrepreneurial system grows, the system will thrive only if the environment is conducive for entrepreneurial activity and new venture creation (Penning 1980). Spilling’s (1996) research points to the importance of the interacting elements in the entrepreneurial system: “Economic development is a result of complex entrepreneurial processes. Many things are linked together; many ventures develop in close interaction with each other and with environmental factors. Furthermore, the development of communities requires more than just the development of a number of businesses; it is also about infrastructure, public institutions, and about firms that can match together in advanced production systems” (p. 91).

Overall, the literature implies a complex relationship of many interacting elements that need to be in place to

support high levels of regional entrepreneurial activity, yet the extant research fails to depict these relationships truly. This study’s research supports previous findings of the environmental factors conducive to entrepreneurship yet contributes additional knowledge regarding the relationships inherent in a geographic area of dense entrepreneurial activity.

The following section (Phase I) discusses the relationship between incubator organizations and related spin-offs and maps the genealogy of high-technology firms in Boulder County. A later section (Phase II) depicts relationships of core components by means of a taxonomy developed from interviews conducted with a sample of founders from firms on the genealogical tree.

### ***Boulder County Genealogy Study Phase I: The Genealogical Tree***

According to Malecki (1997), “Regions with high levels of entrepreneurship will tend to spawn further entrepreneurs” (p. 63). Furthermore, the sociological theory of isomorphism, specifically mimetic isomorphism, claims that organizations tend to mimic one another (DiMaggio and Powell 1983). As a result, the authors believe the “spawning” effect produces a community of similar or related new ventures. In other words, a genealogy of firms created from organizations spawning new organizations is a natural occurrence within an entrepreneurial system. It also is apparent that time and context may play crucial roles in this spawning. Certain critical moments—and when they happen during the evolution—can have dramatic effects on the incidences of spawning. Mapping the relationship between incubator and spin-off organizations, and when viewed together with certain critical moments, can shed light on the evolutionary process occurring within the entrepreneurial system.

In this discussion (and within the trees in the figures), only the “families” within Boulder County are reported on. The limitations of not discussing other family members within this open system that may reside outside of Boulder County are recognized; however, the initial research design set parameters and boundaries that required a focus on the parents within the local system. Because of this, and before presenting the genealogical tree and describing its development, it is necessary to establish a definitional foundation from which this research builds.

### **Incubator Organizations and Spin-Offs**

For the purpose of this research, an *incubator* is defined as the organization where the entrepreneur was employed before starting his or her new venture (Cooper 1985). The literature is relatively sparse with respect to incubators in this context, and there has been even less research aimed at understanding the various roles an incubator organization may play in new venture creation.

A *spin-off organization* is defined as a new firm formed by an individual or group of individuals leaving an existing firm and starting a new firm in the same industry (Garvin 1983, p. 3). The authors believe this definition is restrictive, particularly given Cooper’s (1985) definition of an incubator; he does not imply that the incubator and the spin-off are in the same industry. As a result, the authors adopted Garvin’s (1983) definition with one important deviation: “In the same industry” was changed to “in a related industry.” Industry similarity in today’s high-technology environment often is blurred, and boundaries are not detected easily.

Relatedness is researched most often under the domain of diversification strategy or parent–subsidiary relationships within large corporations. But it seems reasonable to view incubator and spin-

off relationships using similar terminology. Woo, Willard, and Daellenbach (1992, p. 438) stated that a parent and subsidiary were related if they met one of the following criteria: (1) Both sold to the same or very similar types of customers; (2) Both engaged in the sale of similar lines of products or services; or (3) Both produced their products or services through the use of similar production technologies.

### **Sample, Data Collection, and Genealogical Mapping**

*The 1998 Boulder County R&D/Manufacturers Directory* was used in this study to develop the sample. A brief survey was mailed to each chief executive officer (CEO)/founder of the 999 technology firms in the directory. The survey contained four simple questions regarding firm findings and spin-offs that would allow assessment if the founder met the established criteria for inclusion on the tree. A total of 184 useable surveys were returned, and 42 were returned due to wrong address or no forwarding address, giving a 19-percent response rate. In addition to the mail survey, informal interviews were conducted with five well-regarded venture capitalists in Boulder County and with six key business leaders considered to be historians of the business community. These informal interviews, combined with the mail survey, allowed for creation of the beginnings of the high-technology genealogy.

A set of criteria was developed to ensure that the appropriate companies were depicted on the tree. First, the authors were interested in individual founders and founding teams; however, a passive investor was not considered part of a founding team. For example, if company B spins off from company A, but if a member of the founding team comes from company C, then it is assumed that company B is a product of company A and C. Second, the authors were interested only in related, high-technology spin-offs.

Once the tree was in workable form, it was shown in various mediums (formal interviews, presentations to companies, newspapers, Internet) to solicit feedback and to make additions and corrections. Developing the genealogical tree was an iterative process that required multiple data sources and informants. New technology firms are born daily in Boulder County. Many of these firms die, merge, or are acquired; therefore, the genealogical tree is a snapshot at one point in time of the entrepreneurial system's evolution.

### **What Does the Genealogical Tree Tell Us?**

The genealogy of high-technology firms in Boulder County is seen in Figures 1a and 1b. A total of 176 companies are depicted on the tree, of which seven are considered incubator organizations (tree trunks) that have led to the spawning effect in Boulder County. Boxes on Figures 1a and 1b denote these companies.

The seven main incubator organizations illustrated on the tree represent a diverse mix of organizations. Figure 1a points to the importance and impact of a few large corporations. IBM was one of the first large technology companies to arrive in Boulder County in 1965. Four years later (1969) a team of IBM technical employees left the company and founded StorageTek,<sup>1</sup> today a leading global data storage company. Figure 1b depicts the role of a large research university and two scientific government organizations, the National Center for Atmospheric Research (NCAR) and the National Institute of Standards and Technology (NIST), as also contributing to the spawning effect. Ball Aerospace (Figure 1b) is considered a corporate incubator (as is IBM, for example), yet the university played a role in its beginning. In summary, four large corporations, the

university, and two scientific government organizations were the impetus for the spawning effect that created a multitude of related spin-offs that are contained within the Boulder County entrepreneurial system.

Viewing the genealogical tree from a "trunk-only" perspective contributes additional insights into factors leading to increased rates of new venture creation. Figure 2 charts the rate of new venture creation by what is considered to be the critical corporate incubators of Boulder County (StorageTek, Ball Aerospace, NBI). There is at least one critical moment in the evolution of these corporations that motivated employees to leave the incubator (by choice or by force) and to create a related new venture. It is during and after these critical moments that the rate of spawning is the greatest.

## ***Boulder County Genealogy Study Phase II: The Entrepreneurial System***

Two questions drove this research process as Phase II was entered. First, given the relatively sparse research on incubators and their related spin-offs, are there various roles the incubators play in the entrepreneur spinning off and starting a related new venture? Second, if an entrepreneur is truly just an actor among many (Barth 1972), what are the other driving forces in an entrepreneurial system, and how are these components related?

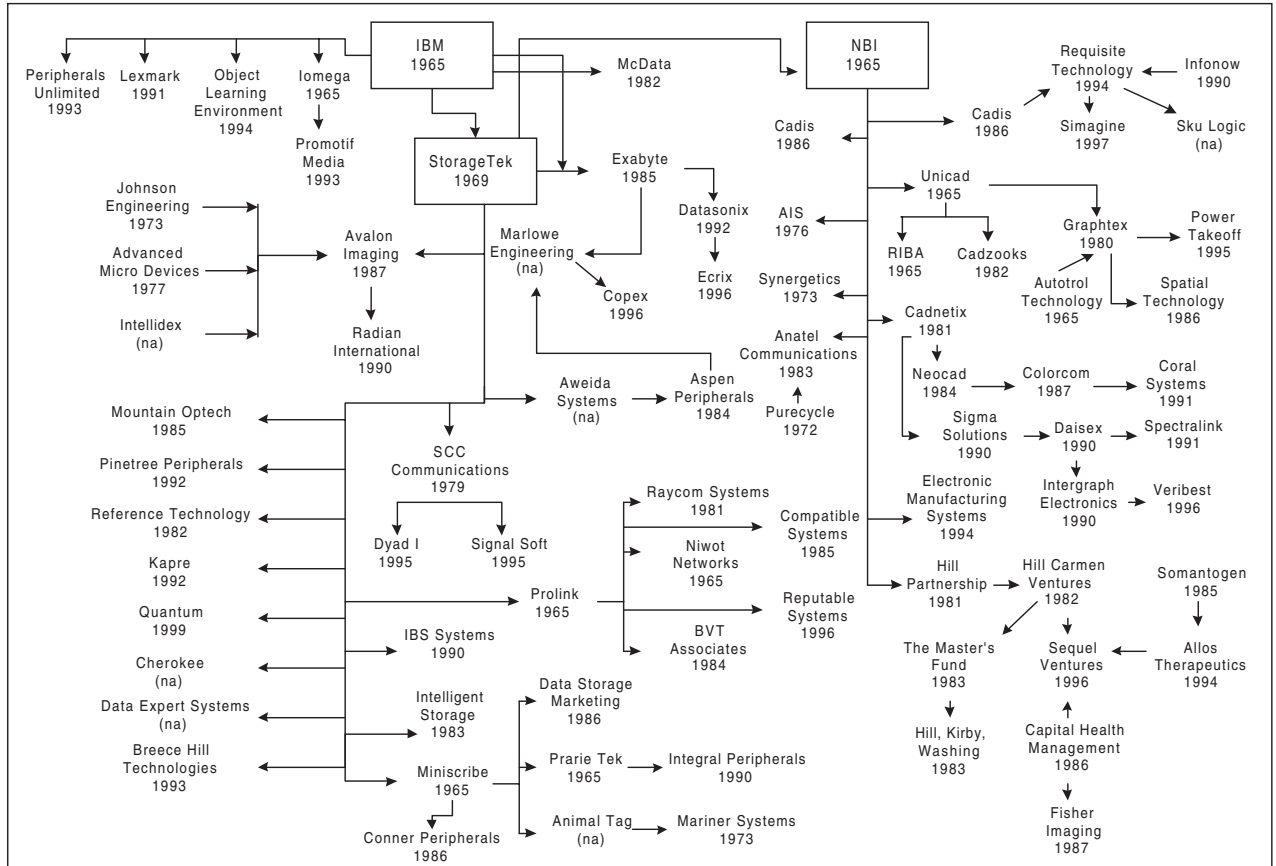
### **Sample and Data Collection**

Semi-structured interviews lasting one to one and one-half hours in length were conducted with 15 founders of spin-off firms found on the family tree.

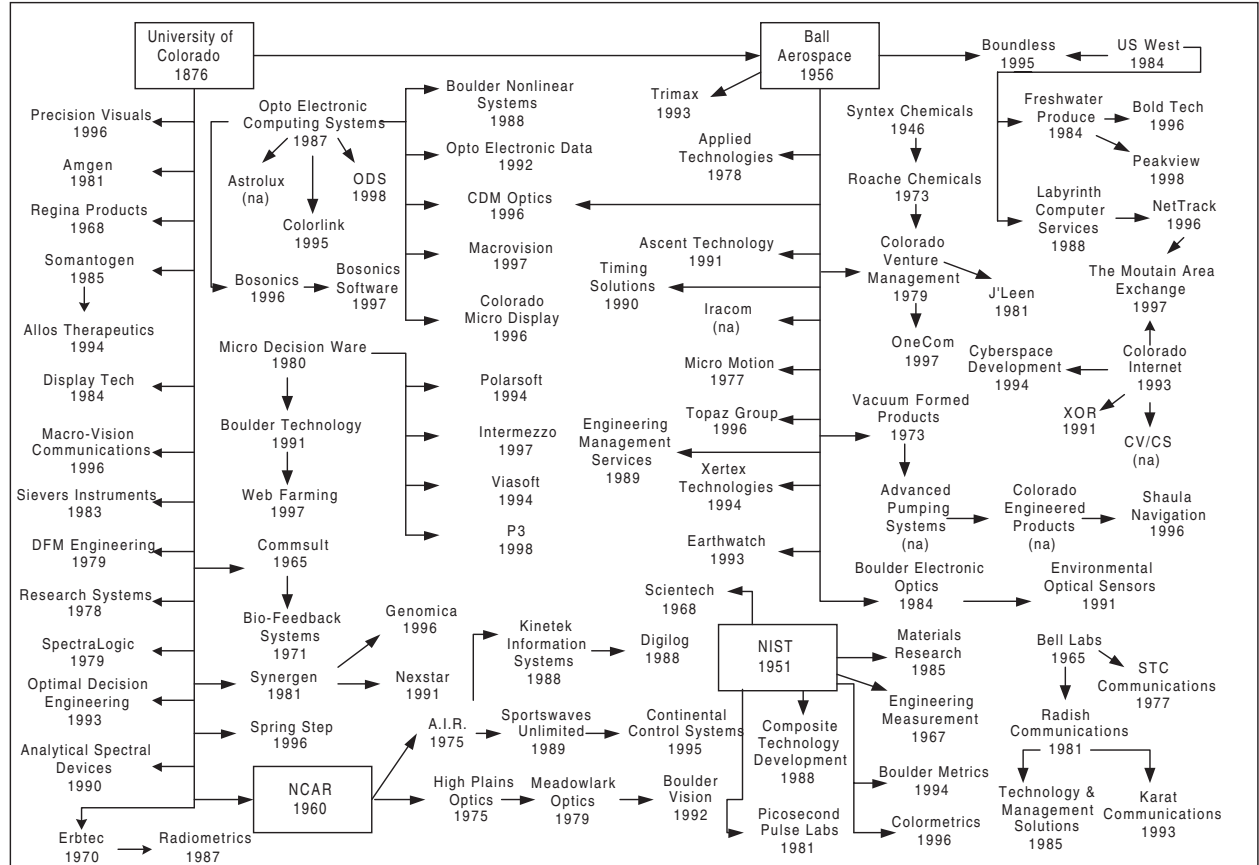
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<sup>1</sup>Prior to 1987 StorageTek was called Storage Technology Corporation. After emerging from Chapter 11 bankruptcy protection, the company renamed itself StorageTek.

# Figure 1a Genealogical Tree (Corporate Incubators)

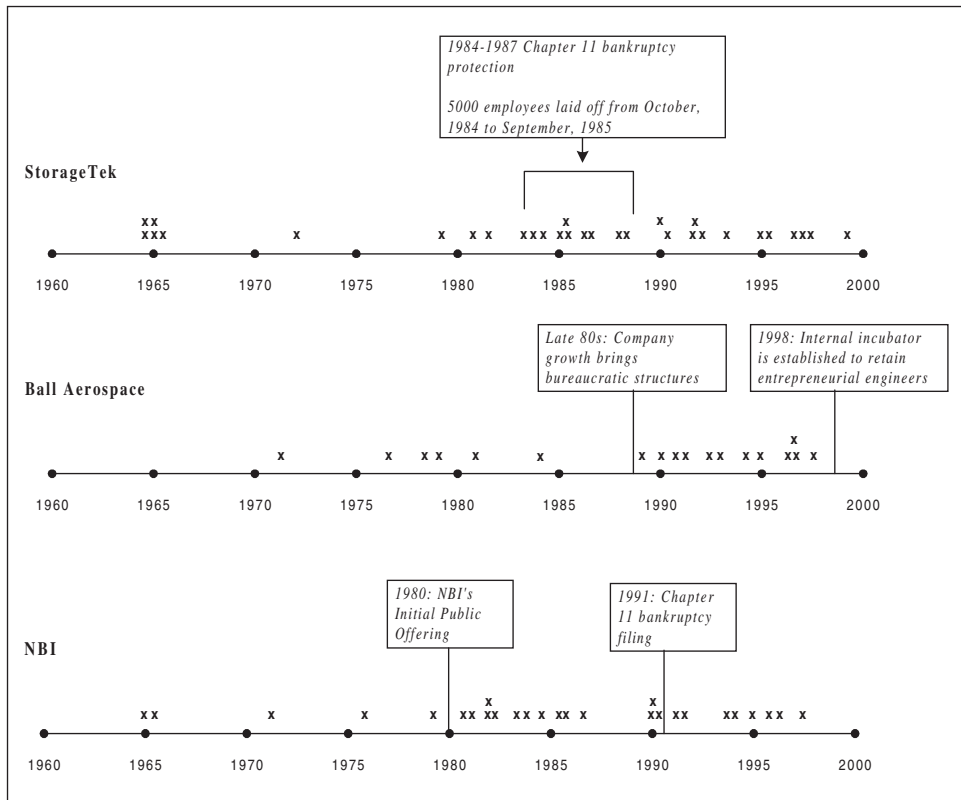


### Figure 1b Genealogical Tree (University and Government Incubators)





**Figure 2**  
**Critical Incubator Moments Spawning Greater Rates of**  
**New Venture Creation**



At least one company founder was interviewed from five of the seven trunks. Of the 15 firms interviewed, the mean number of employees is 222 (s.d. = 632) and mean annual sales (1997) is \$6.2M (s.d. = 9.6). There were four concentration areas that bounded the interview: (1) role of the incubator organization; (2) role of Boulder County; (3) description

of the spin-off and how it emerged; and (4) the entrepreneurial team. All interviews were recorded and later were transcribed.

**Semantic Structure Analysis via NUD-IST<sup>2</sup>**

Two forms of qualitative analysis, domain and taxonomic analyses, were

<sup>2</sup>Interested readers may wish to have more detail on the methods involved in this study's semantic structure analysis. Please contact the authors for more detail regarding the qualitative methodology.



used to make sense of the interview data. Both of these analyses are based on semantic relationships and thus can be classified as semantic structure analysis (Spradley 1980). First, the domain analysis was used to uncover patterns in the data. Next, taxonomic analysis was used to uncover relationships among the identified patterns. "The domain analysis and taxonomic analysis are often combined into a single process because the taxonomic analysis is often an extension of the domain analysis" (Spradley 1980, p. 116). The entire qualitative analysis (domain and taxonomic) was conducted using a computer aided text analysis (CATA) software program called NUD-IST. The use of computer software to analyze qualitative data allows for a more systematic approach to the analysis that contributes to reduced coding error, increased objectivity, validity, and rigor (Wolfe, Gephart, and Johnson 1993).

A *domain* is defined as a category of meaning that includes other smaller categories (Spradley 1980). Using the interview questions, an initial domain list was developed, and as the interviews were coded, other domains were added. Upon completion, the domain analysis is simply a hierarchical coding schema designed to bring order to unstructured data. Then, the taxonomic analysis allows the researcher to discover the story of the patterns and the relationships among specific domains (Spradley 1980). The patterns are based on semantic relationships (for example, X is a part of Y; X describes Y; X is a kind of Y).

The authors' interest was in identifying the parts of the entrepreneurial system in Boulder County as well as in identifying the role the incubator played in the spin-off. It soon became evident that these questions were not exclusive mutually. Rather, they were tied to each other by one semantic relationship: X is a part of Y. The taxonomy combines

domains into a larger, more inclusive domain: the Boulder County entrepreneurial system. The taxonomy shown in Figure 3 depicts the Boulder County entrepreneurial system as the domain, and all boxes to the right of this domain illustrate the relationship each component has to the other in the entrepreneurial system.

The taxonomy should be read right to left in order to understand how each component is related (Spradley 1980). There are two domains, incubator organizations and the county, that represent the core of the entrepreneurial system. More important, however, are the parts of these domains and how these parts connect with the whole. There are six major components within Boulder County that emerged from the taxonomic analysis (see Figure 3). First, the relationship between *incubators* and their related *spin-offs* plays an important role in creating and growing the entrepreneurial system. Next, *formal* and *informal networks* are critical to supporting and enhancing new venture creation. Finally, the *physical infrastructure* and *culture* also contribute to the spawning effect within the boundaries of the system. Together, these components (incubators, spin-offs, informal networks, formal networks, physical infrastructure, and culture) are all related and are all part of the Boulder County entrepreneurial system.

The percentages noted in Figure 3 indicate frequency of responses (for example, 73 percent of the founders interviewed discussed the university as playing a role in the number of high-technology startups in Boulder County; 67 percent of the founders participate in some type of informal network). In the following sections the taxonomy is used to guide this discussion. The components will be defined in greater detail, and interview excerpts will be used to support the components (parts) further we uncovered in the system.

**Figure 3**  
**Taxonomy of the Boulder County Entrepreneurial System**  
**Components with Frequencies of Founders Reporting**

Components of the Boulder County Entrepreneurial System	Incubator Organizations	Implicit Spin-Offs (New Ventures)	67%	Second and Future Generation Spin-Offs	13%	
		Explicit Spin-Offs (New Ventures)	33%			
	County	Formal Network	Informal Network			67%
			University		73%	
			Government		60%	
			Professional/Support Services		73%	
			Capital Sources		53%	
			Talent Pool		67%	
			Large Corporations		47%	
	Physical Infrastructure			20%		
Culture			100%			

***Entrepreneurial System Components***

It is necessary for descriptive purpose to discuss the components of the Boulder County entrepreneurial system independently. However, this study's notion of a

system points to the interaction of the components and the relationships each has with the other. Therefore, it seems fitting to begin with a quote from a founder that exemplifies looking at the whole system comprised of individual parts.

*“Every one of the founders really likes the Boulder County area. We like the quality of life and there is good access to high-tech jobs. We all have a history in engineering-type disciplines, and so that combination of having the right skill set and having the right environment attracted us all here. And the community is very, in my opinion, very proactive in terms of wanting new companies to start up. And I expect new technology to continue to be developed here. I think right now if you talk to most of the major venture capital companies, they do have some investment in Boulder County one way or another and it’s seen as a very positive thing.” (Founder, Company 12)*

### **The Incubator Spin-Off Relationship**

It was found that the incubator can play an implicit or explicit role in the entrepreneur leaving her or his current organization to start a new venture. Those incubator organizations playing an implicit role were not aware of the employee planning to leave and to start a related business. As a result, the role the incubator played revolved mainly around the founder acquiring technical or product knowledge, market knowledge, experience, and relationships with customers who eventually would follow the founder. From Figure 3, it can be seen that 67 percent of the founders’ incubators played an implicit role. Those incubators who played an explicit role knew about the employee’s intention, and the incubator provided support in terms of such things as assistance in setting up the business or use of facilities and equipment. In 33 percent of the companies interviewed, the incubator played an explicit role. Arguably it can be stated that all incubators provide some type of implicit role in terms of

developing skills and abilities necessary to the entrepreneur’s success; however, it is necessary to show that some incubators do provide, or at least try to play, an explicit role. The first excerpt is illustrative of an incubator playing an *implicit* role while the second excerpt pertains to an *explicit* role.

*“Because of the experience that I had learned at [incubator], I knew exactly how to mark-up these products and how to bring them to market and what customers really needed. And so it turns out that that experience I had at [incubator] was invaluable when it came to marketing the lines of products that we have now.” (Founder, Company 7)*

*“So they wanted to get out of the business, but they had signed contracts with a variety of customers with installed systems that they would be around for five, ten years to support these systems. So for them to get out of the business, they had to find somebody to do that support, and since [Joe] and I were both involved in that department, we said, ‘Gee, we’ll start [Company 9], and we’ll take over all that for you.’ They said, ‘Great. Here’s all the equipment.’ They basically set up our business.” (Founder, Company 9)*

Founders were asked about their own role as an incubator in spinning off new ventures (second generation spin-offs). The majority of the companies interviewed (87 percent) indicated that their company had not incubated entrepreneurs. A critical issue for the founders was keeping the entrepreneurial talent they had in-house and their preference not to play an explicit role in incubating their employees. The next excerpt is indicative of these findings. However, the

one following does point to the exception of those founders interviewed. The founder of Company 4 (the only one in this sample) spoke about the desire to incubate but about the difficulties involved (second excerpt).

*“Really we try to keep people here. The reality is we’ve tried to structure an environment where people, even if they have an entrepreneurial kind of makeup and desire, they have the opportunity to do things here to fulfill that.” (Founder, Company 14)*

*“I think we would like to be more of an incubator. In fact, we have some money put aside if a good idea comes along, whether it be internal or external, we would be open to looking into that. But, that’s a very difficult field to get involved in. It’s a tricky thing because you need to look at a high number of opportunities before you find something that’s worthwhile. You don’t want to beat the drum too loud and then people will come up with ideas and you keep giving them negative feedback.” (Founder, Company 4)*

### **Informal and Formal Networks**

This study’s perspective of networks in the entrepreneurial system is that of a *social network* defined as “as set of nodes (for example, persons, organizations) linked by a set of social relationships (for example, friendship, transfer of funds, overlapping membership) of a specific type” (Laumann, Galskeiwicz, and Mardsen 1978, p. 458). Therefore, the various aspects of the network in the entrepreneurial system are joined by various relationships (Tichy, Tushman, and Fombrun 1979). For this analysis, following Birley (1985), the social network was separated into formal networks (university, government, professional and

support services, capital sources, talent, and large corporations) and informal networks (friends, families, colleagues, and informal relations with similar high-technology companies).

The informal network appeared to be an important element of the system. In fact, 67 percent of those interviewed identified at least one part of the informal network as being important to the evolution of the entrepreneurial system and their particular startup. One founder expressed the role of the informal network this way:

*“What I think clicks and why you get these threads of things is really the social part, the community building, where you get a group of people that are in a work situation and they see each other under various kinds of stress over a period of a year or so. The company blows up or is acquired or becomes non-profitable or something like that and you get one or more people leaving. You know, there’s a natural tendency for those people to kind of come together again. Since there’s been this shared experience, and if they come together again, it’s almost an indication that there’s a trust relationship. You can have fantastic ideas, but any idea is going to break on you and you just have to have that kind of social inertia to make it work.” (Founder, Company 2)*

The formal network as can be seen from the taxonomy (Figure 3) is comprised of the research university, regional government agencies, professional and support services (for example, lawyers, accountants, consultants, suppliers), capital sources (for example, venture capitalists, business angels, and banks), a high-technology talent pool, and large corporations. Each of these components of the formal network ranged in per-

ceived importance from the sample of founders from 73 percent for both the importance of the university and for professional and support services to only 47 percent for large corporations. When taken together, the components of the formal network clearly are critical for the growth and evolution of an entrepreneurial system.

*The University.* The importance of a research university for the development of an entrepreneurial system has been discussed since Frederick Terman from Stanford helped launch Silicon Valley by supporting Hewlett and Packard (Bahrami and Evans 1995; Bruno and Tyebjee 1982). The university can support the system in many ways, such as developing talented graduates, generating leading-edge technology, and providing faculty as consultants. Within the formal network, the university was among the most commonly cited reasons (73 percent) for the development of the entrepreneurial system:

*“You know, IBM, I’m sure wouldn’t have located here if it hadn’t been for the university, and I expect the Bureau of Standards likely wouldn’t have been here. So it’s sort of a symbiotic relationship between these.” (Founder, Company 4)*

*Government.* The role the government plays in the development of an entrepreneurial system is an important area of study. The government can play many other roles, in either fostering or hampering entrepreneurship in their regions through tax rates and incentives, in providing other forms of financial support, and in eliminating the bureaucratic “red tape” often associated with applying for permits and licenses. One founder noted the importance of the government (or lack thereof):

*“You don’t get people, regulators and others, walking in your door wanting to check everything. I’m not saying companies should not be regulated. I think we should have regulation and so on, but you can stifle a company and drive them into the ground by policing them too much. You don’t get that happening here.” (Founder, Company 3)*

*Professional and Support Services.* This component includes entrepreneurial tax and legal support, and consultants, as well as the existence of organizations that provide other inputs, some of which go into the finished product. Professional and support services were identified by 73 percent of the respondents as an important component of the entrepreneurial system:

*“The accounting firms are here and some of them have specialists in high-tech here. There are a number of very competent corporate attorneys now that are experienced in start-ups and initial public offerings, plus the fact that you have the other services. You’ve got machine shops and glassblowers and electronic assemblers and all that.” (Founder, Company 13)*

*Capital Sources.* The growth of Boulder County’s high-technology activity has attracted venture and other forms of capital. Although some of the founders from this sample were not convinced that Boulder has developed extensive capital sources, 53 percent did feel that the presence of capital sources was a necessary component fueling new venture creation. Not only are venture capitalists from Silicon Valley entering the region, but also many new venture capital firms have been founded in the county.

*“There are a lot of people [in Boulder] who have made a great amount of money in the high-tech business and investments and through various jobs and stuff. So there’s money available to you—venture capital money. And there are angels that will come along, private investors who’ll come along and invest in you.” (Founder, Company 15)*

**Talent Pool.** Without ample talent in the area, entrepreneurs are likely to go elsewhere to start their ventures. In the Boulder area, the early layoffs of talented IBM employees played a large role in supplying individuals to start ventures or to be hired by other startups. The mere presence of high-technology entrepreneurial activity can attract talented people to an area. Furthermore, in a region of densely populated and related ventures, an employee can leave one startup and immediately can find employment at a similar startup in close proximity to the employee’s previous employer. In other words, there is a cross-pollination occurring. In this survey, 67 percent of the founders cited talent pool as an important element of the entrepreneurial system and that it contributed to their founding and success:

*“There’s a critical mass of not only technology knowledge or technical people if you’re thinking of high-tech, but there’s also a lot of people now that have the business school skills. They know how to raise money. They know how to manage. They know how to grow things. The other big thing that people fail to realize is that it’s not until employees can quit one job and walk across the street and get another that it’s easy to attract people.” (Founder, Company 13)*

**Large Corporations.** Large corporations play significant roles in the evolution of an entrepreneurial system. First they support the talent pool as identified above. They often employ talented people who feel stifled by the bureaucracy and eventually spin off a new venture with tangible technology taken from the incubator organization or intellectual capital developed while employed at the incubator. Additionally, some of the larger corporations such as IBM and Storage Technology in Boulder County downsized and left many technical people unemployed. These individuals then were motivated to start new ventures. Large corporations also can provide the foundation for a technology base in an area. As was found through the development of the genealogical tree, four employees of IBM who had been working in the data storage area founded their own storage company, Storage Technology. Data storage now has become the most prolific technology developed in the Boulder County area. One founder, speaking of the role of large corporations, stated the following:

*“I actually think, in my opinion, it actually got started when [name deleted] left IBM and started up Storage Technology. Because when Storage Technology grew to be a fairly good-sized company there were literally thousands of engineering jobs between IBM and Storage Technology. Then, Hewlett Packard also was along the front range—so that was the third, what I would call anchor company, that provided an area where engineers could go between companies if they needed to. It wasn’t a one-company kind of environment. In many towns, in the South especially or even in the Midwest, there’ll be one manufacturing plant or one company per town. So, if you live in that town you*



*don't have many options. Boulder started off much better off than that. They had access to three large companies then lots of smaller companies were starting up in the area.” (Founder, Company 7)*

### **Physical Infrastructure**

To differentiate from the intangible infrastructure found in the network, the *physical infrastructure* is defined as the tangible components of the county's infrastructure such as roads, traffic, office space, housing, and real estate. Of all the components of the entrepreneurial system, the founders interviewed viewed the physical infrastructure most negatively. Their perception was that Boulder County, through its high cost of living and its recent no-growth government initiative, ultimately would limit further growth of the entrepreneurial system.

Only 20 percent of the founders found the physical infrastructure of Boulder to be supportive of the entrepreneurial system. This seems to be an issue in Silicon Valley as well, since it is becoming increasingly cost-prohibitive to locate there, particularly for employees who cannot afford housing in the area. Specifically, Boulder County has open-space and growth-control policies in place that contribute to above-average property values because land availability is scarce (Cote 1999). Therefore, high-margin firms will remain in the area, but when margins begin to diminish they may be priced out of the system.

*“It's really the high-margin companies that can afford to stay here. As soon as you're out in the big competitive world where your margins are getting slimmed down you won't be able to pay the rent, so people will move to Weld County or wherever they're going these days where things are cheaper.” (Founder, Company 5)*

Given the constraints of the physical infrastructure, the migration of entrepreneurs to more cost-effective areas is imminent. The corridor connecting Boulder to Denver makes travel to and from Denver International Airport convenient (40 minutes); however, as the corridor continues to develop, areas closer to Denver and outside of Boulder County most likely will offer entrepreneurs lower cost alternatives.

### **Culture**

The last component of the county found in this study's taxonomy is the culture of Boulder County. According to Mintzberg, Ahlstrand, and Lampel (1998) culture is what makes an organization, industry, or nation unique. Responses included the geography and climate of the region, the intellectual capital, the high-technology capabilities, and the “spirit of the West.” The culture of Boulder County initially attracted the entrepreneurs to locate to Boulder County, and few enticements from the outside can encourage them to move.

A full 100 percent of the founders in this study cited culture as an important element of the entrepreneurial system:

*“Anytime you tell someone, or you put on an application, that you're from Boulder, it carries a cachet that is useful. There's a lot of intellectual stimulation. There's not too much dumbness that goes on in Boulder. It's just everywhere you turn there are neat people. . . . It's beautiful; it's healthy.” (Founder, Company 11).*

Culture may be the single most important element for a system to develop and also may be the most difficult element to replicate and to manage.

### **Discussion and Implications**

The genealogical tree of high-technology companies born in Boulder



County, in conjunction with a taxonomy of the components of the entrepreneurial system that support new venture creation, tell an intriguing story. The genealogical tree provides insights into the presence of seven primary incubators that were the impetus for the densely populated region of high-technology spin-offs. The tree gives a surface view of the evolution of the entrepreneurial system and the impact new venture creation can have on an environment and existing businesses in the environment. For example, today managers from Storage Technology peruse the tree and ask, "How did we lose all these entrepreneurs?" They go on further to try to quantify their opportunity losses from the related new ventures that did not stay in-house.

The genealogical tree supports much of the current literature on entrepreneurial environments and systems, but it also expands our existing body of knowledge in the field. It is evident that the university plays an important role (Leslie and Kargon 1996) and that a few large organizations contributed to even more spawning (Smilor, Gibson, and Kozmetsky 1988), as did the scientific institutions (Van de Ven 1993). The tree, however, visually depicts the true impact of such "incubators" on the growth and evolution of the system. Additionally, the impact of time and the critical moments of an organization over this time contribute to the rate of new venture creation (see Figure 2). The old adage "Pictures are worth a thousand words" is not an understatement here. The problem, however, is that pictures are only snapshots; therefore, the authors attempted to delve into the complexities of the system to make sense of why and how the genealogical tree was planted and was nurtured.

From this starting point, Phase II of the study was begun, which included interviews of a sampling of high-technology founders. The taxonomy of

the Boulder County entrepreneurial system unfolds an accurate story of what must be in place for a region to attract high levels of entrepreneurial activity. The components also are supported in the literature (for example, Bruno and Tyebjee 1982), yet the relationships between and among the components have been researched less. It should be noted that perception could be just as important (if not more) as reality. The taxonomy was developed based on the views of the founders living in the system. More often than not, the founders viewed the components as positive; however, any negative perceptions of the system (physical infrastructure for example) can have serious implications on the future of the system. The region, combined with the entrepreneurs in the region, will encourage or will inhibit future entrants; therefore, positive perceptions become an important aspect of maintaining the system. Capturing these perceptions, as seen in the interview excerpts, is one benefit of using qualitative methods to study entrepreneurship.

Overall, these results represent only a beginning in uncovering the phenomenon of new venture creation. Studying new ventures in the context of an entrepreneurial system is a productive undertaking; however, this study really only has scratched the surface in terms of understanding the dynamic relationships involved within the system. From interviews with founders, the components of the entrepreneurial system can be seen to represent an evolving process; these components came into existence over time and continue to evolve and to expand.

The question of replication is challenging. Before modeling of entrepreneurial systems for replication can begin (if it can), first a "theory of evolution" must be created to understand how entrepreneurial systems are built over time. In the case of Boulder County, the evolution followed a well-defined path can be spec-

ulated with some certainty—from the founding of the university through the establishment of a number of “anchor” organizations to the development of a highway, a new international airport, and the influx of local venture capital (Cote 1999). These “moments” mark critical time periods in the evolution of Boulder County as an area of dense high-technology entrepreneurial activity. The intricate networks that have been developed throughout the system are highly complex and involved, which make intentional replication of these successful networks virtually impossible (Hannan and Freeman 1977). According to Aldrich (1999, 1990) the rate of new venture creation is highly dependent on the events experienced by existing organizations in the population; therefore, the evolution of Boulder County as an entrepreneurial system could not have been predicted. For example, the ups and downs of the older, established corporations have motivated aspiring entrepreneurs to leave and to start new ventures. It would not be wishful thinking to have corporations replicate the Chapter 11 bankruptcies of StorageTek and NBI and the layoffs that resulted. However, these moments were critical in the evolution of the Boulder County entrepreneurial system. It is evident from Figures 1a and 1b that the number of firms spawned from these two companies had a strong economic impact. A cofounder of StorageTek was quoted recently as saying, “I have this pet theory that entrepreneurship starts out of the ashes of older companies. You need success and failure in order to generate more and more startups . . . You look at all the companies that have StorageTek as an ancestor, and there are quite a few of them. That has a lot to do with the ups and downs of StorageTek” (Cote 1999, p. 12).

## Conclusion

At a time when the rate of total entrepreneurial activity is decreasing in the

United States due to the recession and the dot.com bust (Zacharakis et al. 2002), the importance of entrepreneurship to economic development cannot be understated. This research exposed the elements of a system that spawns regional entrepreneurial activity. The outcomes of strong entrepreneurial systems were not addressed explicitly, but these certainly can be implied. Job creation, wealth creation, business growth, and economic prosperity—these are all outcomes of entrepreneurship when healthy systems are in place (Morris 1998). But as we continue to find our way in our new networked and knowledge-based economy, it is quite possible that entrepreneurial systems, as this study has depicted, ultimately will transcend physical boundaries.

## References

- Aldrich, H. (1999). *Organizations Evolving*. London, UK: Sage Publications
- (1990). “Using an Ecological Perspective to Study Organizational Founding Rates,” *Entrepreneurship Theory & Practice* 14(3), 7–24.
- Bahrami, H., and S. Evans (1995). “Flexible Re-Cycling and High-Technology Entrepreneurship,” *California Management Review* 37(3), 62–89.
- Barth, F. (1972). *The Role of the Entrepreneur in Social Change in Northern Norway*. Bergen, Norway: Universitetsforlaget.
- Birley, S. (1985). “The Role of Networks in the Entrepreneurial Process,” *Journal of Business Venturing* 1(1), 107–117.
- Bruno, A. V., and T. T. Tyebjee (1982). “The Environment for Entrepreneurship,” in *Encyclopedia of Entrepreneurship*. Ed. C. A. Kent, D. L. Sexton, and K. H. Vesper. Englewood Cliffs, NJ: Prentice-Hall.
- Constant, E. W. (1980). *The Origins of the Turbojet Revolution*. Baltimore, MD: Johns Hopkins University Press.
- Cooper, A. C. (1985). “The Role of Incubator Organizations in the Founding

- of Growth-Oriented Firms," *Journal of Business Venturing* 1(1), 75–86.
- Cote, M. (1999). "A Century of Commerce: A Look at the Milestones That Have Shaped Boulder Business," *Daily Camera*, 12 July (Business Plus), pp. 10–12.
- DiMaggio, P. J., and W. W. Powell (1983). "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," *American Sociological Review* 48(2), 147–160.
- Florida, R., and M. Kenney (1988). "Venture Capital and High-Technology Entrepreneurship," *Journal of Business Venturing* 3(4), 301–319.
- Garvin, D. A. (1983). "Spin-Offs and the New Firm Formation Process," *California Management Review* 35(2), 3–20.
- Hall, P., and A. Markusen (1985). *Silicon Landscapes*. Boston, MA: Allen and Unwin.
- Hannan, M. T., and J. Freeman (1977). "The Population Ecology of Organizations," *American Journal of Sociology*, 78(6), 1360–1380.
- Jewkes, J., D. Sawers, and R. Stillerman (1958). *The Sources of Invention*. New York: MacMillan.
- Laumann, E. O., L. Galskeiwicz, and P. V. Marsden (1978). "Community Structure of Interorganizational Linkages," *Annual Review of Sociology* 4, 455–484.
- Leslie, S. W., and R. H. Kargon (1996). "Selling Silicon Valley: Frederick Termin's Model for Regional Advantage," *Business History Review* 70(4), 435–472.
- Malecki, E. J. 1997. "Entrepreneurs, Networks, and Economic Development," *Advances in Entrepreneurship, Firm Emergence, and Growth* 3, 57–118.
- Miller, R., and M. Cote (1987). *Growing the Next Silicon Valley*. Lexington, MA: Lexington Books.
- Mintzberg, H., B. Ahlstrand and J. Lampel (1998). *Strategy Safari: A Guided Tour through the Wilds of Strategic Management*. New York: Free Press.
- Morris, M. H. (1998). *Entrepreneurial Intensity: Sustainable Advantages for Individuals, Organizations, and Societies*. Westport, CT: Quorum.
- Pennings, J. M. (1980). "Environmental Influences on the Creation Process," in *The Organizational Life Cycle*. Ed. J. R. Kimberly, R. H. Miles, and Associates. San Francisco, CA: Jossey-Bass.
- Rogers, E. M., and J. K. Larsen (1984). *Silicon Valley Fever*. New York: Basic Books.
- Rosenberg, N. (1983). *Inside the Black Box: Technology and Economics*. Cambridge, MA: Cambridge University Press.
- Shepherd, J. (1987). "Manufacturing in Britain: Industrial Support Policies," *National Institute of Economic Review* 122, 59–71.
- Smilor, R. W., D. V. Gibson, and G. Kozmetsky (1988). "Creating the Technopolis: High-Technology Development in Austin, Texas," *Journal of Business Venturing* 4(1), 49–67.
- Spilling, O. R. (1996). "The Entrepreneurial System: On Entrepreneurship in the Context of a Mega-Event," *Journal of Business Research* 36(1), 91–103.
- Spradley, J. P. (1980). *Participant Observation*. Fort Worth, TX: Harcourt Brace.
- Stough, R. R., K. E. Haynes, and S. Campbell (1998). "Small Business Entrepreneurship in the High-Technology Services Sector: An Assessment for the Edge Cities of the U.S. National Capital Region," *Small Business Economics* 10(1), 61–74.
- Tichy, N. M., M. L. Tushman, and C. Fombrun (1979). "Social Network Analysis for Organizations," *Academy of Management Review* 4(4), 507–519.
- Timmons, J. A. (1999). *New Venture Creation: Entrepreneurship for the 21st Century*, 5th ed. Boston, MA: Irwin McGraw-Hill.

- Usher, A. P. (1954). *A History of Mechanical Inventions*. Cambridge, MA: Harvard University Press.
- Van de Ven, A. H. (1993). "The Development of an Infrastructure for Entrepreneurship," *Journal of Business Venturing* 8(3), 211-230.
- Wolfe, R. A., R. P. Gephart, and T. E. Johnson (1993). "Computer-Facilitated Qualitative Data Analysis: Potential Contributions to Management Research," *Journal of Management* 19(3), 637-660.
- Woo, C. Y., G. F. Willard, and U. S. Daellenbach (1992). "Spin-Off Performance: A Case of Overstated Expectations?" *Strategic Management Journal* 13(6), 433-447.
- Zacharakis, A., H. M. Neck, W. B. Bygrave, and L. W. Cox (2002). "National Entrepreneurship Assessment, United States 2001 Executive Report: Global Entrepreneurship Monitor." Kauffman Center for Entrepreneurial Leadership.