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SBIR PROGRAMS AND PRODUCT COMMERCIALIZATION: KINETIC ART & TECHNOLOGY – AN EXAMPLE

Edward M. Hufft, Jr.
Alcorn State University
ehufft@lorman.alcorn.edu

Brenda Swartz
Indiana University Southeast
bswartz@ius.edu

ABSTRACT

The SBIR (Small Business Innovation Research) program provides a way to assist entrepreneurs in commercializing their technology, and it provides government access to new technology. There are many issues facing technology start-ups. Some of the issues and possible responses are discussed. Kinetic Art & Technology (KAT) is an SBIR success story. With almost four million dollars in federal grant funds, the company developed and is commercializing new electric motor technology. The issues they faced and the decisions they made are key components of their success.

INTRODUCTION

Streams of new technology are unveiled each year. However, only a small percentage of these promising technologies reach commercialization. True, not every invention is worth the cost involved in bringing a product to market. Even for those technologies which offer society great promise, the path to commercialization is long, difficult, and costly. This paper discusses the challenges a technology start-up faces, and ways the entrepreneur can meet them. A major source of help is the Small Business Investment Research (SBIR) program, launched as a ten-agency, applied research experiment by the Small Business Innovation Development Act of 1982 (Brown & Turner, 1999).

Recent articles demonstrate the difficulties start-ups have faced with developing technology. Baron and Hannan (2002) suggested that personnel issues and how an organization designs its human resources are key elements of success. Stewart and Giagtzis (2001) suggested that the entrepreneur cannot just put a product on the market, but must know the needs and requirements of their potential customers. Piper (2002) asserted that NASA's attempts at commercialization of technology result in putting technology "out there" with anticipation that the market will come to the provider of the technology, but their programs have had little success. Achibald and Finifter (2003) found focusing on projects with more commercial potential led to higher rates of commercial success.

SBIR PROGRAM

The federal government recognized that useful technology was resident within small businesses, but saw no way to access it systematically for government use. In 1982, Congress created the Small Business Innovation Research (SBIR) grant program to address that problem. Currently, ten federal agencies (Departments of Agriculture, Education, Transportation, Commerce, Energy, Defense, Health and Human Services/National Institute of Health, Environmental Protection Agency, National Science Foundation, and National Aeronautics and Space Administration) participate in the program and each spends 2.5 percent of their agency budget on the SBIR program. The goal of the SBIR program is commercialization of new technologies, which can be used by both the public and private sectors.

Each of the participating agencies publishes electronic solicitations seeking grant proposals from small businesses on specific, or in some cases general, topics. Usually the topics are problems the agency is unable to solve internally. The SBIR program has three phases. In Phase I, agencies offer up to $100,000 for six months for the company to develop proof of concept. In Phase II, the agencies offer up to $750,000 to assist the company in developing a prototype. To be eligible for Phase II funding, a company must have successfully completed a Phase I project. Phase III is the commercialization segment, in which no grant funds flow from the federal government. Frequently, the agency that funds Phase I and Phase II becomes the customer of the small business that has developed the technology. Additionally, companies are encouraged to seek private sector customers. The dual use of technologies is a key feature of the SBIR program. Persistence, following the solicitation guidelines to the letter, and knowing the agency and what they need/want are keys to entry in all phases of the program.

There has been little large-scale evaluation of the economic success of the program. Brown and Turner (1999) argued that the successes have been at the expense of other government research support for small business. Lerner (2000) reported on a large-scale study comparing the employment and growth of 1435 SBIR firms with matching firms over a ten-year period. He stated, "SBIR awardees enjoyed substantially greater employment and sales growth than the matching firms." (Lerner, 2000 p. 977). The awardees had a mean sales increase of $4.0 million and the matching firms of $1.1 million (98% increase for awardees and 27% for matching firms). Lerner suggested that the awards play a certification function for the awardees. Both Brown and Turner (1999) and Lerner (2000) call for changes in the program to make it more focused on commercialization of technology. Cooper (2003) discussed the commercialization obstacles faced by SBIR firms. Others have suggested that the successes of the program show its continued value (*Science*, 5/5/2000).

Mervis (1992) reported that the Defense Department ignores the intent of the program by insisting that most of its awards be used to make things that the military can use. However, the program is designed to provide improved technology for government use as well as for commercial use. Nelton (1998) reported that some agencies, such as Defense and Energy, do make use of the technologies developed, while agencies such as Education and Agriculture do not tend to be end users.

ISSUES FACING STARTUPS

Wu and Young (2001), in a study of small firms over the period 1973-97, found financing problems increasing over the time period; marketing and human resource problems persistent over time; and liquidity, record keeping, accounting, and inventory problems decreasing over the period of study. Stewart and Giagtzis (2001) suggested, "...that new technology is not enough to ensure success, and other issues must be attended to. These include product positioning, engineering utilization, and management competence"(P.120). The given is engineering competence and the product, but they do not lead to success of a venture.

Gans and Stern (2003) found that "SBIR project performance is highest for those projects in industrial segments which, themselves, receive the highest level of venture funding" (p.382). This indicates that funding of technology by government agencies in sectors most interesting to venture capital promises the highest levels of commercial success of ventures. Conversely, this suggests that technology in these sectors has the highest chance of developing with private capital and that the government should focus its funding efforts in technology sectors with less venture capital interest. Nicolaou and Birley (2003) studied university technology spinouts. They examined "the interaction between non-redundancy and tie strength" (p.1718), the interaction of the social networks of entrepreneurs. Nonredundancy in social contacts, or lack of crossover among the principals, improves success of spinouts. Also, the strength of the ties to the network improves success. They called for "universities to organize networking events showcasing the technology generated at universities" (p.1719). Technology transfer offices should provide a brokering role between entrepreneurs, external investors, and inventors. Kinetic Art and Technology (*KAT*) benefited from Indiana University's setting up contacts both to advise the inventor/entrepreneur at various stages of the venture and to assist in locating opportunities for the product.

Spencer, Murtha, and Lenway (2005) argued for a framework depicting "technological innovation as an evolutionary process of variation, selection, and retention characterized by incremental advances punctuated by occasional discontinuous changes. ... industry evolution as a process that involves the co-development of technology and institutions via repeated interactions among a range of industry participants. ... As industries develop from initial breakthrough to commercialization and large scale manufacturing, the level of uncertainty inherent in the innovation process diminishes" (p.321-2). This view supports Nicolaou and Birley (2003), as discussed above. *KAT*'s success appears to support this framework as well.

Models of new venture creation have been proposed by several authors. A problem with most is that they highlight only one aspect of formation. Kaulio (2003) suggested a model looking at the process of the transition stage between initial conditions and the initial process of evolution. The model is based on a critical incident study of Swedish startups. The most critical incidents are financing the venture and then recruiting. Two observations about recruiting are: (1) the entrepreneur's personal network is relied on to a large extent, thus supporting studies of the importance of networks to infant ventures; and (2) recruiting has a strategic, as well as a marketing, related dimension. Attracting the right people to the startup appears to signal the market that the strategy is set, thus indicating the organization is stable and viable. Two other critical incidents are the signing of the reference or first customers to contracts, indicating the venture is 'real', and the utilization of entrepreneurial service providers. The use of public, not for profit, and private sources of assistance supports the call for developing networks of service providers to assist startups to succeed.

Technology business models emphasize cooperative strategies and highly flexible relationship-based structures capable of responding to rapid and sometimes radical changes in the marketplace and technology (Kelly, Schaan, & Joncas, 2002). Collaborative success is elusive (See Kelly, *et al*, 2002, for list of studies). A study of alliances finds issues centered on people/relationship issues, operations issues, strategic agenda issues, and results or problems related to the performance of the venture (Kelly, Schaan, & Joncas, 2002). Their study suggests eight items that need careful consideration in developing the relationships necessary to create successful startup alliances. The key points are: (1) partner selection -- not only hard facts but also soft issues such as potential compatibility; (2) negotiation, a win-win process of building linkages between the companies; (3) people selection, (4) learning and relationship building; (5) communication building; (6) reconciliation of cultural differences; (7) ongoing relationship management; and (8) constructive interaction.

Several studies, already discussed, highlight the people issues that are critical to startup success, especially a technology startup. The need for an excellent management team and a board of directors with skills that supplement the management team are critical components of success (McCaffrey, 2003; Preston, 2003). The use of outside advisors often spells the difference between success and failure of startups (Leonard & Swap, 2000). *KAT*'s recruitment of engineers, technicians, and,ultimately, of a new venture-experienced marketing executive to supervise commercialization of their technology was a key component of their success. Their use of the resources of Indiana University and other advisors is also critical in moving their technology to the marketplace.

KAT's Story

Much has been written on the success and failure of high tech start-ups. Much of it is mirrored in the challenges Kinetic Art & Technology (*KAT*) has faced. LaPlante (1997) wrote in *Computerworld* the "formula for success: equal parts pain, vision, money, luck, and timing"(P.S2). *KAT*'s story shows that it is important to meet the needs of the customer; without a customer in "pain," there is no market. The initial idea was for a miniature electric motor to drive animation cameras, but *KAT* learned that SBIR funds were likely to be for larger applications. They sold the idea to the Department of Defense's Defense Advanced Research Projects Agency (DARPA) and provided a proposal that could meet their needs for shipboard motors for precise movement of large loads (Nelton, 1998). The entrepreneur is a most intriguing engineer, in that from the beginning he had a "vision" for what he wanted to accomplish, and he kept the vision at the forefront of his efforts. His business card indicates he is president and "keeper of the vision". The specifics have changed, but not the vision. "Money" came from meeting customers' needs for new technology, selling them on *KAT*'s ability to accomplish the task, and winning grants to fund the development of motors (Berry, Hill, and Klompmaker, 1999). *KAT* was "lucky" enough to be in "the right place at the right time" to gain the support to move forward time after time.

The entrepreneur has a Masters of Engineering (Computer Science) degree, did an internship with the Central Intelligence Agency, and worked for a large aerospace company in Colorado. He had a dream of making a video camera move under computer control, but he needed the time and environment in which he could develop his ideas. He left his job in 1990, moved to Greenville, Indiana where his family could live rent free in a house his parents fixed up for them. The family had an abrupt change in lifestyle, but they were all committed to his making improved motor technology a reality. He withdrew his funds from his retirement plan, the couple used their savings, and they pressed their credit card balances to the limit to support the family and his work. In this way Kinetic Arts Technology (*KAT*) (a.k.a. Visual Computing Systems) was founded. (http://www.katech.com/)

Navigating the SBIR Process

As funds were dwindling, a fellow church member of the entrepreneur read about an SBIR seminar at Indiana University Southeast, and sent him the $10 registration fee. Afterwards, he approached the presenters, saying he wanted to participate in the program. His Indiana University SBIR counselor encouraged him to write a proposal, and he responded to a Navy solicitation. The proposal was rejected. He was dejected, but felt his scientific ideas were well founded. At the encouragement of his family and people familiar with the SBIR program, he attended one of the three national SBIR conferences held each year. Attending the conference provided two benefits: (1) he learned more about the SBIR program, and (2) he was able to meet with agency people and present an abbreviated form of his ideas. The entrepreneur demonstrated the advice of the Small Business Administration to "be persistent" (Nelton, 1998).

At the conference, government agency after government agency indicated lack of interest in the entrepreneur's ideas. Finally, he unleashed his well-planned phrases on the person from the Department of Defense's

Defense Advanced Research Projects Agency (DARPA), who listened attentively. Afterwards he was disappointed that the person had taken no notes. When the DARPA solicitation was released a few months later, the entrepreneur was elated to discover that one solicitation was in his area of interest; it had the same wording he had used when chatting with the DARPA representative at the national SBIR conference. The entrepreneur wrote a proposal to develop general-purpose motion modules and was awarded a Phase I for a bit less than the then the limit of $50,000. Again, the entrepreneur was an example of following the instructions when preparing the proposal and being responsive to an agency's solicitation (Nelton, 1998). The entrepreneur actually was persistent enough to have an agency solicit what he was interested in pursuing.

The grant provided the entrepreneur with funding to continue his research, but it also provided new challenges. The first was the Government Accounting System. The entrepreneur adroitly accepted the challenge, and with the help of Peachtree software, learned a new skill set. Another challenge and luxury was being able to hire more engineering talent and pay them. The entrepreneur then had the challenge of becoming an effective manager (Baron and Hannan, 2002).

Between the conclusion of the six-month DARPA SBIR Phase I and announcement of Phase II selection was a potentially devastating eight-month gap. The team of twelve stayed with the company during the lean times, choosing to work for stock in the company rather than leaving. The entrepreneur applied for and received Bridge Funding from Indiana's Business Modernization and Technology program, which provided a loan to be repaid as a percentage of non-research and development sales.

In the course of time, the company was awarded a DARPA SBIR Phase II for $350,000 for a year and a half. Based on the results they submitted, the company was awarded six months "follow-on" funding of $275,000, which came from DARPA SBIR funds and another pool of DARPA money. The company used the funding to design a new motor.

The entrepreneur's interests and strengths are in research and development. At the suggestion of their attorney, *KAT* formed a subsidiary company to do product development and commercialization. From the beginning, the entrepreneur was able to listen to advice from others, develop new skill sets, and hire and utilize excellent professionals. With the formation of Lynx Motion Technology, KAT hired, as president, someone with expertise in marketing new technology to industry, a skill set that did not exist in the firm. The sister company, Lynx Motion Technology, built the prototype of the new motor and is commercializing the product.

Lynx Motion Technology is an investor-funded company created to build, test, and license technology developed by *KAT*. The entrepreneur was presented with another challenge: raising funding for Lynx. Again working outside of his comfort zone, he made presentations to venture capital groups. His efforts were successful not only in attracting funding, but in attracting marketing and management talent. Also, some local community people were very proud of him and having a high tech company in the community, and they invested in the company. This is an example of commercializing the technology and the ability to further the technology through outside financing, a key success factor of the SBIR program (Brown and Turner, 1999; Lerner, 2000).

During the lean months awaiting Bridge Funding, the entrepreneur once again scoured the pages of SBIR solicitations. Indiana University's Industrial Research Liaison program helped by creating a search profile of his interests and expertise and running it against the agency solicitations as they were released. The entrepreneur responded to a Department of Energy (DOE) SBIR "Green Car" solicitation on hybrid electric vehicles. He was awarded the SBIR Phase I for $75,000, but later his Phase II proposal was rejected. He had developed a good working relationship with a person in DOE during the Phase I, who became a champion of the technology in which the entrepreneur's company excelled.

The entrepreneur applied for a Phase I DOE STTR (Small Business Technology Transfer), a sister program of SBIR, which requires a percentage of involvement by a university or federal research laboratory, and was awarded $75,000 to design flywheel motor alternators. During the time the entrepreneur was working on this project, DOE's interest moved away from flywheels and toward hybrid motors. The entrepreneur applied for a Phase II and received an award of $500,000 to develop high-speed Segmented Electro Magnetic Array (SEMA) motors.

KAT additionally completed a DOE SBIR Phase I ($100,000) and Phase II ($750,000), developing traction motors for hybrid electric vehicles. Beyond that they have completed two DOE SBIR Phase I's ($100,000 each) dealing with different aspects of integrated motion module motors and controls. Neither of the Phase II proposals was funded. The company also completed an Air Force SBIR Phase I ($100,000), designing flight control actuators. Again the Phase II proposal was not funded.

The company also submitted proposals and received funding from another DOE research and development program, CARAT, that is similar to the SBIR and STTR programs. *KAT* received Phase I ($150,000) and Phase II ($500,000) funding to work on integrated motors and controls for hybrid motor applications.

In 2000, the entrepreneur was awarded the coveted Small Business Administration Roland Tibbitts Award for exemplary achievement in the SBIR program. At that point the company had been awarded more than $4 million from four federal agencies and had begun commercializing the technology.

CONCLUSION

Examining a start-up high tech company pulls into focus both the company's internal and external needs. A person may be technically gifted, but unless the entrepreneur is able to develop or otherwise acquire other skills, an idea may never get beyond the conceptualization stage. An entrepreneur needs to be able to organize and manage a business and be willing to take a risk. Writing grant proposals, administering grant funding, and managing a project are skills that need to be honed. Later, the head of the company needs to capitalize upon the technical strengths of the group, identify critical weaknesses, and in some cases hire to overcome the weaknesses. Putting together compensation packages that elicit the best from each worker presents a challenge. Effective public speaking is imperative for one who is seeking investors. The entrepreneur/inventor continuously needs to learn or otherwise acquire new skills. Another key feature is spousal, extended family, and community support, which is critical to the success of the project. "Partnerships help bring innovations to the point where private actors can bring them to the market. Accelerated progress in bringing the benefits of new products, new processes, and new knowledge to the market has positive consequences for economic growth and human welfare." (Wessner, 2002 p. 23). By understanding the perils faced by an entrepreneur, governments may create programs to minimize their failures and increase their successes.

The SBIR program was instrumental in the development and commercialization of *KAT*'s technology. While changes may be necessary as the economy changes (Brown & Turner, 1999; Lerner, 2000), the program works in its current form and provides new technology to government agencies and to the commercial sector.

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