The Business of Commercialization in DoD SBIR Program

Is the Small Firm Ready for Prime Time?

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INTRODUCTION

This paper addresses DoD SBIR Commercialization efforts. Commercialization, also referred to as SBIR Phase 3, includes sales to the government through public procurement as well as sales through private commercial markets. In some cases, the technology may have dual uses, with the government gaining the benefit of an innovation, which later moves into the commercial market. In other cases, the initial award successfully meets the department's goals, with no need for additional funds or sales.

The merits or faults of the SBIR Program as a whole are not addressed here; rather, the point of view is strictly from a **business perspective only addressing Phase 3**. It uses the SBIR Program as implemented by the DoD as the working model. As pointed out in NRC's comprehensive report[1] DoD's focus is on maturation of technology readiness and aligning companies with its acquisition programs.

This paper:

1. Places SBIR awards within the general context of the DoD market
2. Identifies the main paths/sources of SBIR innovation
3. Identifies problems of commercializing SBIR results
4. Offers suggestions to foster commercialization

In spite of Phase 3 successes reported, admitted commercialization problems remain[2]. This paper addresses some issues using a general business model. The main problems are easily identified from a for profit business point of view. Solutions are difficult.

[1]**An Assessment of the Small Business Innovation Research Program**, Charles W. Wessner, Editor, National Research Council, ISBN: 0-309-11085-8, 2007, p. 235 (available at http://www.nap.edu/catalog/11989.html).

[2] **SBIR and the Phase III Challenge of Commercialization: Report of a Symposium, Committee on Capitalizing on Science, Technology, and Innovation: An Assessment of the Small Business Innovation Research Program**, Charles W. Wessner, Editor, National Research Council, ISBN: 0-309-66633-3, 2007 (available at http://www.nap.edu/catalog/11851.html).

MARKET DESCRIPTION

The DoD Market as a whole is in the Mature Market Category. It is *oligarchic,* dominated by several extremely large primes and with first, second, and third tier firms below them serving as subcontractors. All are very large compared to a small business concern (SBC), which must have less than 500 employees to bid on an SBIR. This market lasts as long as the Federal Government operates. A Program is the major vehicle for procurement within this market and it goes through its own life cycle, following a revenue curve taking it from inception to termination, much as in the consumer market.

The Government controls this Market through its funding cycle and uses prime contractors (or the tiers below, depending on program size) to manage and subcontract. Thus, in *this* Mature Market, dominant firms primarily use *integration* and *value chain optimization* to create revenue and profit for themselves in the process of delivering a product to the DoD at lowest total cost of ownership.

A prime contractor manages an extended value chain. A new program tends to form around a major new platform; this is the deliverable product. There may be many refinements and refurbishments associated with maintaining this platform to take it to the end of its useful life. Thus, the revenue curve timeline may extend to 20-30 years, which is as long as some major consumer product lines.

Many considerations that apply in the commercial sector don't apply to the DoD sector because the market is largely uncompetitive compared to Business-to-Business (B-to-B) or Business-to-Consumer (B-to-C) markets. When an SBC has deep technical knowledge they usually exploit it by finding a market in which there are *no large rivals*. They would then become the big player in a small market and dominate it. This is not the case for the DoD market.

For the SBC, all the competition is in Phase 1 and by Phase 2, the SBC usually has no other SBC to compete with. In Phase 3, the SBC certainly does not compete with the Primes. There are some advantages. The need is firmly stated, the customer is well known, there is possible future revenue in follow-on contracting, and the marketing and sales requirements are minimal.

If an SBC is *already* in this market, it is unlikely that it will bid on an SBIR. Rather it tends toward fulfilling a role in the value chain as supplier of something at lowest possible cost. Improvements to an offering may be had over time but it is unlikely the firm will produce a breakthrough innovation of the type sought by the SBIR Program. It is not impossible for an established SBC to attempt to break this pattern and offer something new. The firm needs a change of strategy, a different mode of operation, and the personnel needed to work innovatively. Management needs to commit to these changes and firmly support an SBIR effort; otherwise it will not succeed and become discouraged from pursuing such an effort in future.

Generally, a suitable SBIR innovative offering comes from an SBC in the G*rowth Market Stage* (defined below). There are several possible innovation paths to pursue in a growth stage but only two seem viable paths for the SBC interested in an SBIR contract.

SOURCES of INNOVATION

DISRUPTIVE PRODUCT

The well-known New Technology Adoption Cycle[3] is shown in Figure 1. A disruptive product is one delivering a truly **new product in a new market**. The innovation is likely to cause a shift away from existing products to the new product because of the potential for at least an order of magnitude improvement in technical performance or capability. Risk is high but so is the payoff. Both the product and the market need development. The market is usually so new that it is undefined at the outset—not the case with the DoD market outlined above.

Note that Figure 1 shows "The Chasm" area—a term coined by G. Moore as early as 1991. This is largely equivalent to the "Valley of Death" area used in describing the transition from SBIR Phase 2 to commercialization. Here, significant investment moves the technology from near nothing onto the beginning of a steep growth curve.

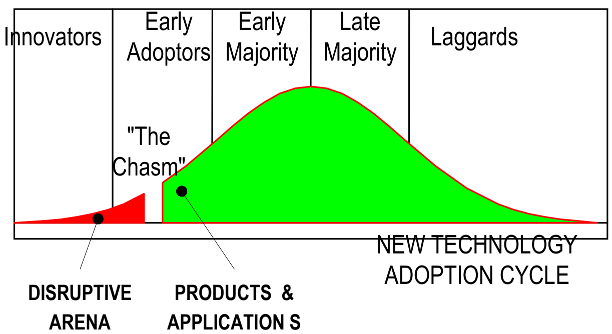

Figure 1 New Technology Adoption Cycle

The SBC that has truly disruptive technology likely will not consider the SBIR Program as a funding source. The open world market has vastly more potential than a DoD market as defined by an SBIR solicitation. Since the SBIR is so specific and the application so narrow, the revenue potential is too small for a really disruptive product. An SBIR will actually take away valuable time and resources in service to the Government customer that should be aimed at creating a differentiated product for a more lucrative target market. The SBC will not want to become the next Boeing and compete with it. It is better off participating in establishing a new market and reaping most of the new market revenue.

If the SBC attracts a Venture Capitalist (VC), he will be interested in far greater returns than the Government can provide no matter how large the promise of a Phase 3 or production contract. VCs tend not to like Government contracts. There are too many regulations, one-sided contracts favoring the Government, profit limitations, and the potential for termination at any time for any reason, which makes the arrangement unreliable.

NEW APPLICATION or NEW PRODUCT in DoD MARKET

Innovation most likely comes from an SBC looking at the market as either a *new problem area for an existing product* or as a *new product for the existing problem area*, see Figure 2.

Innovating as a new application, an *existing* product is tailored to meet the stated needs and requirements of the DoD customer. There is a greater chance of commercialization success since something already exists and the market exists. There is innovation; it is simply that the SBC does not start with a blank sheet of paper.

[3]**Crossing the Chasm**, Geoffrey Moore, Harper Collins, New York, ISBN-13: 9780060517120, 2002

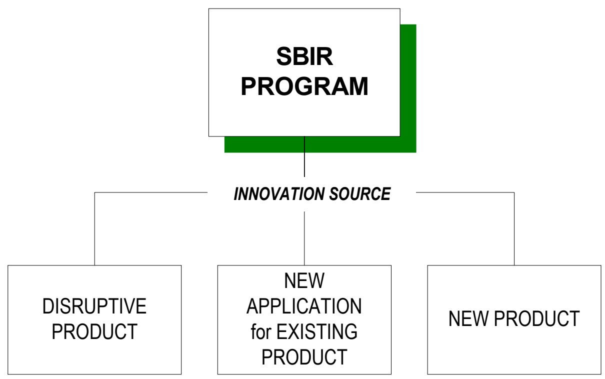

Figure 2 Sources of Innovation for SBIR Program

In a new product innovation, the SBC creates a completely new product in response to the SBIR requirements. Normally primes take their products and extend them with new variations and/or enhancements. For the SBC to make an impact it must substantially enhance a platform's performance—usually a component or assembly, possibly a subsystem—by a large factor in a vertically aligned chain. The SBC needs to concentrate on one or two, at most three critical features to improve upon and simplify everything else. It needs to produce a stand-alone product with all required features and with interfaces that permit integration into a much larger system.

Alone, the SBC incurs high cost and high risk on either path. But an SBIR contract reduces some risk by providing funding for maturing the technology. The product will automatically be differentiated from everything else on the market, and the Government allows the firm to patent and commercialize the product as possible, requiring only royalty free rights.

On the negative side, the firm needs to determine if this *Niche Market* is large enough. Often the DoD customer does not have a firm plan for inserting the technology in any program; thus, there really is little follow on potential beyond the immediate revenue generated by a Phase 2 contract. If the SBC creates a product the DoD wants, *its value decreases in the commercial sector* as the product is so specialized that it usually cannot be used in another market for a different customer. If the product should have potential in the non-defense sector, competitors will realize this and exploit it; thus there is lost opportunity cost for the SBC with an SBIR contract. **There really is no "dual use technology"** in this sense and is a reason the SBC has difficulty in attracting other funding once it pursues the SBIR path.

No company creates an entire product itself. The SBC must focus on core pieces it is able to create and find a way to come up with the rest. The strategy must focus on the firm's position within its own smaller supply chain. It will never dominate this mature market no matter how good the product, due to existing companies within the chain who provide more than just technology. It needs to scale up its operations beyond Phase 2 to achieve a low rate production capability. Ordinarily, it would ally with larger firms to achieve economy of scale—difficult to do with the primes.

In the commercial sector, the SBC would normally have a *killer application*—a breakthrough that changes the market creating a very large and immediate market demand. For the DoD, this is generally not the case as both demand and buying volume are low.

PROBLEMS IN REALIZING PHASE 3 COMMERCIALIZATION

POSSIBLE WRONG BUSINESS STRATEGY for the SBC

In Figure 3 the main curves depict the market revenue for a single DoD Program going from growth to maturity to decline and termination. The total revenue curve is bounded at the top by a prime. The remaining curves show a primary subcontractor working with the prime from the Growth Stage through the end of life. The lower revenue curves depict subcontractors added primarily in the middle during the mature stage, roughly at platform quantity production. Fluctuations reflect the government spending profile. When this program ends, the market does not as there are always other DoD programs as long as the Federal Government is in business. [Overall this figure is a generalization meant to depict the typical cycle].

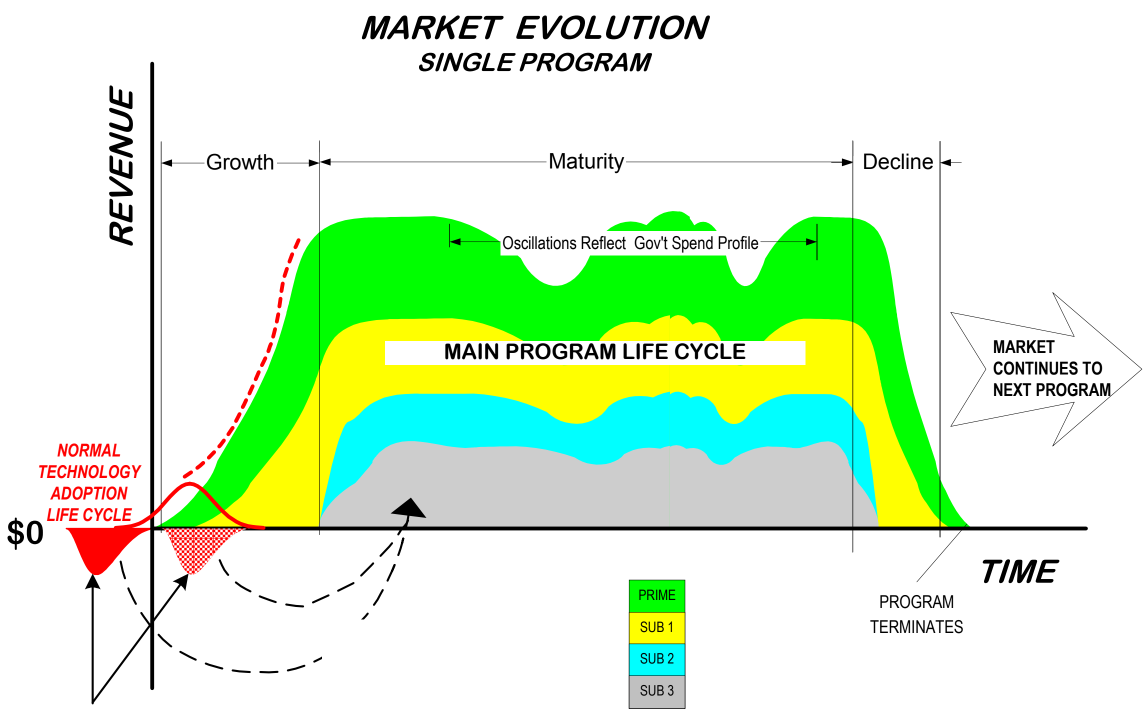

Figure 3 Program Revenue/Life Cycle

The SBC and SBIR Program pieces are shown in red. SBIR contracts are Sunk Costs and may occur before the main acquisition program or into its start, during the Growth Stage. The normal new technology adoption cycle is shown above this SBIR funding. The dashed red curve depicts the path that the SBC would normally take assuming that the SBC gets to Phase 3, equated with commercialization. But the SBIR process inserts the company directly into a Mature Market, bypassing the Growth Stage.

Here is a fundamental problem: ***the SBC innovates in a Growth Stage market category but sells in a Mature Market that it did not create***. The successful tech innovation company—and one ***whose business model is the commercialization of the innovation***—would follow the dashed red path and continue along the entire revenue curve. The small company is too small to participate at any place other than the bottom of the value chain in *this* market. ***The net result is that the SBC receives no revenue from the Growth portion of the curve*** that it would normally receive by completely following the curve. This is the stage of lower risk, high margins, large revenue, and rapid growth. *Along this path is the main inflection point determining commercialization success for a high tech small business*.

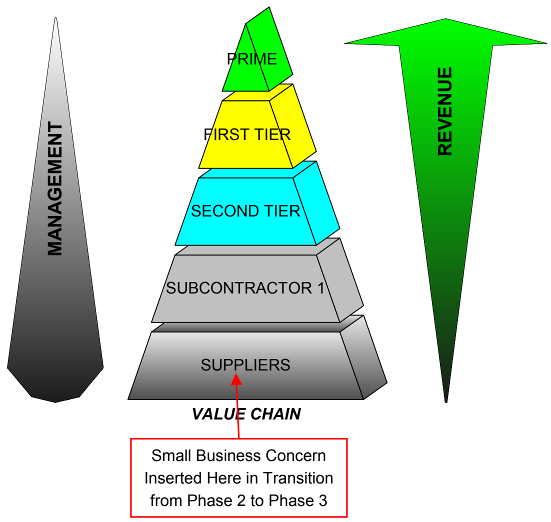

Figure 4 The SBC Business Position in Transition from Phase 2 to Phase 3

The path forced by the SBIR process into the seemingly new market opportunity most likely generates insufficient revenue for the SBC to succeed as a commercial venture. In this Mature Market, most of the revenue is acquired at the top of a pyramidal structure by a prime, see Figure 4. If the small company really had a good marketable product, it would gain revenue at the growth stage, grow to reasonable size with commensurate experience, and likely be better off selling product directly to the primes. Thus, the first key problem is: ***overall, following this insertion path is the wrong business strategy for commercially viable technology from the SBC perspective***.

TRANSITION to FULL PROGRAM

From the DoD viewpoint, the top SBIR Program goals are to search for and identify new innovations, and then reduce technology risk of the promising ones using Technology Readiness Level (TRL) as the metric. The SBC is expected to deliver product at sufficient maturation that it can be integrated by the prime at a point near initial platform production in the life cycle of the main program.

But in the most likely situation, the SBC probably did not participate in the overall program process, and likely knows little of the requirements and concept of operations (CONOPS). Some agencies are better than others in exposing the SBC to the overall program requirements and CONOPS—it depends on the agency's real intent. It is difficult for the firm to transition directly into a full up ongoing program performing at a different level.

In the current DoD model, the SBC must be ready to produce the product in Low Rate Initial Production (LRIP) and at moderate to low cost by Phase 3. It is the prime's duty to wring excess costs out of the value chain in integrating the final platform. This requires a different mindset and likely different personnel than those used by the small business at the ideation stage. But cost reduction is not a good strategy for a firm supposedly in the Growth Stage where it is concentrating on gaining market share and maximizing profits for a differentiated offering.

A TENUOUS BUSINESS ALLIANCE

Initially, an alliance forms between the SBC and the DoD in Phase 1 and maintains In Phase 2. The DoD agency may bring a Prime into the picture depending on the Program; however, this involvement is mostly informal—undefined and not a requirement. By Phase 3, the alliance shifts to one between the SBC and prime with DoD adopting an oversight role.

Most business alliances form to reduce market risks. Two main uncertainties are in play here: government demand on the customer side affecting the SBC's business planning, and technological development on the provider side affecting the DoD's product risk tolerance, which is passed along to the prime. (There is also the risk the SBC will go out of business by Phase 3; however, this does not relate directly to the SBIR Program and is not discussed here).

A strategic alliance needs both strategic as well as organizational complementarities between partners, incentives—especially for the SBC as the transferring firm, and assurances that the prime as partner does not become a competitor. Incompatible operating systems and cultures, and a lack of rules for decision making contribute to failure of these alliances. These are all in play here.

A second problem with commercialization stems from the alliance forced on the prime and SBC through the SBIR process. To describe this problem fully, examine each partner's viewpoint.

THE DoD VIEWPOINT

The advantage to DoD is access to new technology. DoD is willing to pay for this access and incurs all the *financial* risk in Phase 1 and 2. It wants enhanced platform capabilities and lower total cost of ownership.

Due to Congressional mandates to meet societal objectives, it wants more commercialization via the private sector as well as minority and disadvantaged participation, but leaves this for others to accomplish.

THE PRIME'S VIEWPOINT

It most often feels it could advance the same technology itself, or buy it when/if necessary. Some of its own resources must be diverted to deal with the SBIR technology insertion and this is viewed as more of a burden than it is worth. Generally, rapid technology change is unattractive in markets with high levels of vertical integration due to possible technological immaturity or obsolescence—certainly true here. In most cases the prime feels that this uncertainty has not been reduced enough by the SBIR investment.

There is no competitive advantage to be gained by the prime in this market. The primes and top tiers do not really compete and all have access to all suppliers as needed. If the technology was truly worthwhile to its business, the prime could acquire the SBC or offer employment to the SBC's key technology employees thus acquiring the know-how through the back door. ***The prime has no real business incentive to cooperate with the SBC.*** However, there is a federally mandated requirement to outsource a certain level of contracting to small businesses.

THE SBC VIEWPOINT

The advantage is access to a new market. Normally another advantage would be access to complementary resources/capabilities—but this is *not* the case here. It does not derive value from the chain before it is inserted into the market—then it may be too late. The only way the SBC really gains access to meaningful resources is to include the prime as part of its Phase 1 or 2. This appears to be a reverse subsidy with a contract that steers away from the informality of the alliance that was started. Why should the SBC give money to an extremely large company when it needs it itself?

Market uncertainties mean risk associated with doing business, especially the development of internal resources, assets, and capabilities. These take time so two added risks to the SBC are lost opportunity costs (i.e. developing a market having higher revenue potential and lower customer risk) and possibly first mover advantage.

Additionally, investments in specialized assets (examples are special test equipment or high cost, leading edge components needed to complete a product) needed to support the SBIR contract lead to high exit barriers for investors, equal to increased sunk costs. There is the uncertainty that the DoD loses interest and terminates at the end of Phase 2 or the alliance with the prime simply does not work. Alliances should decrease these costs and increase flexibility in responding to market uncertainty, but these sunk costs are *not* offset by the SBIR investment and the SBC may be left more vulnerable than it was entering the SBIR Program. As stated earlier, if the SBC creates a DoD product, the product is so specialized that it has lost potential opportunities in the commercial sector.

All things considered, the SBC incurs most of the risks in these alliances even though the government bears an explicit financial burden. The prime bears no burden until and if the DoD insists it work with the SBC. These realizations go a long way to understanding the reluctance by the prime and SBC to work together and form a true alliance.

Strategic Alliances, Joint Ventures, Consortia, and Networks—all of these are unlikely to bring competitive advantage to either the prime or SBC. The market is not really competitive; the primes access all available lower tiers and subs and suppliers as needed. The SBC provides no strategic advantage at this insertion point.

SBIR CONTRACTS

Phases 1 and 2 are written as contracts, but act more as grants since monies are not repayable in the event of failure. While an advantage to the SBC, requirements are too severe in many cases even in Phase 1 and seem to grow by Phase 2. The Phase 1-2 cycle of create, build a prototype, field test by end of Phase 2, then refine, ready for manufacture, manufacture, deliver to prime in Phase 3—simply does not match the SBIR investment level.

A Spiral Development Methodology will not work for hardware prototyping for an individual SBIR contract (Phase 2). It may work for a DoD Program as a whole when multiple SBIR results are examined and new efforts build on previous efforts, suggested in the NRC report[4]. A prototype here usually amounts to a complete small system. If it fails to work *in toto*, it may fail to demonstrate anything—the SBIR effort appears useless.

There is no latitude to build, test, get feedback, then refine, incorporate changes, and test again as in the Spiral Method. The SBC can only perform on a linear optimum path and will be lucky to produce a single working model/prototype at the end of Phase 2—there is little room for incorporating change. Thus any prototype must be created as if it were the only one.

As much as a third to one half of the contract amount may go to Other Direct Costs (ODC) and then the SBC must perform testing on this prototype. Also, many SBCs have not contracted directly before with the federal government, thus they spend an inordinate amount of effort on contract and property administration. Less work is spent on actual development.

If the prototype is "successful," this model version will need more work to ready it for manufacture—there is no specified financial source for this. Phase 1+2 monies alone appear insufficient to get to LRIP readiness even though SBC labor, and overhead plus G&A rates, are already low compared to the primes. By Phase 3, the effort is supposed to shift to a regular contract for limited (sometimes full) production with a prime and with many of the DoD/military spec performance requirements. ***This contractual situation is simply unrealistic—another problem.***

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[4] Ref 2, p. 141

RECOMMENDATIONS

STRATEGY

1. The SBC needs to carefully consider whether it wants to be in this market long term or at all. First it should have a strategy and then decide if SBIRs fit within this strategy. If the SBC is in it just to get Phase 1 and Phase 2 monies and not provide value to the customer it will not succeed.

   There is nothing inherently wrong with the process outlined In Figure 3. It is up to the SBC to decide if this is a good strategy for it to pursue. It must realize where it will fit in this mature market.

2. There may be certain SBCs whose business model stops short of commercializing SBIR results. As this is inconsistent with clearly stated SBIR Program goals, they should refrain from bidding. Other possibilities include teaming with another SBC to further the development to the point of commercialization, or licensing. If a firm continues to receive awards without much commercialization, they should not receive additional SBIR awards.

3. The SBC must realize that there are other strategies to pursue:
   a. Sell a Product
   b. Seek acquisition
   c. Licensing
   d. A Joint Venture
   e. A value chain partnership – see recommendation 4 below
   f. Become a Captive Company, independent but exclusively serving a larger company's product line
   g. Liquidation
      i. Spin Off the Product Group
      ii. Entirely sell off the company

ALLIANCES

4. If the DoD is serious about inserting the technology into a real program in Phase 3 but production readiness is risky, then the SBC might ally with an aerospace **contract manufacturer** (CM) instead of directly with a Prime. This applies mainly to efforts close to or at a LRIP state. A contract manufacturer solves the export regulations problem since they reside in the USA. CMs can handle the documentation required by the Primes. They are geared toward lower volumes, use a greater mix of assemblies, and provide the quality of workmanship required in military/aerospace work.

   This alliance places both sides on an equitable basis, each providing complementary value. It is unlikely that a contract manufacturer would "steal" intellectual property—it is not their focus to develop technology. The contract manufacturer receives more contracts, and the SBC, needing manufacturing assistance, gets to production without having to expend resources on non-core processes. The DoD might introduce small businesses to this part of the value chain.

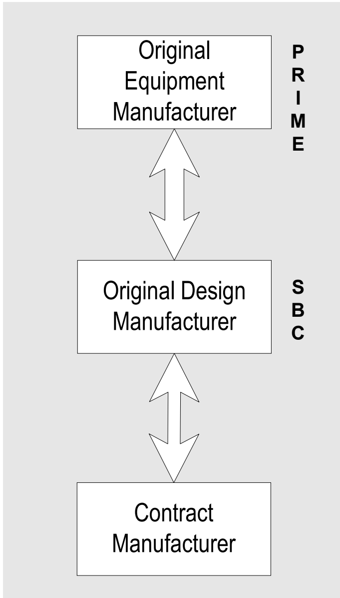

Figure 5 A Different Alliance for the SBC

In this role the SBC resembles an Original Design Manufacturer (ODM). It owns and designs the product and supplies a design to the CM, but then the product is "branded" by the prime for sale to the DoD—see Figure 5.

5. Equity arrangements are better than contracts. Equity participation better aligns two-party arrangements and provides incentive for trust and to mutually succeed. Contracts identify minimum expectations but provide no incentive for maximum effort. Contracts are more useful as technology uncertainty decreases and deliverables become definitive.

Since the DoD cannot enter into an equity arrangement under the SBIR Program, this leaves the primes or other *existing companies in the value chain* to consider such arrangements for successful commercialization. The DoD might encourage this process.

6. Under the existing alliance conditions, the only real protection afforded the SBC is patent protection. Thus, licensing as mentioned above (recommendation #3) becomes a primary mechanism. It should be pointed out that the mere presence of a patent does not guarantee royalties; thus, commercialization success to the SBIR Program cannot be guaranteed.

CONTRACT

7. As presently structured, ***the single most important thing to do within the SBIR Program is to increase funding amounts to decrease technical risk***. More money might be appropriated to fewer contracts in Phase 2. A new Phase 3 vehicle might be valuable to bring up the state of manufacturing readiness. All things considered, the technology becomes more valuable as risk decreases whether direct contracting, IP licensing, corporate venture capital investment, or acquisition, all strictly financial considerations. The reason is that for all these vehicles, ***the investment cost is inversely proportional to risk.***

8. Shorten Phase 2 to 18 months (maybe even 12 months) and increase award amount. While two years for Phase 2 is sufficient time, it is unnecessary if the product is to get out quickly.

9. Contracts need more simplification. A substantial effort goes to financial accounting and property management in government contracts. Technical requirements should be reduced. As an example, the SBC should not be required to perform field tests at a government agency's facilities in Phase 2 as part of the acceptance/success criteria. This could justifiably be charged to the Phase 2 contract, but such tests incur substantial costs, *many hidden*, leaving less for real development.

10. Use the SBIR results in Pre-Planned Product Improvements (P^3I). Providing such a “hook” within a program for upgrades and improvements provides a smoother migration path for technology insertion. This option is so advantageous, it should be mainstream adoption by all agencies. There is no risk to DoD involved, as the technology would not be inserted if it were not ready.

OTHER

11. The primes feel they should be compensated in some manner for dealing with the SBC in Phase 3—some suggest additional fee. The primes already have a mandatory small business contract component in place. They should be allowed to get “credit” (or more credit) for insertion of new SBIR technologies in their procurement programs without having to obtain additional fees.

12. Marketing and Sales (M&S) skills have been consistently cited as a problem for the SBC. This statement needs clarification. **Marketing and selling technology to the DoD market is actually much simpler than in the business-to-business or business-to-consumer market.**

    For marketing the DoD, the customer is identified and well known, the general customer requirements and features are identified, and the acquisition processes and procedures are explicitly defined. The SBIR Program really concentrates on the product - technology.

    Sales tactics for the military customer are the same as for any advanced technology item. New technology uses “direct” sales as the main tactic. Customers will want slightly different versions (e.g. Navy vs. Air Force), buy as a team, and need to be sold on the merits of the product by using lots of information and data.

    Contrast this with a new market for new technology where both the market and customer might be unknown as is the case in the non-defense sector. More and different marketing effort is required and sales tactics are completely different, especially for consumer products. If “commercialization success” means sales in non-DoD markets, then certainly M&S education is one reason that the SBC may fail. As stated earlier, the SBC must concentrate on serving the DoD customer to succeed and not divert resources to a non-DoD market.

Questions & Comments E-Mail: dwonica@laserlightnetworks.com