The Business Case for SBIR Commercialization

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Introduction

This paper is for the Small Business Concern (SBC) contemplating using an SBIR contract to fund its technology development, or one that already has a contract and is concerned about the commercialization aspects. This discussion focuses on the Department of Defense's (DoD) version of the SBIR program. It does not discuss the SBIR Program in general, or how to win contracts, or how to write a proposal.

A goal of the technology based SBIR Program is "commercialization." Commercialization includes both sales to the government through agency procurement and to non-government markets. The technology may have dual uses, with the government gaining the benefit of an innovation, which later moves into the non-government market. In other cases, the initial award successfully meets the agency's goals, with no need for additional funds or sales. Note that the term "Phase 3" equals commercialization, even though there is no funding for it.

The vast majority of SBIR winners have not crossed over the barrier to Phase 3. Something does not add up within the SBIR Program: *Congress specifically identified SBIR Commercialization as a problem area*, wanting to see more return on its investment[1]. Congress urges the DoD agencies to help small firms make the transition from the Phase 2 demonstration or prototype phase to an ability to commercialize or "insert" a technology into an agency acquisition program or into the public marketplace. This transition is difficult because it requires a small firm to evolve quickly from a narrow focus on R&D to a much broader understanding of agency systems and missions.

[1] See **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 (http://www.nap.edu/catalog/11851.html).

Business Case

Strategy

You must seriously consider whether an SBIR contract fits within the firm's strategy. In achieving "commercialization" success, you place yourself at the bottom of a supply chain in an oligarchic market of very large prime contractors. There is nothing intrinsically wrong with this placement if this is a part of the overall strategy. However, you usually give up substantial growth opportunity and revenue potential by pursuing this path if the technology has a chance to sell in the open market. It is improbable for you to compete with the primes (and first, second, third tiers) and become large in this sector using only SBIR contracts.

There are other reasons to pursue an SBIR contract. You may simply want (need) the Phase 1&2 monies. You may decide to become a small supplier in the defense sector, or may want to list the government agency as one of your customers for publicity. You know the topic very well and can provide exactly what it calls for. Alternatively, you know the agency contact and know exactly what he wants and thinks about the topic. Two other good reasons are that the SBC has an existing product that can be adapted to meet agency requirements, or the proposal effort is minimal and fits within the budget.

SBIR Contracts fund New Product Development (NPD). Figure 1 shows an exploded view of this process. For the advanced technology small business, Strategy addresses at least three essential items: a Portfolio of Technologies, Finances, and Marketing.

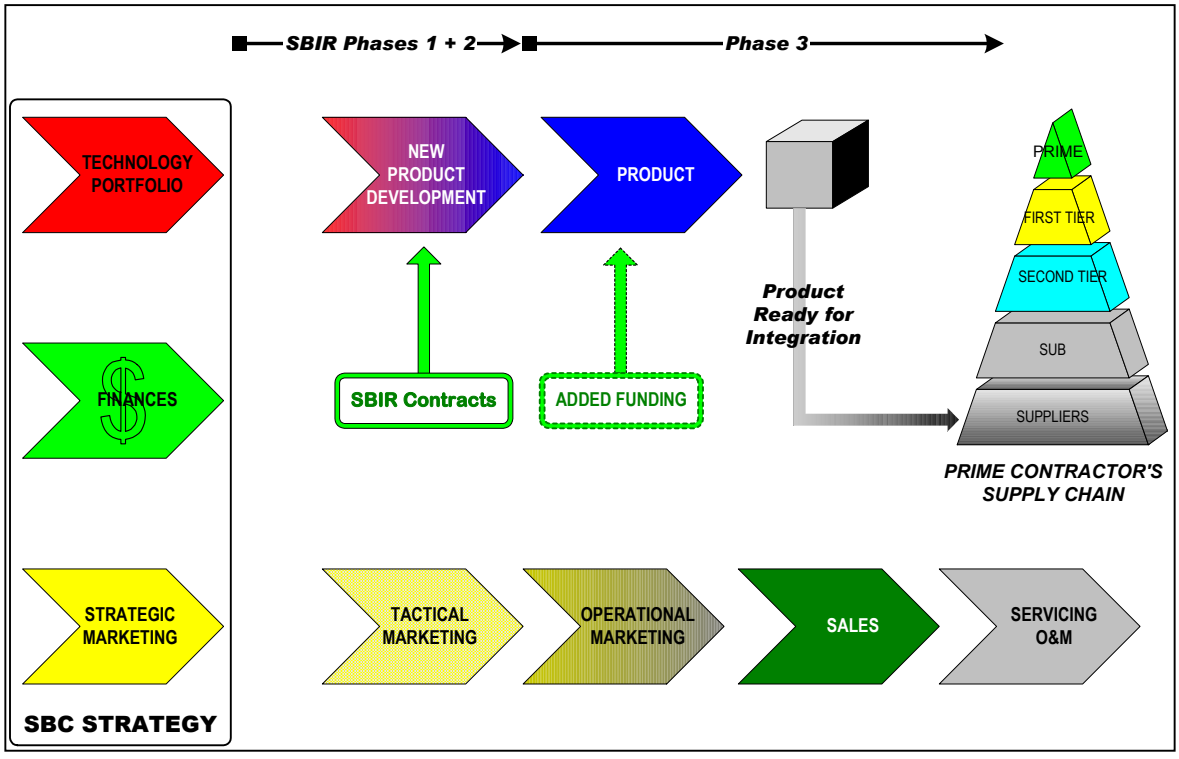

Figure 1 Business Case for SBIR Contracts

You select one technology in your portfolio and decide to pursue SBIR Phases 1 and 2 to help fund NPD. You must also consider what to do for Phase 3. Phase 3 is unofficial in the sense that there is no funding apportioned for it in the SBIR Program. It is the commercialization phase—you consider *now* a contract that *may* result from either the DoD agency or its prime contractor in the future.

The DoD Agencies mostly define commercialization "success" as sales to the Agency and insertion of the technology into a Prime Contractor's major program and this is unlikely to change soon. Thus, the SBC should understand the acquisition life cycle for a major program for the DoD to know where to watch for the pitfalls in commercialization. See Appendix A for a synopsis of this life cycle.

Much of the difficulty in commercialization lies along the path in maturing the technology from design to manufacture, and in meeting agency testing requirements. Different sized firms will have different capabilities and varying amounts and levels of resources (beyond monies). These considerations as well as external resources and complementary assets available through alliances (especially with the prime contractor), informal relationships, other contracts, letters of interest, teaming agreements, etc. all contribute to furthering the SBC along this path. Financing is usually the single largest barrier to successful NPD. There usually comes a point where there is no other substitute for added funding.

There are five pitfall areas for SBIR commercialization in the DoD acquisition process you should recognize:

1. Technology maturity, where TRL is the metric,
2. Manufacturing readiness, where MRL is the metric,
3. Testing and Evaluation (T&E), to verify TRL and MRL,
4. Interchanges/Alliances with the prime contractor, and
5. Finances beyond Phase 2.

Technology and Manufacturing

The SBIR Program emphasizes and funds the maturation of the select technology over time. Technology Readiness Level (TRL) recognizes technology maturity using straightforward definitions. Firms start out with technologies at varying maturities, but generally not at level 1. Most SBIR Phase 2 contracts result in a TRL 3 or 4. The technology must mature further to keep up with the prime program to level 5 or 6 (refer to Figure A, Appendix A).

Beyond technology, a bigger problem may be the readiness to produce a product to military requirements and produce it in quantity. Manufacturing Readiness Level (MRL) is necessary, as TRL does not require prototype components to be producible, reliable, or affordable. MRL supplements TRL, addresses these concerns, and attempts to identify main manufacturing processes and sources of supply associated with a technology. Both TRL and MRL help the DoD Agencies manage risk. The goal is an MRL 6 at the end of the Technology Development Phase.

Test and Evaluation (T&E)

Evidence of both TRL and MRL maturity comes through a witnessed demonstration or test, which leads to another problem area: test and evaluation. An SBC might consider a prototype demonstrated indoors or in a parking lot with all functions operating as advertised as perfectly acceptable for a commercial application.

A DoD Program Office might not consider a product from an SBIR until it reaches a TRL 7/8. Major program testing has two levels, the first is Development T&E at the completion of full-scale development of a system, and the second is Operational T&E that occurs in an operational environment. The T&E stage "sells" the final product to the customer, where there is overall confirmation that the product meets *all* requirements.

These tests are extensive and exhaustive. The SBC will need much help to mature both the technology and producibility to get to this level. It may need specialized testing, equipment, and access to facilities, all of which may require new capital.

Alliances

The gap in the Technology Portfolio line of Figure 1 symbolizes the leap required to get to a product ready for delivery. If you have passed through the NPD path completely, your marketable product is one ready for quantity production, ready to perform to specification, and compatible with an existing platform design headed by a prime contractor. The product inserts into the platform program through specified interfaces, controlled by mutually agreed upon interface control documentation defined well in advance.

The model business case states you are now part of a vertical defense supply chain—or are you? What if the prime does not want your product? The DoD agency generally wants the SBC to form an alliance with the prime to ensure the product transitions properly into the platform. However, *the prime has no real business reason to cooperate with the SBC*. Usually the prime feels it could develop the technology itself, or acquire it if and when necessary. Most times, the TRL/MRL are immature at the end of the SBIR contract and the prime would have to expend its own resources developing it further.

An alliance usually gets you access to complementary assets you don't have – manufacturing, marketing, additional contracts, etc. Do not expect that to happen spontaneously just because you have a Phase 2 with the agency. Unless you pursue an alliance and formalize it, you will not gain much from an informal alliance with the prime.

Overall, 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. However, the government cannot force two businesses to cooperate. These realizations go a long way to understanding the reluctance by the prime and SBC to work together and form a true alliance (See the author's paper[2] for additional discussion).

[2] D. Wonica, "Commercialization in the DoD SBIR Program"

Finances

SBIR funding alone is almost always insufficient to take the selected technology all the way through the NPD path indicated in Figure 1. There is simply too much to accomplish both in technology maturation and in production readiness with too little money.

SBIR contracts offset some of the ***sunk costs*** associated with NPD. Other sources include internal monies, Angel investment, owner financing, stocks, loans, Venture Capital, and Corporate Investment.

The Finances path in Figure 1 shows gaps and the need for at least one additional Funding injection. Without some injection of money immediately after Phase 2 you will likely fail to launch. If the Technology Readiness Level (TRL) is not at level 5/6 then these funds will go to technology maturation. Most funding should go to manufacturing and production engineering costs or pilot production to get to Low Rate Initial Production (LRIP) capability.

From discussions with the agency, you determined that the SBIR topic may tie in to a new or existing program and that if you are successful the result may be a Phase 3 contract for *widget* delivery. You must understand your costs and your offering price and project the value of a contract—use the best available information *now*.

Decision Tree Analysis

Ideally, the SBC considers its longer-term options at the same time it is considering writing its Phase 1 proposal. Decision Tree Analysis provides a guided, risk-qualified value assessment. It forces the firm to think through how to react to the outcome at each phase of the SBIR process.

You consider the options available for the three SBIR Phases, weigh risks at each stage, determine possible outcomes, and then assign probabilities of occurrence based on the information you have now. Use discounted cash flows as a metric for expected monetary value (EMV). Obtain the current expected value *today* by computing the probability weighted average of the discounted cash flows at each stage.

Decision Tree Analysis works well for the SBIR Process because:

- The win probabilities for SBIR Phases 1&2 are well known from historical data.
- The overall process is sequential with Phase 3 depending upon Phase 2 and Phase 2 depending upon Phase 1.
- The Government defines both the contracting process and duration of each phase, so you can construct a realistic time line with easily defined decision points.
- The Government defines profit margins by regulation (Federal Acquisition Regulation, FAR) so it is easy to predict cash flows.
- The outcome of the effort of Phases 1&2 is a prototype. You may qualify its maturity within discrete bounds of uncertainty.

The expected value of this analysis incorporates both upside and downside risks and the actions to take at each stage. The range of values encapsulates the potential risk in the investment in the product.

SBIR Contract Win Probabilities Are Known

Historically there is a roughly 15% chance that your Phase 1 proposal results in a win and a 40% success rate for Phase 2[3]. Generally in Phase 1 you must be invited to submit a proposal for Phase 2 consideration. An implicit assumption is that you submit a proposal if invited to do so; you may decide to abandon the effort at the end of Phase 2.

Recent research reported by the National Research Council indicates that the Phase 3 success rate is as high as 55%[4].

SBIR Phase 1&2 Development Cost

Assume development cost amounts to only the proposal cost. Usually proposal costs are labor (including overhead and G&A) and other direct costs (ODC). In practice, firms spend more on proposals than they think when *all* time spent converts to dollars. The "official" cost may equate to what the firm can allocate to a proposal from its Bid & Proposal Budget.

Assume a Phase 1 proposal cost of $10K, Phase 2 at $30K. For Phase 3, a reasonable amount may be $100K due to the amount of effort required.

Payoffs

The contract awards are limited by the SBIR Program:

- Phase 1 is usually a Firm Fixed Price (FFP) contract for $100K for 6 months, and
- Phase 2 is usually a Cost Plus Fixed Fee (CPFF) for $750K for 2 years.

The exact amounts differ among agencies, these are the SBA guidelines[5]. Assume Phase 1 yields 25% profit, and Phase 2 yields 10%[6].

Assume a potential Phase 3 CPFF contract for *widget* delivery over 3 years at a profit of 10% on cost of $30M for a total price of $33M. Note that you must estimate the costs of production and your price in the form of a proposal for Phase 3 and that this would go through several rounds of discussion before acceptance. For simplicity, assume the annual cash flow is then $1M.

Prototypes Gage Phase 2 Strength

From Phase 2 work assume three potential prototypes *might* result, classified as Strong, Average, and Weak, with a 10% chance of a Strong Prototype, 30% chance for an Average one, and a 10% chance for a Weak prototype (this equates roughly to the 55% commercialization success rate reported by the NRC). Failure to achieve anything in Phase 2 is an option, equal to the remaining 50%.

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[3] **An Assessment of the Small Business Innovation Research Program**, Charles W. Wessner, Editor, National Research Council, ISBN: ISBN-10: 0-309-11086-6, p. 20 (http://www.nap.edu/catalog/11989.html).

[4] Reference 1, p. 50.

[5] It is also possible to negotiate an FFP contract for Phase 2, but this is unimportant to the general calculations and discussion.

[6] The profit limitation for most CPFF contracts is 10%. For experimental, development, or research contracts, the limit is15%. Ref: FAR Part 15.404. An FFP contract has no profit limitation in principle.

Prototype Development Costs

Assume you decide that if the resultant prototype at the end of Phase 2 is a Strong model, then you require $1M to develop it. Similarly, an Average Prototype will need more development money, say $2M, and a Weak Prototype still more money at $3M. For simplicity, assume that any one of the three prototypes takes 2 years beyond Phase 2 for development to the point of being able to deliver it to the DoD agency.

Lastly, you assume that if you should get this far, for a Strong Prototype, you will have an 80% chance of succeeding at development. The Average and Weak Prototypes have 50% and 20% success rates, respectively. Each type may still *fail to develop* to the point of not being able to deliver under the contract.

There are two points to note. By now you would be working for 5 years from Phase 1 inception before you begin to realize profit. Note that for venture capital, the canonical timeframe over which investors expect to start to see a return on investment is five years.

Second, a very large assumption here is that $1-3M of development money materializes. If the firm does not have the internal funds, it must raise it from investors (usually a bank loan or SBA/SBIC loan is not a good option). This is the point that the SBIR program makes when it states it encourages the firm to seek outside investment funds. It may be possible to obtain additional monies from the DoD agency, not assumed here.

Cost of Capital

You determine the time value of money using a Present Value (PV) calculation with a presumed discount rate. Firms able to raise funding for new product development equate this rate to a Capital Asset Pricing Model (CAPM) rate or Weighted Average Cost of Capital (WACC)[7].

For the Aerospace/Defense sector, averages for well established firms are as follows[8]:

Cost of Equity = 9.20%
Cost of Debt = 5.95%
Cost of Capital = 8.42%.

Unless you are well established the Cost of Capital for Phase 3 will be high and this will hamper product development. Most of the time, the very small business gives up equity for capital investment. You must determine if a Phase 3 contract is worth this ownership dilution. For the purposes of this example, assume 15% for a small firm.

Note that for Phases 1 and 2, the Cost of Capital is zero. The investment comes from the SBIR Program and you do not need to repay the Government if the product development fails.

[7] This subject is more complex than meets the eye. For a small privately held firm, a better rate may equal an illiquidity rate, or a rate equivalent to a restricted stock discount.
[8] Aswath Damodaran, Web Site at http://pages.stern.nyu.edu/~adamodar has Cost Of Capital data—see under Discount Rate estimation. Data are current as of January, 2007.

Input Summary

	Contract						Proposal				
	Type	Price	Cost	Percent Profit	Annual Profit	Duration (yrs)	Cost	Psuccess	Pfailure	WACC	PV of Profit
Phase 1	FFP	$100	$80	25%	$20	1	-$10	15%	85%	0%	$20
Phase 2	CPFF	$750	$682	10%	$34	2	-$30	40%	60%	0%	$68
Phase 3	CPFF	$33,000	$30,000	10%	$1,000	3	-$100	50%	50%	15%	$2,283

All Amounts in $K

Table 1 Summary of Phase Costs and Contracts

Prototype	Outcome	Dev Duration (yrs)	Dev Cost	Psuccess	Pfailure	Profit Discounted (yrs)	
						2	5
Strong	10%	2	-$1,000	80%	20%	$1,726	$1,135
Average	30%	2	-$1,500	50%	50%		
Weak	10%	2	-$2,000	20%	80%		

Table 2 Characterization of Prototypes

Discussion of Calculations

For this analysis, the Phase 3 payoff is the same regardless of the quality of the prototype created during Phase 2—$10M over 3 years—thus the PVs of the cash flows are the same. Differences are in the amounts needed to complete the development at the end of Phase 2 to bring the technology to the proper Technology Readiness level (TRL) and corresponding Manufacturing Readiness Level (MRL).

The discount factor to use depends upon the Phase. For the Proposal Phase (time=0), Phase 1, and Phase 2, the Cost of Capital is zero.

In Phase 3, the total development period to use in the discount factor is:
1 year (Phase 1) + 2 years (Phase 2) + 2 years (Phase 3) = 5 years. This brings the calculation to the present time.

Considering Phase 3 alone, the development time is 2 years.

Results for All Phases Combined

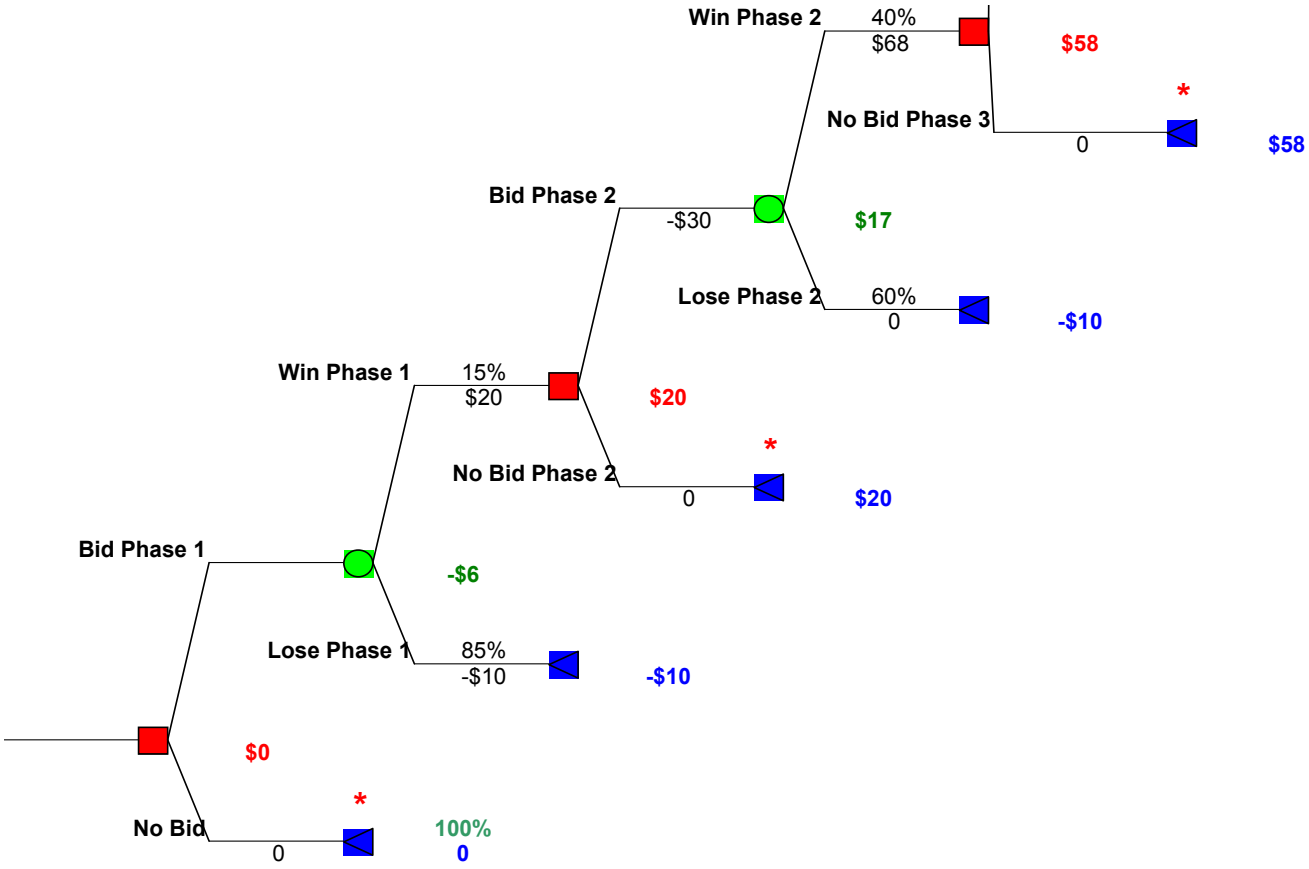

Figure 2-A All 3 Phases – Phase 1 & Phase 2 Shown

All Phases Combined, Continued

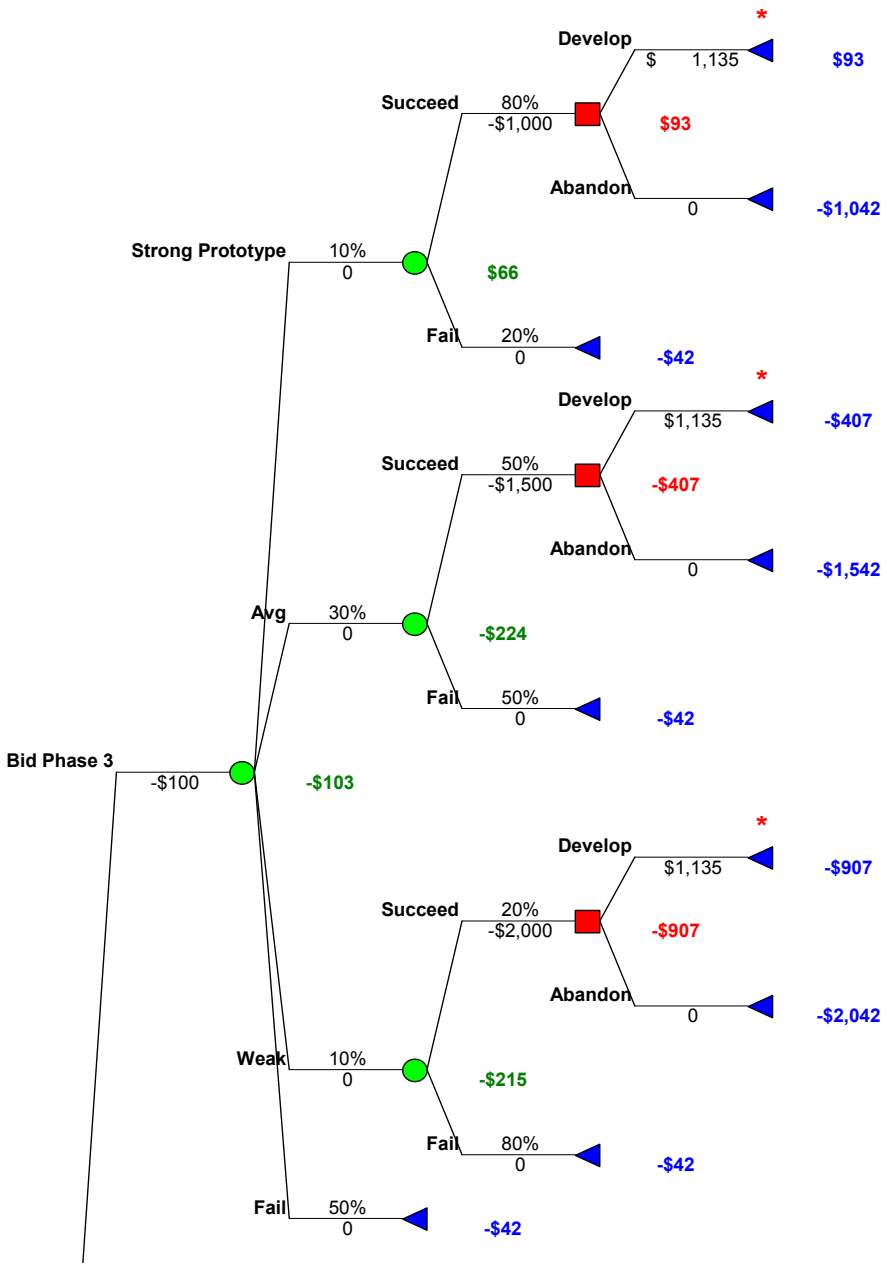

Figure 2-B All 3 Phases – Phase 3 Shown

Discussion of Results for All Three Phases Combined

Based on an overall Expected Monetary Value of -$6K (Figures 2A + 2B), the conclusion is to *No Bid* the SBIR proposal. The combined Phase 1 and Phase 2 statistics (Probability of Success) and Profit Margins are **not** in your favor. It is not worth pursuing even at Phase 1 *unless you can bias* $P_{success}$ *in your favor or if the solicitation is already biased in your favor*—you need a pre-award marketing effort.

If Phase 3 requires added investment (almost a certainty), it will be difficult to repay investors from earnings from a Phase 3 Contract due to Government profit limitations. You must seriously consider pursuing a non-Government contract or other commercially viable product development to increase profit margin.

The primary advantage to the SBIR Program is that the Cost of Capital is zero for Phases 1 & 2 and all contract monies may be used to fund NPD. You must determine if your NPD benefits from Phase 1 & 2 contracts versus the necessity of dealing with Government regulations and addressing specific defense contracting requirements. Phases 1 + 2 combined total less than $1M ($850K in the baseline example). An increase may come by Congressional mandate in the near future[9].

Table 3 presents a summary of results. Under the baseline assumptions, a profit of 10-15% results in an EMV of -$6K, which, if this is the only consideration, must result in a No Bid.

Profit	*Conditions*	*EMV ($K)*	*GO/NO GO*
	Phase 1&2&3 Combined, using Baseline Inputs		
10%	Max alllowed by FAR for most contracts	-$6	No Bid
15%	Max allowed by FAR for development contracts	-$6	No Bid
25%	Typical Commercial	$10	Bid
50%	As high as this amount - for Commercial special instrumentatio	$53	Bid
10%	Nearly double the assumed Phase 3 baseline Contract Value to $64.9M	$0	Threshold
	Phase 1 only		
25%	Cost < $4,000	$0	Threshold
	Phase 1 & 2		
25% & 10%	Cost < $4,000 Phase 1 and Cost < $24,000 Phase 2	$0	Threshold

Table 3 Summary of Results for All Phases Combined

A commercial contract with 25-50% profit results in a $10K-$53K EMV, which indicates a Bid decision. If the Government contract price were nearly doubled to $65M, at 10% profit, the EMV is at threshold (just about $0).

Considering Phase 1 only, at 25% profit (quite high by Government standards), the cost would need to be < $4K to reach threshold. For Phases 1+2 combined, the threshold costs would need to be $4K for Phase 1 and $24K for Phase 3—it is difficult to overcome the profit limitations imposed by Government contracting.

[9] There is movement and a recommendation to increase these amounts to $150K for Phase 1 and to approximately $1M for Phase 2. See Reference 3, p. 8.

Discussion of Results for Phase 3 Considered Alone

If you already are working on a Phase 1 and/or Phase 2 and must weigh a potential Phase 3 contract, the results differ from considering all three Phases together. The Present Value in aggregate for the three Phases is ignored and you consider only a 2 year development cycle plus the investor money required.

Figure 3 indicates that you *might* proceed if you have a Strong Prototype but not if the Prototype is Average or Weak. Under the given assumptions, the overall EMV is still negative, -$13K, and based on this alone, you should not pursue the Phase 3.

You will need a larger overall Government contract to earn more to offset the development monies. At 10% profit and with the other baseline assumptions held constant, the price threshold is $34.1M, which just pays back the investors. You may need to weigh the advantages of an even larger contract against subcontracting and also against possible firm expansion—strategic choices.

As a function of development money, consider a Strong Prototype that requires $500K, an Average one $1000K, and a Weak one $1500K; all other conditions are unchanged. Figure 4 indicates a Bid Decision, as the EMV is $112K.

Of course, if you can self fund the development, or otherwise reduce the amount of capital required, Phase 3 becomes more attractive. The most attractive option is to pursue a true commercial (non-Government) contract as the profit margin may be increased.

Results for Phase 3 Only

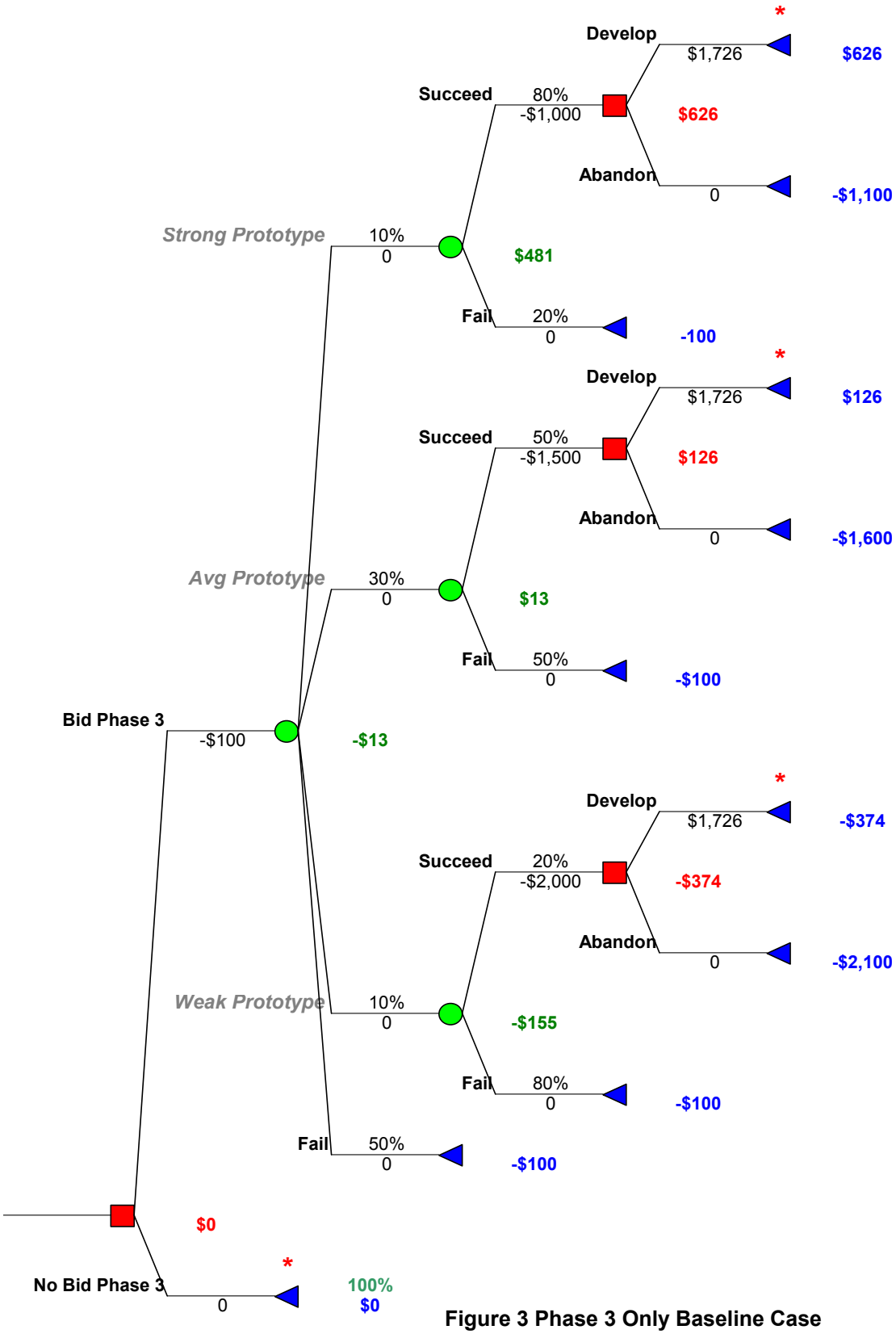

Figure 3 Phase 3 Only Baseline Case

Results for Phase 3 Only with Investment Changes

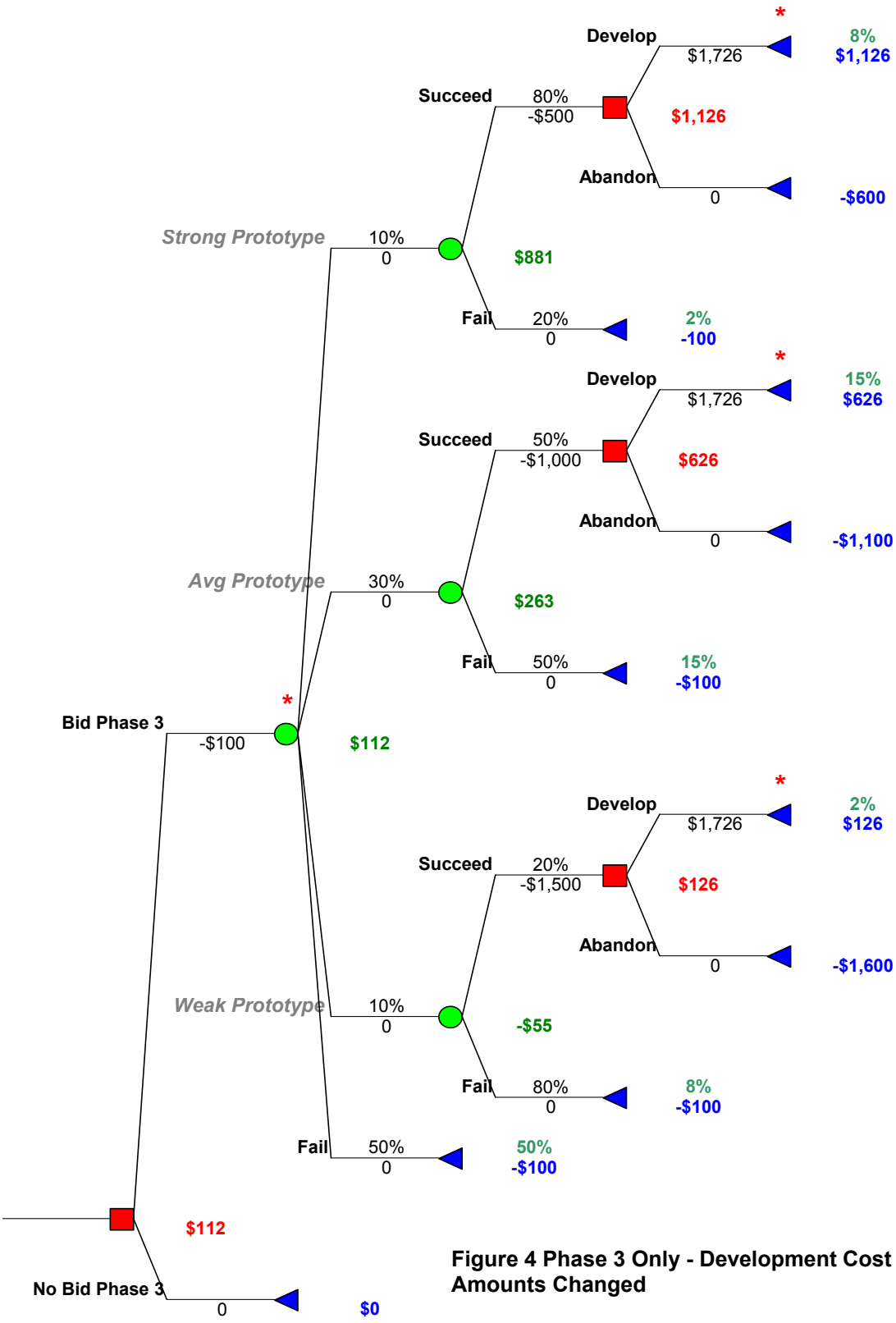

Figure 4 Phase 3 Only - Development Cost Amounts Changed

Marketing

The DoD encourages "dual use" (a misnomer) of technology. Commercial success occurs if the technology finds its way into the non-military sector as a profitable product. The DoD might then purchase it in the open market. The problem is that going down the military path usually makes the product less useful in any other sector. More importantly, if the technology has any possibility of emerging in the open market and making substantial profit, the SBC incurs lost opportunity cost, lower growth, and possibly first mover (even rapid second adapter) advantage.

Generally, Marketing falls into three phases: Strategic, Tactical, and Operational.

> STRATEGIC MARKETING includes activities that ideate, define, develop, evaluate, and select projects for commercialization. The goal is to transform a portfolio of technologies via projects into products and services offered by the firm.
>
> TACTICAL MARKETING includes activities in support of design and development of a **specific** product to prepare it for commercialization.
>
> OPERATIONAL MARKETING includes activities supporting post product launch, including sales and servicing.

Marketing and sales in the open market[10] entails identifying a need, finding the customer, developing a solution, firming customer preferences, and closing the sale. The marketing and sales process becomes more difficult when the technology breaks new ground. You may need to *create* a new market as well as new product[11].

Marketing and selling to the DoD is actually easier. The SBIR solicitation gives a technical point of contact. You need to determine if this contact is the ultimate user before the close of the submission period. The ultimate user may have different requirements. Discovering them will tell you how the product will be used, thus which features must be included and which are non-essential. This gives you much better perspective on the end game.

Many topics originate from government laboratories without ties at the program/command level—the SBIR effort dies at the end of Phase 2. In the ideal case, the DoD agency links the SBIR topic to a large procurement, usually a major acquisition that is ongoing or slated to become a new program. This points to potential future sales. Without this link, there is likely no real commitment to the topic.

The solicitation statement gives technical requirements and usually highlights key features. Marketing centers mainly on technical performance figures of merit—for example, your widget performs 25% better for 20% less power consumption, and costs 15% less than the existing assembly. You don't advertise to get to other DoD customers (advertising is an unallowable cost on government contracts). You sell to other agencies most effectively by using your prototype or product demonstration as proof of capability.

[10] This discussion revolves around Business to Business (B-B) and Business to Government (B-G) transactions. Business to Consumer (B-C) marketing is very different and not considered.
[11] See the author's E-Book, Marketing Requirements for High Tech Start-Up and Small Businesses

Your primary scientist/engineer for the product usually sells through demonstration, analyses, field tests, briefings, and other *direct* sales (these are allowable costs) methods that place him in front of the users. A sale usually entails a group of people buying as a team and perhaps multiple meetings in different locations.

You must ultimately deliver a product to spec for acceptance. Linking to a full-up procurement program for a major platform means meeting technology maturity, manufacturing readiness, test and evaluation criteria, and interface requirements. These constitute a "complete" product for this market segment. If you can't completely address these agency needs, as with any customer you probably should not pursue this segment.

Servicing is usually not discussed anywhere with regard to the SBC. Note that one study contends that support and maintenance services generate up to **seven times as much profit as do sales of the original product** over the product's lifetime.[12] The authors studied service supply chain contracts in aerospace and defense as well as "simple" products such as automobiles.

It is unlikely the SBC will generate profit at a comparable level. If the SBC becomes a supplier in the defense sector, it should at least consider maintenance and servicing as part of its total offerings.

[12] Power by the Hour: Can Paying Only for Performance Redefine How Products Are Sold and Serviced? M. Cohen and S. Netessine, 21 Feb 07, in Knowledge@Wharton http://knowledge.wharton.upenn.edu/article.cfm?articleid=1665

Conclusions & Recommendations

While there are instances of Phase 3 successes, commercialization within the SBIR Program as a whole is unsuccessful. Congress wants more return on its investment; however, it leaves it to the individual government agencies to decide how to improve their positions on the matter. As of this writing, uncertainty abounds and each agency uses a different approach.

The NRC reported 55% Phase 3 success rate seems especially high compared to small firm success rates derived from Venture Capital data. If the success rate were really this high, there would be no problem with commercialization in the DoD SBIR Program.

This paper presented some fundamental items for the Small Business Concern to consider regarding the SBIR Program from a purely business viewpoint.

1. The two main advantages of winning Phase 1 and Phase 2 SBIR contracts are:
    a. Your cost of capital is zero, and
    b. within the confines of the solicitation statement, all the contract monies may be applied to new product development since the firm essentially writes its own statement of work. Whatever the actual level of its NPD, the firm can propose to the SBIR Program.
2. The probability of winning Phase 1 is low; therefore, you must try to bias the win probability in your favor through focused, pre-solicitation marketing.
3. For a Phase 3 contract with the government agency or its prime contractor, you must realize you will place the company at the bottom of a vertical supply chain dominated by the prime. You must decide if this is the best positioning of your company's new product from a strategic viewpoint.
4. Decision Tree Analysis provides a basis for evaluating risk and value in deciding on Phase 3 SBIR contracts versus investments. It is a sequential process, with discrete probabilities based on an established SBIR success history, and with cash flows (profit) and time lines defined by Government regulations.
5. As important as advancing a vetted technology to a mature level is the effort required to get to the proper manufacturing level to enable a new product to integrate with a major platform developed by a prime contractor. The general DoD goals are TRL 6 and MRL 6 at the end of Phase 2.
6. It is highly likely that you will require additional investment beyond Phase 2 to advance either the TRL or MRL level (or both). You must consider the amount and cost of capital to achieve this position.
    a. While the cost of capital is zero in Phases 1 and 2, it will be substantial for Phase 3 for a firm needing external investment.
    b. Depending on the firm's size and maturity, you may need to give up equity in return for investment capital money—a strategic decision.
    c. The SBC may obtain additional zero cost of capital investment through a supplemental government development contract. These are usually extensions and worth pursuing[13].

[13] Example: As of Spring 2007, the USAF may grant an enhancement up to $500K with matching 1:1 money, or up to $1M under extenuating circumstances. Also, it has started listing "Critical Topics" in the solicitations whereby awards up to $5M may be granted for Phase 2.

7. Alliances with a prime contractor present hidden problems that cannot be resolved by the DoD agency. You must work these problems separately and directly with the prime.
8. The best overall business position is to use SBIR contracts to advance the technology with the goal of developing a product that serves the open market. This frees the SBC from government profit limitations.
9. It is easier for the advanced technology firm to market Business to Government than market both Business to Business and Business to Consumer, since:
    a. the Government customer (usually) identifies itself,
    b. the customer identifies general product requirements and features, and
    c. the customer uses explicitly defined procedures and processes to acquire the product.

Appendix A: DoD Acquisition Life Cycle Framework

The top line of Figure A shows the general Framework of an Acquisition Life Cycle in its entirety for a major Defense Program. Technology Readiness Levels (TRLs) 1 through 9 are shown on the second line phased to the desired gates in the review (Milestones A, B, and C) of the life cycle. The Manufacturing Readiness Level (MRL) should be in synch with the TRL. Figure A succinctly defines TRLs and MRLs. For more discussion of these terms, see TRL reference[14] and MRL reference.[15]

The SBIR Program fits within and feeds into the Concept Refinement and Technology Development Phases.

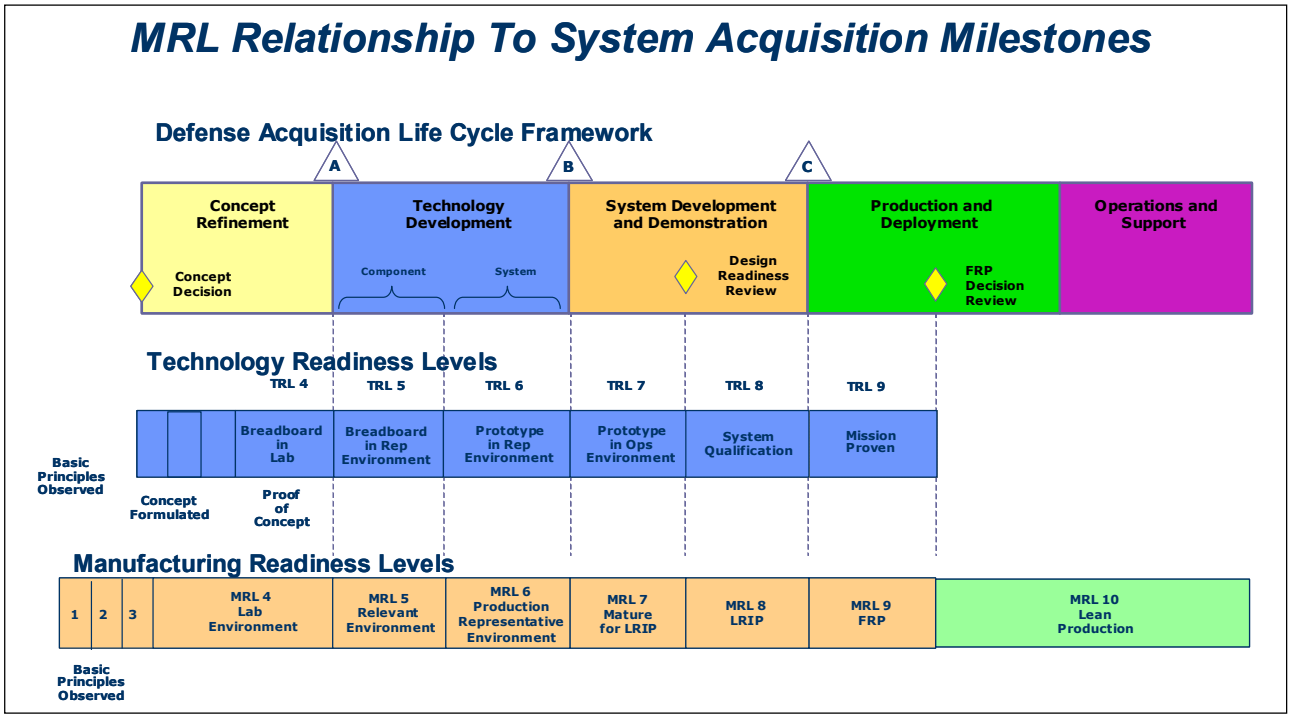

Figure A Source: https://acc.dau.mil/pqm, see *Manufacturing Readiness Life Cycle Chart* under Manufacturing Readiness Assessments

[14] http://www.dod.mil/ddre/doc/tra_deskbook_2005.pdf May 2005

[15] An MRL Matrix in Excel form is available at: https://acc.dau.mil/CommunityBrowser.aspx?id=18231 see Manufacturing Readiness Assessments (MRL Matrix Updated v4.2a.xls; also a Word Document, DoD MRL definitions v4.1.DOC)

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