

ROCKET BUILDERS
bringing technology to market

Final Summary:

Commercialization Success in Early Stage Technology Companies

Summary of Key Findings and Recommendations of a market research study on the commercialization challenges associated with early stage technology companies' development.

Report Funding by the National Research Council of Canada.

Research Guidance by the Advanced Systems Institute.

25/06/2004

AUTHOR INFORMATION

Authors

Dave Thomas
Geoffrey Hansen
Reg Nordman

CREDITS

FUNDING

This report was made possible by funding from the National Research Council of Canada.



National Research
Council Canada

Conseil national
de recherches Canada

GUIDANCE AND DIRECTION

The research was performed under the guidance and direction of the Advanced Systems Institute.



PROJECT MANAGEMENT

This research project was managed and coordinated by Rocket Builders.

RESEARCH AND ANALYSIS BY:

Thealzel Lee

Noulan W. Bowker

Catherine Crucil

Geoffrey Hansen

Reg Nordman

Dave Thomas

TABLE OF CONTENTS

Overview	4
Objectives	5
Purpose	5
Questions of Interest	6
Methodology	7
Approach	7
Interview Candidates	7
Interview Process	8
Results, Analysis and Recommendations	8
Sectors Chosen for Study	9
Background	10
Valley of Death	10
Factors In Commercialization	11
Commercialization Output	12
Secondary Research	13
Highlights from Publications	13
Highlights from Other Countries	22
Primary Research	24
Sector Analysis	24
Cross Sector Analysis	31
Conclusions	36
Best Practices	36
Implementing Best Practices	37
Models for Critical Success Paths	37
Commercialization Output	38
Recommendations	40
Recommendations for Companies	40
Themes for Supporting Commercialization	48

OVERVIEW

Rocket Builders was contracted to investigate and report on the commercialization challenges associated with early stage technology development in selected sectors of British Columbia's technology industry. Rocket Builders managed a team of researchers and applied its expertise in commercialization to analyze the data. Best practices for early stage commercialization were generalized from the patterns across the sectors, and sector-specific challenges were highlighted. These findings provide insight valuable to entrepreneurs engaging in early stage commercialization, and industry associations, investors and government can benefit as well.

OBJECTIVES

PURPOSE

The overall purpose of the project was defined by the NRC as follows:

- A study to address the commercialization challenges associated with early stage technology development and exploitation by SME's. Through experience and success stories the study will identify working examples of creative solutions to determine best practices in the process of growing technologically innovative companies through their formative years.
- Federal and provincially funded University research is primarily focused on fundamental research and Universities are a great source of scientific breakthroughs. However a much smaller percentage of federal grants are allotted to further developing breakthrough technologies and reducing commercial risk. At the same time, investing in the development of early stage technology is often too risky for established companies, thereby stagnating the innovation process by trapping technologies in a gap between funding sources. This gap is often referred to as the "valley of death". In an effort to bridge the valley of death thereby reducing commercial risk this study will review and analyse existing models of the commercialization process.
- The focus of the interviews will be to determine best practices in the commercialization process for the benefit of IRAP and its clients and lies within the mandate of the National Research Council.

QUESTIONS OF INTEREST

Based on these requirements, the objectives of the project were defined with the following "questions of interest":

- As small companies transition from research to commercialization, what are the milestones that are involved in surviving this transition?
- As small companies transition from research to commercialization, what are the best practices used by successful companies?
- How can companies in the early stages of commercialization leverage these best practices?
- What other roles should government and industry play in stimulating or supporting these commercialization activities by small technology companies?

METHODOLOGY

A planning committee was formed by the ASI and, in collaboration with the NRC, the committee selected three (3) sectors of interest.

APPROACH

The approach agreed upon for this research project involved primary research in the three (3) sectors of interest to discover how these sectors are unique and how these sectors are the same in terms of commercialization challenges. In parallel, secondary research into published books and research relevant to the subject of commercialization were referenced for comparison with the primary research.

INTERVIEW CANDIDATES

Interview candidates were chosen from companies that successfully bridged the "valley of death". From these successful, or succeeding, companies, a senior management representative (usually founder and/or CEO) was approached to provide their input.

Industry directories and contacts provided by NRC ITAs were the source of targeted interview candidates. Across the three (3) sectors, over seventy (70) companies were approached to participate in the study with forty-one (41) companies participating.

INTERVIEW PROCESS

The interview process focuses on the experience and success stories by retrospectively interviewing executives on past critical success factors and obstacles when the company was in early commercialization stages. This interview approach is used to identify the best practices used by technology companies through their formative years. Interviews were quite involved with many of them exceeding 2 hours in length. Interviewers were instructed to carefully validate the data during the interview process with the knowledge of potential bias introduced by the retrospective approach. Also, "need for money" was probed in the interview to correctly assess the true nature of this requirement.

RESULTS, ANALYSIS AND RECOMMENDATIONS

Results were aggregated across sectors and common commercialization patterns were determined as the basis of the "best practices". More detailed analysis was performed to describe these results as "Models for Critical Success Paths".

Recommendations for companies were drafted from the "best practices" and some general themes for Industry, Associations, and Government were suggested as a means for creating a supportive environment for these "best practices".

SECTORS CHOSEN FOR STUDY

The three (3) sectors of focus for the study were Wireless, Security and Medical Devices.

Forty-one (41) Companies participated in the study. Some companies were initially in more than one sector and duplication was eliminated early in the interview process. A second independent study undertaken by NRC of eighteen (18) medium size or 'Growth' companies occurred at the same time. Duplication was again eliminated early in the interview process.

The sector research profiles are shown in the following table:

Wireless	Security	Medical Devices
Research Conducted By: Noulan W. Bowker	Research Conducted By: Catherine Crucil	Research Conducted By: Thealzel Lee
Interviewed 16 companies	Interviewed 13 companies	Interviewed 12 companies
11 – 142 employees	5 – 85 employees	6 – 260 employees
Subsectors: <ul style="list-style-type: none"> • Infrastructure service • Infrastructure systems • Infrastructure components • End-user software • Consumer products • Application software • End-user hardware 	Subsectors: <ul style="list-style-type: none"> • Information security • Perimeter security 	Subsectors: <ul style="list-style-type: none"> • Consumer diagnostics • Clinical diagnostics • Clinical equipment • Clinical implants • Clinical devices

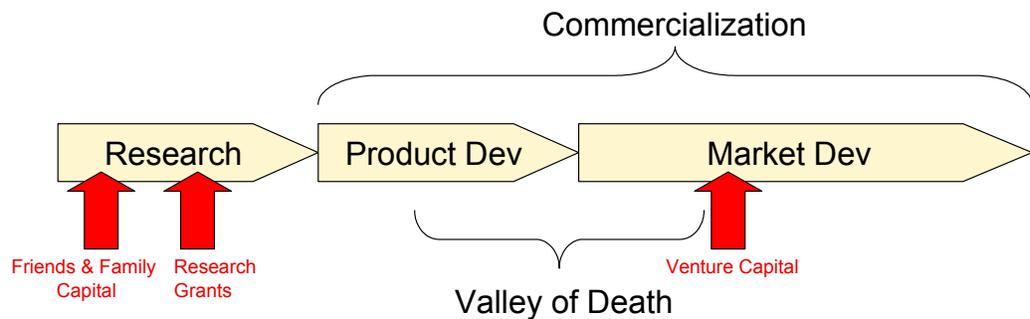
BACKGROUND

VALLEY OF DEATH

The “Valley of Death” is a term used to describe the point in technology company maturation where there is a high rate of company bankruptcies relative to any other maturation stage. This high failure rate is attributed to a gap between funding sources and is characterized by the following facts:

- Initial start-up capital and government support during R&D phases are readily available
- Early commercialization phases often take longer than anticipated so early capital is insufficient to secure early market validation
- Early market validation is important factor in securing venture capital.

The following diagram highlights the location of the “Valley of Death” in the commercialization continuum:



FACTORS IN COMMERCIALIZATION

Based on published research on commercialization, Rocket Builders designed a “Factors in Commercialization” framework to categorize the data collection. This framework recognizes the balance between “Key Success Factors” and “Key Obstacles” in enabling small technology companies to mature and prosper.

The “Key Success Factors” are divided into two sub-categories:

- Milestones
 - needed for acceleration/momentum
 - factors includes customer, product, partner, financial and regulatory milestones
- Resources
 - needed for the engine of growth
 - factors include people/management, financial and infrastructure resources

The “Key Obstacles” encompass both anticipated and unanticipated roadblocks and fall into two factors: financial obstacles and market obstacles.

It is important to note that “Access to Capital” plays a role in all three areas – milestones, resources and obstacles.

COMMERCIALIZATION OUTPUT

Given that one of the motivations for this study was to improve commercialization outcomes in Canada, Rocket Builders developed a simple model to describe the relative amount of commercialization success. This relative model is similar to those used to measure business performance in sales revenue or in manufacturing output - it uses a relative value for efficiency and a percentage value for effectiveness.

Here are the definitions used in our commercialization output model:

- *Commercialization Efficiency* is the number of companies engaged in commercialization
- *Commercialization Effectiveness* is the percentage of companies successful in commercialization

The formula for commercialization output is as follows:

$$\left(\begin{array}{c} \text{Commercialization} \\ \text{Efficiency} \\ \text{(\#)} \end{array} \right) \times \left(\begin{array}{c} \text{Commercialization} \\ \text{Effectiveness} \\ \text{(\%)} \end{array} \right) = \left(\begin{array}{c} \text{Commercialization} \\ \text{Output} \end{array} \right)$$

SECONDARY RESEARCH

HIGHLIGHTS FROM PUBLICATIONS

Book Reviews

There are many books readily available from any bookstore that features excellent insights for entrepreneurs wishing to improve their “commercialization skills” (a companion document to this report is available from Rocket Builders - “Commercialization Book Reviews”). Some of the more popular authors which offer excellent conceptual models and methodologies for best practices are:

- Geoffrey A. Moore (a series of books on market strategy for technology)
- Clayton M. Christensen (a series of books and articles on innovation)
- Robert G. Cooper (a series of books and articles on product management)

Two of the best books on this subject are available only directly from the author:

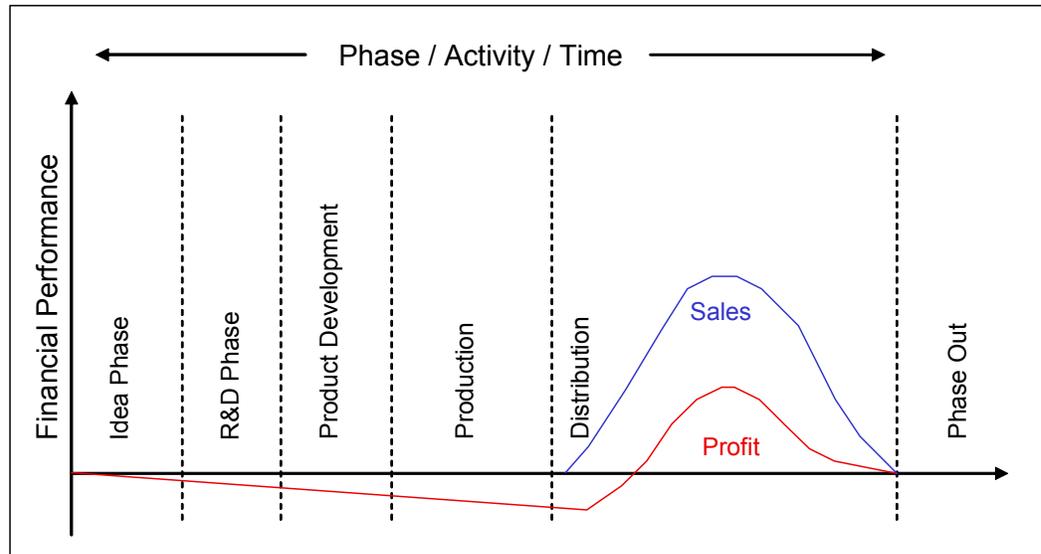
- “Making Technology Happen” by Denzil J. Doyle, Doyletech Corporation
- “High Tech Startup” by John L. Nesheim, Saratoga Venture Finance

Denny Doyle’s book is well referenced in Canada. Particularly relevant to this study are the following financial impacts of the commercialization process:

- Research, development and production will drain a company’s financial resources.

- Once product distribution begins, there is a lag time before sales can generate revenue and an even longer lag time before such sales generate profit for the company.

These financial impacts are clearly visualized on the diagram that follows:



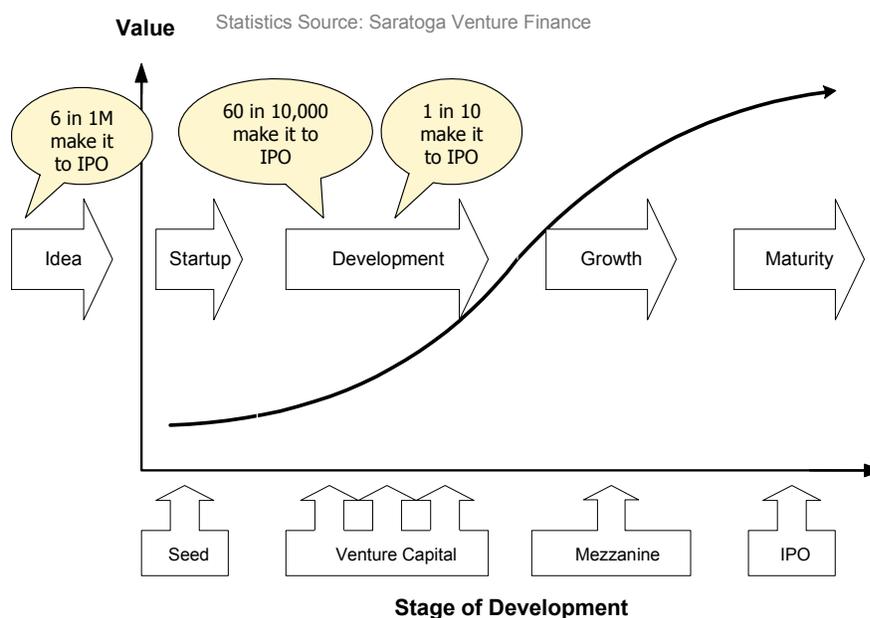
Source: "Making Technology Happen" by Denzil J. Doyle, Doyletech Corporation

Equally relevant are Denny Doyle's insights into some of the factors which threaten an early stage technology company's viability:

"The market research for a new technology-intensive venture can be as difficult, costly and time-consuming as the scientific research and product development that must go into creating the product itself. Most entrepreneurs would find this an overstatement, but most venture capitalists would not. In all too many cases the real reason (for failure) is that not enough homework was done in analyzing the market and properly positioning the product in that market in the first place."

Source: "Making Technology Happen" by Denzil J. Doyle, Doyletech Corporation

John Nesheim's "High Tech Startup" features some research into the success rates of new ventures in the United States in the early 1990's. The figure below highlights some of the relevant research for this study. Clearly the "valley of death" is the endpoint for many great ideas.



"Napkin to NASDAQ" Development Model © Copyright 2003 Rocket Builders Canada Limited.

Other Relevant References

The Internet has a rich library of articles of relevance to this study. In particular, there were many valuable academic papers, commercial white papers, and government commissioned studies on the relationships between innovation and successful commercialization.

Here are some of the more interesting academic findings:

- “Entrepreneur’s assessment of their potential were uncorrelated with typical independent, or outside, predictors of success” (Cooper, Woo and Dunkelberg, 1988) [Cooper, A. C., Woo, C. Y. and Dunkelberg, W. C.: 1988, Entrepreneurs’ perceived chances for success, *Journal of Business Venturing* 3(2), 97–108.]
- “Conditional on achieving first sale, start-ups generate better returns to the university than do established firms” (Lowe and Ziedonis, 2004) [<http://littlehurt.gsia.cmu.edu/gsiadoc/WP/2004-E3.pdf>]
- “Start up firms in general reach first sale, on average, more quickly than do established firms” (Lowe and Ziedonis, 2004)
- “Commercialization for many university inventions occurs through government grants which impose little monitoring on commercialization outcomes, allowing start-ups to endure on projects with little commercial prospects” (Lowe and Ziedonis, 2004)
- “Start-up firm’s ability to attract venture capital, achieve an IPO, and even survival depends on the founders’ network of pre-existing ties to financiers, such as angel investors or venture capitalists” (Shane and Stewart, 2002) [Shane, S. and Stuart, T.: 2002, Organizational endowments and the performance of university start-ups, *Management Science* 48.]

- “Licensing to an investor-founded start-up is a ‘second best’ solution since firms were more likely to lack assets necessary to successfully bring a product to market, such as market knowledge, contacts with customers, or manufacturing capabilities.” (Shane, 2002) [Shane, S.: 2002, Selling university technology, Management Science 48(1), 122-137.]

In reviewing many of the articles available on the Internet, one interesting finding was that Canada was commonly referred to globally for its publications on these subjects. Much of the references pointed to NRC, Industry Canada and the Conference Board of Canada reports or publications.

For example, useful insights from the Conference Board of Canada included:

“Firms that collaborate are significantly more likely to introduce breakthrough (world-first) innovations.”

Source: Second Annual Innovation Report(Ottawa: The Conference Board of Canada, November 2000).

A November 2003 report from the Conference Board of Canada featured data from a survey of chief executive officers (CEOs) or senior executives from over 200 Canadian companies. The “drivers of commercialization” findings were as follows:

- The existence of an internal champion;
- External partnerships and collaborations (in general), and (in particular) partnering with customers, suppliers, and even competitors;
- Formalized new business development processes;
- The use of training, conferences, and both general and technical/learned literature (to generate ideas); and

- Tracking market information and competitive intelligence.

That same survey determined the following “characteristics of strong innovators”:

- Customers, suppliers, and research partners are the primary source of new ideas. Innovators actively bring these groups together to develop new and improved products and services.
- They use more formalized business processes and practices when gathering new ideas and identifying new opportunities.
- When making executive-level investment decisions, innovators use formalized business processes and intuition or “gut feel.”
- More innovative firms usually have an internal champion who brings the players and processes together. Customers are often integrated into the firm’s decision-making processes.
- They go global. Partners offshore not only represent market interests, they also bring innovative ideas and opportunities back to the company. Innovative companies simultaneously export goods or services, and import good ideas.

This survey also identified some key common barriers to commercialization. These include:

- lack of time (to generate new ideas);
- lack of risk capital (from sources external to the firm); and
- lack of (internal) financial capability and resources.

Also, the Conference Board of Canada had a May 2002 paper on “Making Commercialization Happen”. This is the 4th paper of a series of

“Challenge Papers” meant to spark debate on innovation in Canada. This paper posed the following questions relevant to this study:

- What if Canadian SMEs had immediate and direct access to a pathfinding capability that would provide face-to-face assistance in management skills, networking, and the marketing of their new products and services worldwide?
- What if Canadian firms partnered with, learned from, and hired marketing experts worldwide?
- What if we established a National Innovation Centre that would work on behalf of SMEs to establish technical and marketing links worldwide?
- What if we built community-based commercialization teams to spur the collaboration of institutions, governments, industries, and communities around a shared global vision?
- What if we doubled or tripled the number of available education and learning programs in entrepreneurship—for example, courses on applicable business models—to support risk taking, partnerships, and the sustainability and growth of small firms?
- What if these programs targeted selected players in the innovation spectrum, including scientists, policy makers, and financiers?
- What if Canada focused on and was branded as the global high tech expert in three or four distinct niche segments of the world market in which we have natural technical and market strengths?

Of great value to this study was a related study commissioned by the NRC on “Medium Enterprise Commercialization Needs” (Collings & Forrester, 2004). Early access to data from this study enabled this study to further focus its investigation.

The many articles reviewed provided a basis for the framework this study used in categorizing “factors in commercialization”. Some articles provided unique insights such as this one:

“Effective commercialisation implies globalisation for companies to really succeed.”

Source: Workshop Proceedings. NSW Workshop 2001 - Commercialising Innovation - “The Second Step”. Sydney - 10 May 2001.

Some of the more valuable articles came from the “Organisation for Economic Cooperation and Development” (OECD). The OECD studies show that:

- Direct government funding of business R&D and tax incentives tend to be substitutes for each other, increases in one reduces the effectiveness of the other in stimulating R&D
- The effect of tax incentives is short-lived and more effective when stable for a long period of time, thus allowing firms to integrate their value into long-term planning
- Increased direct funding of R&D beyond a certain threshold (in the this study beyond 13% of BERD) typically reduces its effectiveness
- Public/private partnerships need to balance the desire for knowledge diffusion with legitimate rewards of appropriation

Source: D. Guellec and B. van Pottelsberghe, 1999, Does Government Support Stimulate Private R&D? OECD Economic Studies No 29, as quoted in OECD STI 2001 Drivers

When the OECD reevaluated SME R&D programs in 2001, it found that:

- Venture capital and acquisitions by big firms lessen the need for government-funded R&D.
- Venture capital and acquisitions by big firms raise the importance of government funded R&D.

- Publicly-funded R&D did not crowd out opportunities for SME R&D.
- The most successful government-funded small business projects have been in industry sectors that boast high levels of private venture capital

Source: Joshua Gans and Scott Stern, 2001, When Does Funding Research by Small Firms Bear Fruit? Evidence from the SBIR Program NBER Working Paper 7877, referenced in OECD STI 2001 Drivers

Similarly, valuable insights were drawn from many publicly available reports commissioned by foreign governments. According to a report published by Erskinomics Consulting Pty Limited for the Australian Institute for Commercialisation:

“R&D expenditures are likely to have a greater commercial impact if aggregate R&D funds are allocated with commercialization potential as a key criterion. This is best fulfilled through competitive and market-driven or industry-driven mechanisms for allocating R&D funds. For instance, Israel in particular allocates most assistance through industry. In some countries, projects attracting venture capital receive additional public support.”

Source: Alex Erskine, Erskinomics Consulting Pty Limited, March 2003, Critical Factors In Successful R&D - An International Comparison. A Discussion Paper prepared for The Australian Innovation Association and The Australian Institute for Commercialisation.

HIGHLIGHTS FROM OTHER COUNTRIES

Additional insights were gained from researching outcomes and government policy in a variety of countries. Australia, Singapore, Denmark, Finland, Israel, the United Kingdom and the United States all offered interesting context.

For example, here are some interesting findings:

- Israel is an example of best practices for collaborating with private industry.
- Finland is successful despite an unfavorable taxation system
- Singapore has a government body responsible for linkages between research and industry
- Australia has a private institution responsible for commercialization education and for facilitating linkages between public institution research and private industry
- Denmark has formed a private venture capital firm with the responsibility of developing inventions from public research efforts

Below we highlight some data from Australia and the United States for comparison with the situation in Canada.

Australia

Through policy inspired by Canada but executed more aggressively, Australia has been able to improve its commercialization success in recent years.

“Australia has improved its performance in commercialising publicly funded R&D significantly over the past five years. Both the pipeline of new companies and the success rate of these companies reaching

‘maturity’ appears to be growing. Turnover of companies based on publicly funded research has grown from around \$300 million (2002 dollars) in 1983 to over \$1.5 billion (2002 dollars) in 2003. Most of this growth has come since 1998 The major statement by the Commonwealth government on innovation, Backing Australia’s Ability (January 2001), not only provided for a significant additional investment in Australia’s research base, but also provided funding for a number of programs relating directly to accelerating the commercial application of ideas.”

Source: The Allen Consulting Group Pty Ltd. The economic impact of the commercialisation of publicly funded R&D in Australia. A Report prepared for the Australian Institute for Commercialisation on September 4, 2003.

United States

The United States still remains the benchmark for commercialization success. Although there are cultural drivers and access to local markets that make the United States a unique commercialization geography, many experts believe the programs like the SBIR also contribute to their commercialization output.

“The Small Business Innovation Research (SBIR) Act of 1982 is a program designed to more effectively meet the R&D needs brought on by the utilization of small innovative firms and to attract private capital to commercialize the results of Federal Research. The program enables small companies to conduct feasibility studies, do prototype development, and attract private sector financing for further development. In 1998 SBIR funding totalled US\$1.1 billion. Since the program’s inception in 1983, SBIR has made over 45,000 awards, totalling US\$8.4 billion in 1998 dollars.”

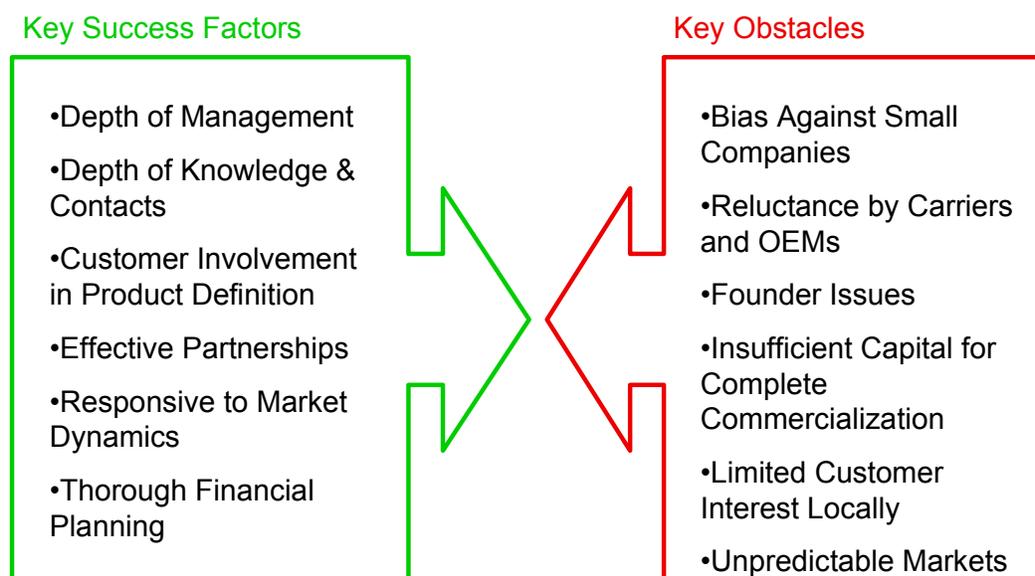
Source: National Research Council (1999), SBIR: Challenges and Opportunities, Annex B - The SBIR Program and NSF SBIR Commercialization Results

PRIMARY RESEARCH

SECTOR ANALYSIS

Wireless

The interviews in the Wireless sector highlighted the following Key Success Factors and Key Obstacles:



When responses were categorized under the “factors for commercialization” framework described previously, the number of responses from the 16 companies is shown in the following tables for milestones, resources and obstacles:

Milestones				
Customer	Product	Partner	Financial	Regulatory
Input from potential customers who served as early adopters and First Customer was key milestone (5)	Business model before product development (8)	Customer as partner enhanced marketing and financing credibility (3)	Customers prepaid product delivery (4)	Certification was key milestone (3)
Selected unique niche market strategy (4)	Differentiated product based on proprietary technology with competitive advantages (2)	Partners key to market acceptance (8)	Favorable investment markets (9)	Partnering enabled certification (1)
Offshore markets developed first (4)		Partners key to product development (4)	Controlled operating expenses (6)	

Resources			Obstacles	
People/	Financial	Infrastructure	Financial	Market
Access to experienced people who can execute is key (10)	Seed and angel investments enabled early growth (4)	On-site customer installations (1)	Lack of patient investment capital for early stage companies (6)	Need to educate market (2)
Recognized "founderitis" and accessed the skill sets required to move Perseverance (1)	Revenue growth to become an acquisition target (1)	Product development and/or marketing help from government and/or Early or venture investment encouraged (1)	Long customer buying cycles (2)	Necessity of securing non-local customers first (3)
Deep domain knowledge (1)			Lacking financing strategy expertise (3)	Need to react to quick changes in the marketplace (3)
			Uncertainty regarding government programs (2)	Long market/customer buying cycles (5)

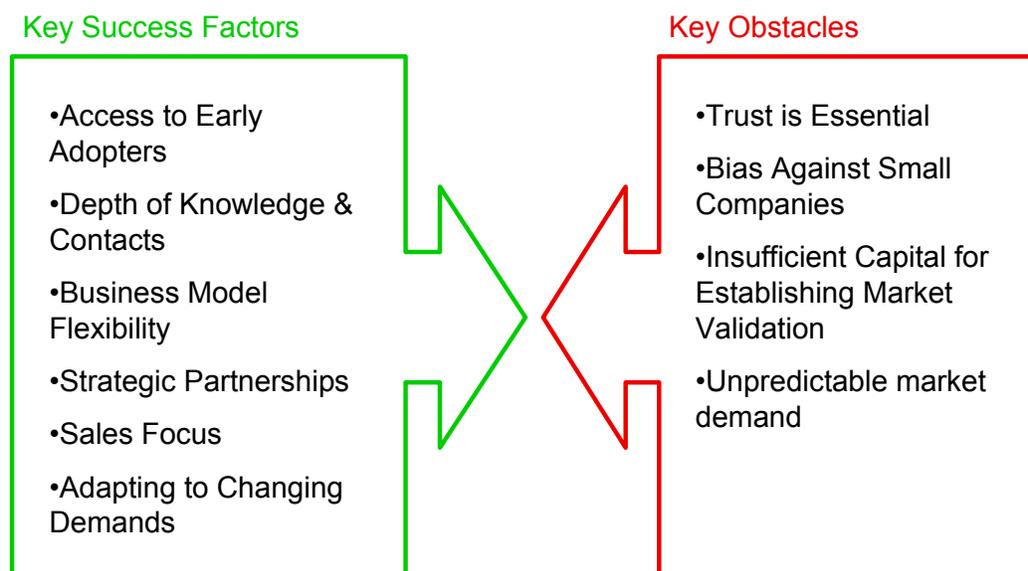
Our analysis also looked for challenges that were unique to each sector. This tells a lot about the “valley of death” in each specific sector. For Wireless, the unique challenges were as follows:

- Carrier endorsement is critical in some product segments
- Certification with a Carrier is only one part of selling product through carriers
- Market timing is especially hard to predict
- Buying cycles follow specific annual timelines

This means that the “valley of death” for Wireless companies is characterized by challenges in effectively working with carriers and in timing market entry with buying cycles and market readiness. In particular, many companies highlighted that it is harder to form a relationship with a Canadian carrier than with a foreign carrier.

Security

The interviews in the Security sector highlighted the following Key Success Factors and Key Obstacles:



When responses were categorized under the “factors for commercialization” framework, the number of responses from the 13 companies is shown in the following tables for milestones, resources and obstacles:

Milestones				
Customer	Product	Partner	Financial	Regulatory
First Customer was key milestone (9)	Customer/market input before product development (5)	Customer as partner aided product development and/or enhanced marketing and financing credibility (6)	Early investment capital crucial to support commercialization (4)	
Input from potential customers who served as early adopters and champions (7)	Developed robust product prior to widespread expansion of sales efforts (4)	Major market player as partner aided product development and/or enhanced marketing and financing credibility (10)	Company generated funds (4)	
Early adopters and champions introduced customers (3)	Business model before product development (5) Building on existing technology (2)		Funding from government programs (2)	

Resources			Obstacles	
People/ Management	Financial	Infrastructure	Financial	Market
Founder(s) with technical expertise attracted key people and resources (3)	Focused on sales growth and controlled operating expenses (9)	Used networks, industry associations, on-site training, etc. to educate customers in the marketplace (3)	Lack of patient investment capital for early stage companies (8)	Challenging economic conditions (2)
Founder(s) with business and marketing expertise attracted key people and resources (3)	Seed and angel investments enabled early growth (1)	Accessed expertise to develop product and to develop company infrastructure to generate sales meet customer needs (6)	Lacking financing strategy expertise (4)	Need to educate customers/market (6)
Hired or engaged key people with business and marketing skill sets (4)		Used existing distribution networks (3)	Long customer buying cycles (1)	Need to prove credibility as a start-up company (2)

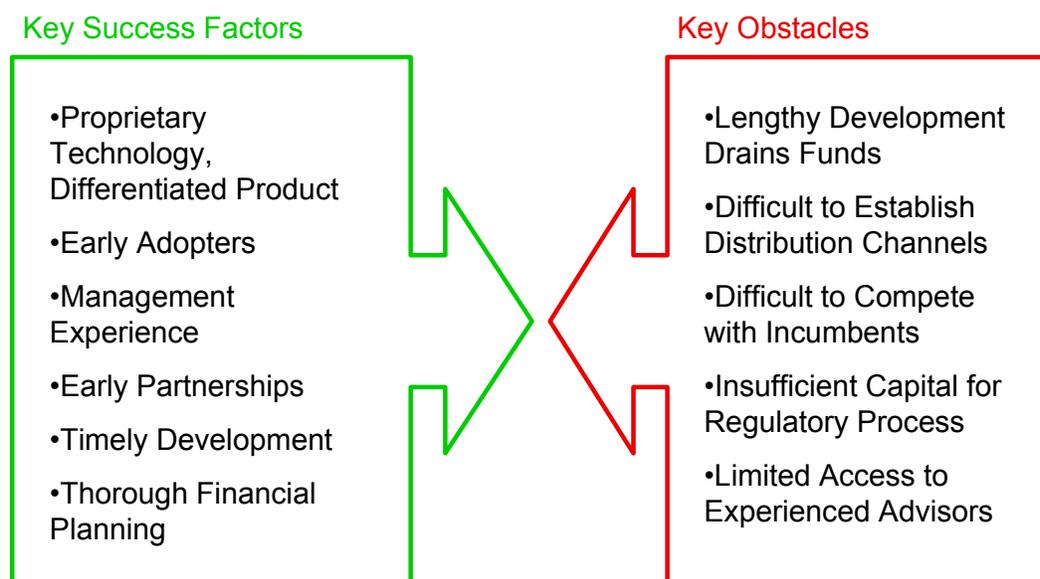
For Security, the unique challenges were as follows:

- Education of market is key to credibility that is needed for adoption
- Perimeter security systems and Network security products have different sales cycles and customers
- Whole solution often requires contributions from many vendors

This means that the “valley of death” for Security companies is characterized by challenges in gaining credibility and challenges in assembling relationships with other vendors who help ‘complete’ the whole solution the customer needs.

Medical Devices

The interviews in the Medical Devices sector highlighted the following Key Success Factors and Key Obstacles:



When responses were categorized under the “factors for commercialization” framework, the number of responses from the 12 companies is shown in the following tables for milestones, resources and obstacles:

Milestones				
Customer	Product	Partner	Financial	Regulatory
First Customer was key milestone (10)	Clinical and field success validated technology (12)	Brand name partner gave credibility for market entry (10)	Early financing from "friends and family", angel investors and management crucial for startup (10)	Regulatory approvals and standards conformity are mandatory before market launch (12)
Early adopters and champions introduced customers (9)		Major market player as partner aided product development (6)	Favorable public equity markets (5) Funding from government programs (3)	

Resources			Obstacles	
People/ Management	Financial	Infrastructure	Financial	Market
Hired or engaged key people with expertise in product development, regulatory affairs, business development, financing strategy and marketing skill sets (12)	Self-financed through own resources and through revenues (3)	Integrated key partners for product development and marketing channel development (8)	Enough capital to sustain long product development time (12)	Need to react to changes in the marketplace (2)
	Favorable public equity markets (7)	Implemented customer-centric company infrastructure to support marketing efforts (5)		Displacing incumbent technologies or market practices takes time (9)
	Seed and angel investments enabled early growth (6)			Competing against established brand name competitors (9)
	Funding from government programs (3)			

For Medical Devices, the unique challenges were as follows:

- Product development time to market launch is dependent upon satisfying regulatory requirements
- Timelines are generally longer in medical device than wireless or security
- The commercialization process in medical device is dominated by well entrenched large companies including; Pharmaceutical companies, HMOs, Medical Insurance Companies, Medical Equipment Distributors and Government. Credible partners are required for market access and successful commercialization
- Effective channel partnering can provide access to the regulatory approval expertise and expedite the process

This means that the “valley of death” for Medical Devices companies is characterized by the length of time it takes to get regulatory approval and the dependency on channel partners for market access.

Summary of Unique Challenges in Each Sector

In each of the sectors profiled above, we mentioned some of the challenges unique to each sector. These challenges make the dynamics of the “valley of death” very different for each sector. Regulatory issues and large established companies that control distribution channels are examples of themes that have differing importance in each sector.

Below is a table highlighting these unique challenges:

Wireless	Security	Medical Devices
<ul style="list-style-type: none"> • Carrier endorsement • Carrier certification • Market timing • Buying cycles 	<ul style="list-style-type: none"> • Market education • Differing sales cycles and customers • Whole solutions requirements 	<ul style="list-style-type: none"> • Long product development time • Complex regulatory environment • Channel dominated by established payors and suppliers

CROSS SECTOR ANALYSIS

The interview data was then categorized based on patterns that could be identified within our framework.

Common Factors

The following table is a summary of the milestone patterns.

Milestones				
Customer	Product	Partner	Financial	Regulatory
Input from potential customers who served as early adopters and champions (31.7%)	Business model before product development (31.7%)	Customer as partner enhanced marketing and financing credibility (22.0%)	Customers prepaid product delivery (9.8%)	Regulatory approvals and standards conformity are mandatory before market launch (39.0%)
First Customer was key milestone (58.5%)	Customer/market input before product development (26.8%)	Partners key to market acceptance (68.3%)	Favorable investment markets (34.1%)	
Selected unique niche market strategy (9.8%)	Development and market validation of differentiated and robust product before widespread expansion	Partners key to product development (48.8%)	Internal company funding and expenditures (24.4%)	
Non-local markets developed first (9.8%)	Building on existing technology (4.9%)		Early investment capital crucial to support	
Early adopters and champions introduced customers (29.3%)			Funding from government programs (12.2%)	

This clearly shows that acquiring a first customer, validating the product, acquiring partners, acquiring investment, managing costs and getting regulatory approval or standards certification are among the most important milestones for successful companies in these early stages.

The next table is a summary of the resource patterns:

Resources		
People/ Management	Financial	Infrastructure
Hired or engaged key people with expertise in product development, regulatory affairs, business development, financing strategy and marketing skill sets who can execute is key (68.5%)	Seed and angel investments enabled early growth (26.8%)	Integrated key people/partners for product development and marketing channel development (41.5%)
Founder(s) with technical expertise and deep domain knowledge attracted key people and resources (9.8%)	Revenue growth and controlled operating expenses (31.7%)	Implemented customer-centric company infrastructure to support marketing efforts (29.3%)
Founder(s) with business and marketing expertise attracted key people and resources (7.3%)	Favorable public equity markets (17.1%)	Used existing distribution networks (7.3%)
	Funding from government programs (7.3%)	Early or venture investment encouraged (2.4%)

Although nearly all interviews mentioned the importance of key hires of management staff were critical to growth, it was difficult to generalize from this form of interview process that this was a requirement for a CEO with commercialization experience. As well, the hiring of staff with commercialization experience and working with channel partners were important pre-requisites to effective sales growth. The importance of an angel investor in both providing funds but also providing the CEO with guidance was identified as a very important contributor to success.

The next table is a summary of the patterns among obstacles that interview participants identified:

Key Obstacles	
Financial	Market
Lack of patient investment capital for early stage companies (63.4%)	Displacing incumbent technologies or market practices takes time (41.5%)
Long customer buying cycles (7.3%)	Necessity of securing non-local customers first (7.3%)
Lacking financing strategy expertise (46.3%)	Challenging marketplace and/or economic conditions (29.3%)
Uncertainty regarding government programs (4.9%)	Competing against established brand name competitors (26.8%)

The common response of “lack of patient investment capital for early stage companies” clearly validates the concept of the “valley of death” being a gap between funding sources. It was interesting to note that “lack of financing strategy expertise” as a key obstacle – many of the interviews pointed out that a good financing strategy acquires capital at the “right time”.

Market timing, both the timing of displacing existing approaches and the timing of favorable economic conditions, is clearly the greatest market obstacle. Competition is also a key obstacle that these successful companies needed to address.

Other Important Factors

Beyond the framework we defined for the categorization of commercialization factors, we discovered additional important factors as patterns among the interviews.

Most importantly, it was clear that success - and especially defining changes in direction that led to success - for these companies were driven by input from external advisors, both formally and informally. Interview after interview contained references to 'key change events' in the company history that were catalyzed by discussions with people external to the company, whether they be consultants, peers, 'customers as mentors', board of directors, 'investors as mentors' or members of formalized advisory boards. Many interview also highlighted opportunistic meetings with strangers at industry events who gave them 'magical insight'. This information clearly identified that external advisors can be critical to commercialization decisions.

Another important observation was that having a number of similar customers led to dramatic growth. This shows the importance of market validation and lighthouse accounts as a means of placing focus on company direction and marketing messages and facilitating industry acceptance.

Unclear Contribution to Commercialization

Although "access to capital" is a common obstacle identified, it was less clear what "additional capital" would enable. When interviewees highlighted "insufficient capital" as an issue, questioning by the interviewer as to how "additional capital" would accelerate them to the success they ultimately achieved did not result in any insight into the role of capital as a potential accelerator of market penetration.

Intellectual property was not identified as a critical success factor in this "valley of death" period in company history. Although patents are

generally 'filed' during the research phase, they are seldom approved until after the company overcomes the 'valley of death' scenario. This suggest that patents are good for long term shareholder value, but that 'pending patents' have little impact on generating first customers and first partners.

Uncommon Factors

It is important to note that some of the most successful companies interviewed (but a minority overall) successfully used a non-traditional approach - they sold a customer a product that had not been built yet.

This "customer first, product second" scenario is a clever way of reducing commercialization risk. Less risk because the product is defined and validated by the customer and the customer capital is provided to fund the development. To achieve this scenario, a technology prototype must be sufficiently illustrative of product potential, the customer must be of the 'visionary type' (define by Geoffrey Moore's book "Crossing the Chasm"), and the company management must be effective at this form of selling.

Another uncommon factor (indicated by a minority of respondents, but of the highly successful respondents) was the transition to a new CEO that was more market driven than technology driven and often brought specific commercialization expertise. In comparing these companies with companies who retained their technology-oriented CEO and were still successful it is important to note that these founder CEOs that survived this commercialization transition did two things well:

- Technology driven CEO adapted to become market driven
- Technology founder surrounded himself with a management team experienced in market driven strategy and tactics

CONCLUSIONS

BEST PRACTICES

Here are the “Common Best Practices” by “Commercialization Factor”:

Customer

- First customer was key
- Early adopters/champions introduced customers

Product

- Market/customer validation prior to product development
- Business model development prior to product development

Partner

- Key to market acceptance
- Key to product development
- Enhanced financing credibility

People/Management

- Access to experience and networks with ability to execute

Financial

- Seed/angel investments enabled early growth
- Focus on sales growth and controlled operating expenses

Infrastructure

- Integrated key people/partners for product and marketing channel development
- Implemented customer-centric company infrastructure to support sales growth

IMPLEMENTING BEST PRACTICES

A balanced approach is required as successful commercialization requires both entrepreneurs with resources and effective execution. Leveraging external advisors is the key to several key balance points in managing the progression through the 'valley of death' including:

- Balancing Technology Push and Market Pull
- Balancing Customer Facing and Development Focused Personnel Levels
- Balancing Financial Prudence and Investment for Growth

Developing customer driven product strategies and business models that meet the market are a challenge for technical teams focused on product innovation. It requires a new or additional focus for the company and senior personnel. Understanding market forces, opportunities and market needs can be accelerated through education and working with trusted advisors.

MODELS FOR CRITICAL SUCCESS PATHS

Across the majority of cases, success followed a similar path. In this **“Common Critical Success Path Model”**, there is a linear sequence of events:

- Critical input was received from an external advisor to guide initial product direction
- Market validation was gained from the “first customer”, and this was followed by validation by “first partner”
- An important introduction to the right investor at the right time was made by an external advisor

- Investment facilitated growth through development of infrastructure to support sales and marketing as well as customer and partner support

This linear process for the “**Common Critical Success Path Model**” can be diagrammed as follows:



We also observed several “**Exceptional Critical Success Path Models**” in a minority of cases. Diagrams for two examples of these exceptions are as follows:

①



②



In these exceptions, we find that entrepreneurs are finding creative ways of achieving the same goal of reducing risk. The key finding here is that the most important criteria for “Critical Success Paths” is achieving all the required milestones before the “valley of death” causes premature company death. We call this creative maneuvering the “**Milestone Shuffle**”.

COMMERCIALIZATION OUTPUT

The lessons learned from successful predecessors coupled with market knowledge and contacts will positively impact company strategy and effectiveness. Increased commercialization effectiveness reduces risk for current and potential investors and increases output. This provides further inducement for investors to finance additional companies developing technology.

If we want to have more companies that achieve commercialization success, then we need to examine efficiency and effectiveness as components in our drive to greater economic development.

$$\left(\begin{array}{c} \text{Commercialization} \\ \text{Efficiency} \\ \text{(\#)} \end{array} \right) \times \left(\begin{array}{c} \text{Commercialization} \\ \text{Effectiveness} \\ \text{(\%)} \end{array} \right) = \left(\begin{array}{c} \text{Commercialization} \\ \text{Output} \end{array} \right)$$

It is also important to note that our secondary research has shown that increasing the number of companies engaging in commercialization does not alone increase commercialization output. For example, more capital to encourage commercialization had the effect of increasing rates of company failures.

In Canada, we have a large volume of small companies engaging in early stage commercialization. For this reason, this study concludes that the greatest impact is possible if we can increase commercialization effectiveness by encouraging adherence to the best practices and critical success paths this study identifies.

RECOMMENDATIONS

RECOMMENDATIONS FOR COMPANIES

Acquire Early Customers

Companies that develop the products potential customers want or need have a greater chance of success. They focus quality resources on potential customers and work with them to ensure that the product meets their needs. Those that commercialize successfully often acquire a group of 'like' customers and 'reference' the initial customer to acquire others in the same market. Successful commercialization is based on acquiring customers, understanding their buying cycle and developing market 'intelligence' by continuing to work with customers to continually develop the product and the market. In addition to acquiring a First Customer, Companies should initially focus on resources and activities that will foster customer acquisition.

Train Management

Companies moving into pre-commercialization and product development phases need to participate in Industry or Government led events that help to educate or train management on commercialization best practices.

Educational events supported and promoted by Industry and Government need to be integrated with other commercialization initiatives and provide companies ongoing feedback and effective metrics for monitoring commercialization success.

Do Market Research

'Research Markets to Develop a Go-To-Market Strategy' Companies need to pick a specific market and research the market to ensure that there is demand for the type of product they will develop. Focusing on a specific vertical or niche market facilitates market entry and allows the company to meet customer need with their initial product. Those that research markets to develop a market driven product strategy commercialize more rapidly and effectively. Their sales and marketing personnel and partners enable them to 'verticalize' their product to meet specific customer needs. They are then able to leverage success in an initial market and develop their core technology to migrate into secondary markets with similar needs.

Define the Product Carefully

'Find the customer before the product.' Successful companies speak with potential customers prior to product development or early in product development cycles and many test competitive products and follow market trends. Many also found that it is important to obtain channel partner product feedback and research potential channel partner sales and marketing systems and initiatives early in the product cycle. Early research can prevent failed attempts and ensure that products meet 'windows of opportunity' in fast moving markets.

'Work with the customer to refine the product' Successful companies continue gathering 'Market Intelligence' after product introduction. They monitor customer behavior with the product to validate or challenge working assumptions. Many also work with Beta customers to adapt products and develop product strategies. They share the risk with the customers and obtain valuable product feedback as the customer needs to have the product succeed.

Leverage Early Customers

Use Early Adopters as Reference Customers. Testimonials or reference customers allow successful companies to validate the assumption that they have identified a market rather than found a couple of early adopters looking to purchase a product of this type. Typical success shows a vertical/niche strategy as preferable in the early days as companies find companies with similar needs and establish a replicable business model. Successful commercialization often allows companies to work out the business model in one specific market before expanding globally.

Leverage Early Markets

Use vertical markets as a springboard into broader markets. Successful companies often develop a suite of products or a complete product line based on one core technology. Initial success with commercialization is leveraged to enable the company to adapt and customize the product for different vertical markets. Continued market research provides 'market intelligence' and allows companies to capitalize on opportunity and target lucrative markets.

Recruit and Leverage Advisors

Recruit advisors with market experience and domain knowledge.

Companies should recruit advisors with market experience and domain knowledge. Their experience, industry contacts and market knowledge can provide valuable market feedback, accelerate product development and 'validate' the company in a specific industry segment. Advisors can also facilitate relationships with partners and introductions to potential customers.

'Lease' necessary skills as advisors or contractors until financial resources allow hiring of full-time employees. Successful companies recruit advisors with market experience and domain knowledge for product feedback and introductions to potential customers and partners. Serial entrepreneurs with a record of success are often effective advisors. Many successful entrepreneurs have also experienced companies that were moderately successful or failed. The lessons learned by advisors in past ventures are valuable when they provide market knowledge and contacts.

Companies need to actively seek advisors who can help them with strategic milestones and direction in commercialization. Industry events and Angel Networks are an excellent source of advisors with domain knowledge and experience. Additional linkages to advisors can be facilitated by Suppliers, Industry and Government.

Prioritize Additional Management Skills as Needed

Profile the skills required in additional management. Successful companies participate in Industry Associations and commercialization focused seminars or educational programs such as Acetech Early Stage and CEO Roundtables. They learn how others have succeeded and the type of personnel and relationships required for effective market entry.

Plan to have a CEO transition to help focus on commercialization. Many successful companies bring in a new CEO to lead commercialization and allow a founder to focus on technology. Others build a strong team around the CEO to provide the spectrum of skills required.

'Target Sales, Marketing and Product Development specialists for initial personnel acquisitions' Successful companies point to a specific hire(s) that enabled them to acquire customers as an immensely important step. Customer acquisition is the basis of revenue generation, growth and crossing the 'Valley of Death'. Many targeted those that would position their products in the marketplace and then enable them to sell in pre-commercialization.

'Target additional personnel in Finance and Human Resources once growth patterns are known' Pursuit of growth will require infrastructure development as part of the evolution from being a technology-driven to market-driven organization.

Leverage Partners

Work with committed Partners to assess the Market and establish Sales Channels

'Validate your channel value proposition early through thorough research'

Successful companies poll partners for market validation and strategic intent. Many establish partner relationships for channel access and develop win/win channel business and pricing models. A number of successful companies pointed to the 'right' partner being instrumental in each phase of commercialization. This enabled them to rely on partner feedback for further product development and market growth.

'Join partner and ISV programs where possible' Successful companies recruited partners and put effort and resources into the relationships. Companies must be prepared to thoroughly train channel in selling their product through and servicing the client. Many companies reported that initial partners didn't always work and that the 'right' partner was not always the first one recruited.

'Identify opportunities to leverage marketing dollars of large vendors (these vendors have Market Development Funds - MDF)' Successful companies worked with large, established vendors as part of product launches or by participating in partner pavilions Comdex or vertical market trade shows. An example would be Intel partnering with WiFi service providers during its Centrino product launch and offering millions of dollars in co-marketing efforts.

Manage Growth with Careful Planning

'Companies need to manage growth looking both internally (personnel and systems) and externally (market intelligence, new trends and potential re-structuring)' Successful companies establish a personnel plan and profile needed skill sets to drive the company through commercialization. They develop required systems for customer support and obtaining customer feedback and many manage personnel expectations prior to growth as new personnel eclipse founders and initial hires.

Don't Underestimate Importance of Regulations

'Research and meet regulatory requirements' Successful companies understand and execute effectively when addressing regulatory requirements. This is quite significant in the Medical Device industry and a growing part of success in Wireless and Security as 'Regulation' is a larger factor in many growth markets.

For meeting foreign regulations, it is useful to leverage government assistance for meeting export requirements and localization issues.

Raise the 'Right' Capital at the 'Right' Time

'Build relationships with potential investors well before you need the capital' Successful companies focus on sales and reference customers to provide market validation so that they understand cash flow requirements prior to raising capital. Those that follow the best practices path reduce risk for potential investors and can 'prove' that investment will foster growth and provide an exit for the investor.

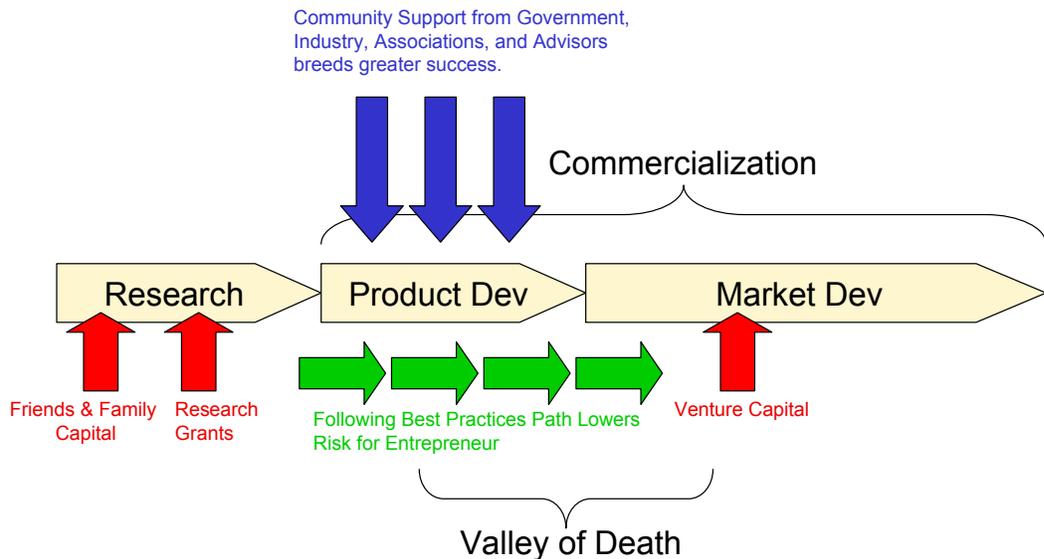
'Develop a financing strategy' Successful companies target investment with market connections whenever possible and raise capital for commercialization, personnel acquisition and marketing as well as product development. Many raise funds with market proof (sales) and carefully document the window of opportunity so that it is clear which milestones will be achieved with the investment capital.

THEMES FOR SUPPORTING COMMERCIALIZATION

Companies that follow the best practices models should be supported in those efforts. Entrepreneurs are looking for advisors, market feedback, effective training and mentorship opportunities and support in attracting partners and customers.

The business community needs to collaborate in offering comprehensive educational and mentorship programs to improve commercialization skills in companies. Programs that specifically target commercialization and utilize best practices models as a benchmark for companies need further development.

Advisors, Investors, Government and Industry can then work with entrepreneurs to promote and support best practices models for commercialization and increase the effectiveness of companies crossing the “Valley of Death”.





About Rocket Builders:

Rocket Builders is a consulting group focused on helping technology companies identify and capitalize on market opportunities. Based on past success in driving the growth of technology companies, Rocket Builders are experts in market research and strategic planning and helps companies in building revenue through proven sales methodologies, building market capabilities through partnering programs, and building processes that lead to winning products. For more information, visit <http://www.rocketbuilders.com>.

Contact information:

Dave Thomas, Partner dthomas@rocketbuilders.com

Geoffrey Hansen, Partner gchansen@rocketbuilders.com

Reg Nordman, Partner rnordman@rocketbuilders.com