

## Commercialization of R&D Results Lecture

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### Introduction

What are the issues faced in R&D commercialization? The target is to create revenues. The commercialization process effectively embodies knowledge in products, processes, etc. which are new, improved, or less costly.

New products do new things which the customer must value, and be prepared to pay for.

Improved products work better, which may be translated into lower total costs for the use of the product over its life-cycle.

Less costly products reduce the cost of acquisition and hence increase the total market size.

Each of these raises different issues. The new product must anticipate changes in the customer behaviour based on a design created in the commercialization process, and also assess how much the customer will be prepared to pay for it. A case of this is the development of Internet access tools.

The improved product has to identify limitations in the current products and identify how an improvement can be made based on technology. A case is that of the CD. In this case the initial cost of the CD is higher than some of the functional equivalents e.g. cassette tape, vinyl record, but offers better performance, longer life and more convenience of access. It comes as a system i.e. the CD itself and the CD player.

Less costly products try to maintain the performance level of existing products but use technology to reduce costs. The best case of this is development of personal computer systems.

## 1. Commercialization context

### 1.1 Goals of R&D and Types of Technology

Commercialization relates to what a technology was developed for. The benefits conferred on an organization which may be deemed commercial include:-

- Cost savings
- Revenue increase
- Access to new markets

- Future revenue increase i.e. platform development
- Knowledge
- Strategic planning thru option evaluation

The technology can be one of several types: the main categories are:-

1. new processes i.e. new ways of producing existing products from existing inputs
2. new products i.e. new goods and services based on existing inputs
3. new sources or new types of raw material
4. new markets, either in the geographic sense or in new uses of existing products and services
5. new organizational methods i.e. new ways of controlling and organizing inputs.

## 1.2 Types of R&D

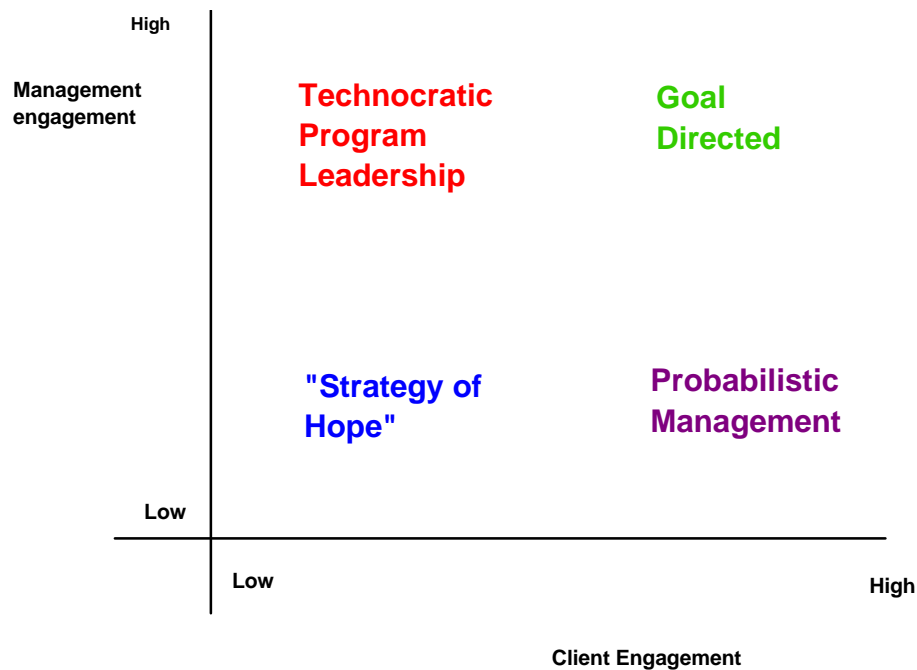


Figure 1: Degree of engagement matrix

### 1. "Strategy of Hope"

Where this arises in the university or equivalent context there is a poor prospect of direct commercialization. A key success factor in commercialization is to have had previous commercialization experience. In addition the level of R&D produced tends to be only the laboratory prototype which leaves a relatively long path to commercialization. In this case a two stage process is most likely to be

employed. The first stage is to transfer to another R&D organization, and the second is to the market.

## 2. Technocratic Program Leadership

This is probably the greatest source of breakthrough products, processes, etc. The degree of risk is relatively high but this is offset by a high expected return. Sometimes the end product is the R&D which is sold or licensed to a Goal Directed or Probabilistic Management organization.

## 3. Goal directed management

This tends to look for incremental change and is often focused as much on cost reduction, or yield improvement as on new revenues.

## 4. Probabilistic management

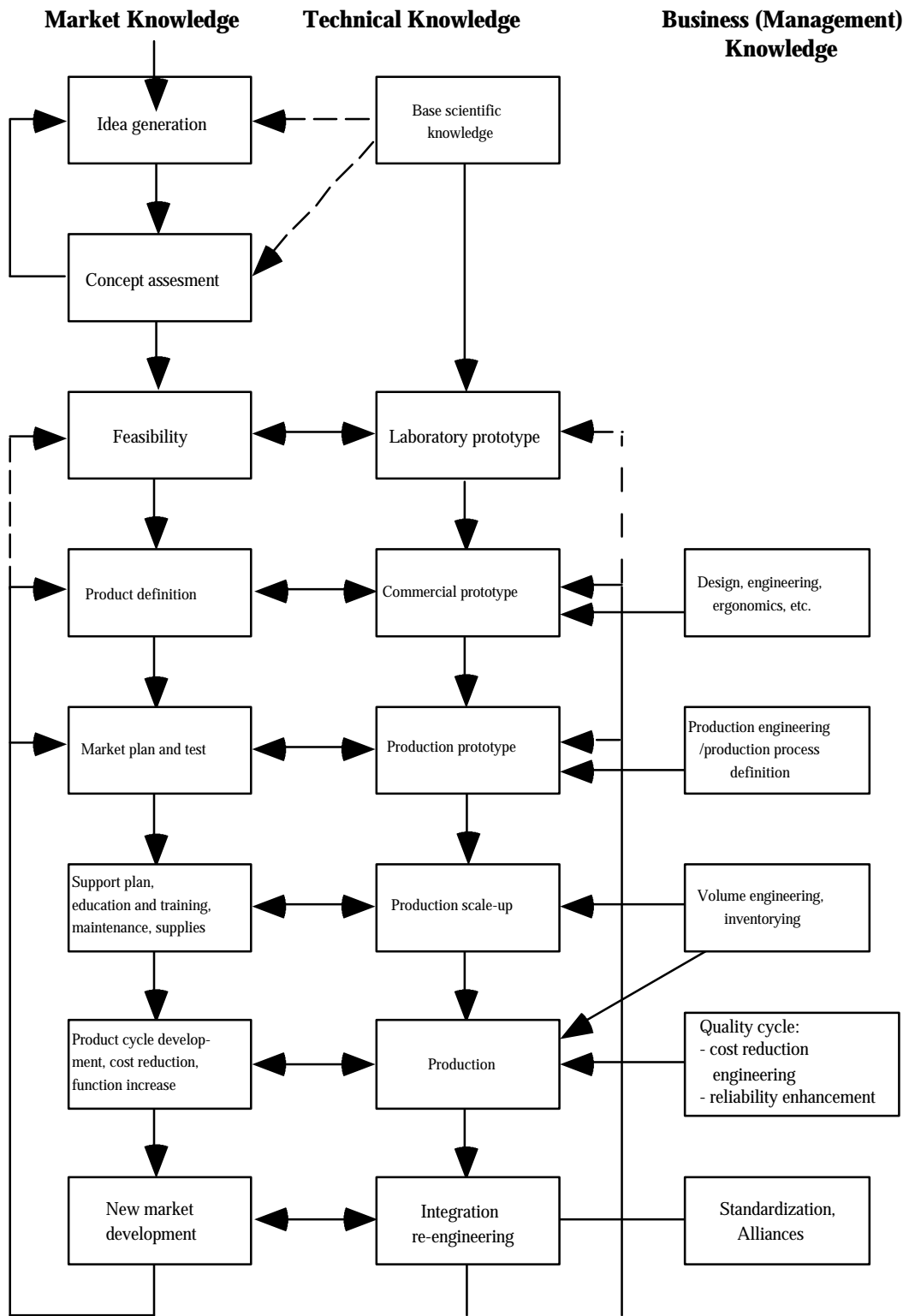
This type of organization is most like the entrepreneur, either as an independent start-up business, or as an intrapreneur within an organization, responsible for starting a new product line, or a new business division. This type of organization is the main focus of the presentation.

	Technocratic leadership	Goal driven	Strategy of Hope	Probabilistic Management
Direct sale of R&D	Sometimes	No	Yes	No
Overall Risk	Medium	Low	High	Medium
Ease of transfer	Low	High	Low	Medium
People continuity	Medium	High	Low	High
Development cycle	Long	Short	Long	Medium

Table 1: R&D commercialization characteristics comparison

1.3 Scope of Commercialization undertaking

**Figure 2**



Projects usually occur in a sequence: the starting point is knowledge, the end point is a new product, a new process, etc. The project does not occur in isolation, and the scope of management is shown in Figure 2. A single project may encompass several of the boxes.

The figure also shows the parallel threads in the commercialization process and the differing skills required for a successful outcome. The small project with a small team can be very flexible and adaptable, but it will not have the in-depth specialized knowledge that a larger undertaking or a larger organization can support.

#### 1.4 Success factors for commercialization

The following table is based on material drawn from "Entrepreneurs in High Technology" by P. Roberts.

<b>Success factor for entrepreneurial start-ups</b>	<b>Implication for corporate commercialization</b>
Successful technological entrepreneurs come from development rather than research	Commercialization should be headed up by an expert in commercialization, not necessarily in the technology employed.
Key initial technologies for new firms were transferred primarily from development projects carried out by the entrepreneurs at their previous employers	Primary or basic research is not a key field for business: spin-offs from existing projects should be seen as the source of opportunity.
Initial capitalization is provided by the entrepreneur directly	The corporate project leader must be motivated in the same way as an entrepreneur who is personally at risk.
Specific plans and an initial product generate greater initial capital	Commercialization projects should not be fully funded until complete plans are available. Staged funding is appropriate
Deficiencies in business plans and in team composition are main hindrances to raising outside capital	The complete plans should include the people who are needed on the project team.
Multifounder teams fare better than single founders	A group to act as a sounding board to the leader is appropriate and beneficial
The more the initial technology, the greater the success	Ensure that all the technology needed has been identified, sourced and accessed.
Marketing early in development of the firm is crucial to success	The technical work should be paralleled by marketing work.
Focus on core technologies and markets is crucial to success	The plan should not consider diversifying until the first stage has been successful
Two-thirds of founders are replaced before a company achieves a high level of success	The project leader will be an evolving position.

The key success factors change as the company moves through various stages:-

1. initiation - the lead individual is key
2. start-up - technology base including degree of technology transfer from base, and product orientation are key.

For an independent business the financial base is also crucial: this is not a factor in a large organization adding a single product. It may be important if the addition is a whole business unit to know that funding is guaranteed and not subject to a short term decision by senior management.

3. Growth - marketing orientation, adequate financing and a focus on managerial issues are all important.

Technology is a spring-board, or an enabler and how it is deployed becomes the critical factor, not what it is.

From a market point of view, it is the product or service, not the technology, which is successful.

- Non-unique or superior products have a 28% success rate
- Unique and superior products have an 82% success rate (only 20% of new products fall in this category)

What defines a superior product? It is:-

1. superior in meeting customer needs
2. higher quality than competitors
3. reduces customer costs
4. unique features for customer

## 2. Commercialization Overview

### 2.1 General

No commercialization project is started unless there is an expectation of success. This starts with a subjective view of what the success might be and becomes steadily more defined as the project moves forward. For a start-up company the perceived success factors are:-

1. Future growth prospects
2. Sound company management
3. Historic earnings
4. Technology glamour

These factors are those which encourage investment in a start-up company. Few people are prepared to invest unless some enticing factors are present: however, they usually depend on the business plan to provide the majority of their information.

Some data on the breakdown of time within successful commercialization ventures (from New Product Development. R Cooper) suggests:-

- 15% on exploration and screening
- 5% on business analysis
- 37% on development
- 17% on testing
- 25% on production

Unsuccessful products spend more on the first two stages and less on the last two. This suggests that 20% of the time but probably less than 20% of the resources have to be invested without a detailed picture of what the venture is going to do, nor how it is going to do it.

New product projects have a high attrition rate: the earlier a project is stopped, if it is going to be stopped, the better:-

- For 7 projects at concept stage,
- 5 enter development,
- 1.5 are launched, and,
- 1 is successful.

Where projects fail late in the process, the causes of failure are:-

- 36% underestimated competitors strength
- 20% over-estimated market size
- 18% set price too high
- 20% had technical difficulties

The business plan collects together all the relevant information, analyses it and proposes strategies to be adopted to ensure success. The plan addresses the market and how it will be addressed, the team of people who will work on the project, the technology to be employed and the financial resources required. The actual requirements which drive the project can be identified as the answers to the following four groups of questions:-

1. What are the basic needs or user function the firm will satisfy with its products and services?
2. What groups of customers share these needs?
3. What technology will deliver the products and services? Where is it obtained?
4. How is the product or service delivered to the marketplace?

An analysis of 20 business plans suggested the following inadequacies:-

- Marketing 70%
- Management team 65%
- Technology 45%
- Financial 60%

The risk associated with technology commercialization is high: the following success distribution has been noted:-

- Very high success - 10%
- High success - 9%
- Average - 13%
- Below average - 43%
- Failed - 23%

## 2.2 Barriers to commercialization

A survey of high technology companies identified the following major business problems:-

- Sales 34%
- HR 24%
- Finance 16%
- Production 2%
- R&D 2%
- Other 15%

This means that technology is not the issue: the chief problem is gauging what the customer wants, and the second is in getting the right people.

### 2.2.1 Marketing

The more aware the company is of competition the more time is spent on sales and marketing. It will start early on customer contacts and it will use these contacts for three purposes:-

- Selling
- Servicing and supporting
- Researching

The marketing plan starts with a broad brush survey to establish existence of the proposed market. This is the earliest stage of business plan. To this can be added the personal sales experience of the team, once the team has been identified. The team will then set to work to carry out a detailed customer survey, which has as its goal to establish specific knowledge of potential customers. This is the creation of the marketing asset.

When a customer is considering whether to purchase a new product or not there are some key decision factors. In generic terms these are:-

1. new technology
2. price N.B. low price is not a certain attractor, high price is a definite deterrent
3. special specifications to meet special needs, customization
4. service and support, including training
5. quality of personnel

### 2.2.2 People

Education is a key qualification for commercialization team membership.

- 31% of technical entrepreneurs have Ph.D's, whereas they form only 20% of the employed category in entrepreneurial firms.
- 90% of technical entrepreneurs are college graduates, whereas only 5% of the general population is.
- 63% of technical entrepreneurs published at least one paper before starting business, compared to 38% of employees.
- 34% were granted at least one patent compared to 5% of employees.

Although prior experience is valuable, to lead a commercialization project a younger person is needed.

- Technical entrepreneurs are usually in the 30 to 40 age range, peaking at 34 to 36 at time of founding.

This allows us to draw up a desirable profile for the individual who will lead the team, and also the most important characteristics of those who will be members. Although expertise is crucial the narrow specialist will not fit in well. The team leader will expect in the early stages of the project e.g. first 6 months to spend time in the following pattern:-

1. engineering	31%
2. sales marketing	28%
3. manufacturing	25%
4. finance/administration	16%

### 2.2.3 Technology

Technology has to be shown to deliver some advantage. There is a cycle of influence which needs to be recognized. technology makes new things possible: awareness of those possibilities creates new possibilities and demand for some of them. This influences how the technology will be used.

Example.

Clean water can be provided by accessing a pristine source and conducting it securely to the point of use. This was the Roman aqueduct solution.

We are now aware that we can clean up water and therefore we take contaminated water and clean it using a variety of technologies. This is less costly than building aqueducts and allows us to use a low cost input.

The advantages that technology can confer are:-

- new function
- improved performance
- cost reduction

the chosen technology has to be the most cost effective for provision of these advantages.

### 2.2.4 Finance

Too much money too early creates a spending habit which can be disastrous for the project or for the company. With start-up companies the following investments were noted:-

- about 30% of start-ups start part-time with a capital of around \$20,000
- the 70% full time have a starting capital of around \$50,000

75% of this money is personal savings etc. This is what ensures the seriousness of the entrepreneur.

The commercialization project will have the following ranked needs for capital:-

1. Product development
2. Equipment
3. Technical personnel
4. Accounts receivable
5. Production facilities

The marketing effort will be in the technical personnel side. All investment is capitalized against the new product being created.

### 3. Stage Gating

<b>Stage</b>	<b>Technical activity</b>	<b>Market related activity</b>
idea	broad screening - conceptual	broad screening - conceptual
preliminary assessment	technical assessment	market assessment
concept crystallization	technical implementation plan	test marketing
development	engineering	detailed marketing plan
testing	prototype testing in-house	focus groups
trial	finalization of design	customer trial, including support
launch	production	sales

Table 5: stage gate process

At each gate a number of questions are asked, with increasing rigour and expectation of specific answers.

#### 3.1 Technology questions

##### 1. Innovation: what is the novelty or uniqueness of the proposed development?

the overall problem:

the background context:

general description of the expected results:

##### 2. Demonstrated understanding of the technical problem and its context

understanding of the complexities of the technical problem:

discussion of the key issues

and the proposed methodology to arrive at a solution

##### 3. Technical working environment and methodology including use of state-of-the-art tools

approach and methodology to be used to develop the technology

and meet the objectives

availability of equipment and facilities to support the methodology

describe a logical methodology in sufficient detail to demonstrate the development process to be followed

##### 4. Technical risk assessment and strategies to ensure attainment of the technical objectives

initial assessment of the technical risks involved (technology and major assumptions)

risk that the performance objectives of the new technology will not be achieved

extent to which higher technical risks are acceptable is dependent upon how well they have been identified, defined, assessed, planned for, and managed once encountered good balance that includes innovative approaches involving some technical risk and appropriate risk management.

### 3. 2 Commercialization questions

#### 1. Need for the technology and potential markets

need to which the technology responds  
 product, system, or service in which the technology is expected to be embedded  
 potential markets for commercialization  
 and the key customers  
 markets in which the firm is currently active  
 motivation for any shift in the markets addressed  
 existing relationships with critical suppliers, if any  
 major competing firms in each of the potential markets identified

#### 2. Commercialization qualifications and experience in similar or related fields

summary description of the resources in terms of people, material resources (equipment and facilities)  
 budgets for operations, sales, marketing, and finance  
 qualifications and experience of the key individuals with regard to technology commercialization

#### 3. Commercialization risk assessment and strategies to ensure successful commercialization of the technology

Several aspects of commercialization, including forecasts of the markets, the expected market share, revenues, costs, investment requirements, profits, and strategic alliances, entail a certain amount of uncertainty and therefore risk.

assessment of the risks associated with commercialization  
 strategy to contain and minimize these risks  
 potential for any patent or other intellectual property infringement  
 technology development staged in a fashion which provides several paths to commercialization  
 forces in the business environment which may impact the viability of the commercialization of the technology

### 3.3 Managerial issues

#### 1. Managerial risk assessment and strategies for risk mitigation

assessment of the managerial risks involved and identify critical issues which may jeopardize the successful completion of the project within cost and schedule constraints  
procedures for risk management under the major assumptions used  
adequate identification and description of the risks associated with managing project.  
Have appropriate risk management strategies been identified  
Are there any risks which appear to have been ignored or missed?

#### 4. Competitive Advantage model

Porter identifies five competitive forces that determine industry profitability. These are:-

1. Threat of new entrants
2. Bargaining power of buyers
3. Threat of substitutes
4. Bargaining power of suppliers
5. Rivalry amongst existing organizations

Technology can be employed to modify these forces and create competitive advantages. The view that this endorses is not that each technology is employed for a specific product and opportunity, but that technology can be used as a long lasting competitive advantage. It has been noted that in the long term process innovation confers higher economic benefit than product innovation.

##### 4.1 Threat of new entrants

There are a number of entry barriers i.e. factors which must be overcome to compete in the arena. Technology can be used to address a number of these.

- economies of scale  
can be obtained by using a common set of technologies to achieve a multiplicity of outputs. This is addressed through identifying the common models and techniques i.e. knowledge, that are used for different purposes and bringing them together. This allows reuse, which reduces costs, and supports the creation of depth in core competence, which creates economies of specialization.
- proprietary differences  
The requirement is to understand enough about the application of a technology to be able to make provision for the adaptation to the user's environment, and hence to ensure full adoption and exploitation of the technology. e.g. the creation of a platform technology.
- reduction of capital costs  
can be achieved in many areas by using technology to replace more specialized types of facility. The use of a simulator reduces the costs of training airplane pilots or for scaling up chemical and biological processes.
- reduction of learning curve costs  
can be achieved by using technology to make knowledge available for general use. This is what a platform does: it offers an advanced starting point for the delivery of new products and services.

## 4.2 Bargaining power of buyers

- bargaining leverage of buyer  
Standardization and the use of a specific technology from a range of possibilities confers advantage to the buyer at the time of choice. The advantage then moves to the supplier, but comes back to the buyer once the competitors recognize the creation of a standardized marketplace, as defined by the buyer.
- substitute products  
The substitute products issue is important because there will be a range of technical approaches to solving a particular problem that a client experiences.
- price-sensitivity  
may be fairly low: this arises from the potentially large scale of the benefit conferred by the technology application.
- product differences  
In many fields e.g. advanced materials, the technology is moving to a "smart" range of products. This means that a material has built in capabilities of monitoring its performance in use and ensuring that replacement or repair occurs when necessary rather than according to schedule.

## 4.3 Threat of substitutes

- relative price performance of substitutes  
raises the issues of how to address the market with an adequate background of data, with knowledge of the options and with information to show the prospective clients what the distinction between alternatives is. This is a reflection of the work in scanning and forecasting technologies, but it implies that a hard comparison of alternatives is undertaken, rather than a soft, qualitative review. A hard comparison will link into a specific business case, for example, providing quantitative outputs.
- buyer propensity to substitute  
is a culture of use issue. It reduces to the question about how to create a conditioned market which sees technology as a strong alternative to promote business goals.

## 4.4 Bargaining power of suppliers

- technology source  
The key issue is the "make or buy" decision with respect to the technology that will be applied. The many barriers to effective technology transfer have been documented extensively. The challenge is to find ways of reducing these

barriers, or of qualifying the technologies that will be acquired, so that the barriers can be expected to be low.

- threat of forward integration by technology suppliers  
is met by the knowledge of the market in which it works and its reputation in that market.

#### 4.5 Rivalry amongst existing organizations.

- knowledge of the industry  
The key is the understanding and knowledge of the technology industry. It has been established since 1980 when Porter prepared this framework that partnership is a much more important factor than had previously been realized. Industry growth is partly a collaborative partnership effort. Technology can continually change industry by creating alliances in previously unrelated areas. the exchange of knowledge that this allows between non-competitors confers economic advantage.
- informational complexity  
is a major characteristic of the technology industry. It is hard to enter because of this, but it is equally hard to make progress. The early substitution of technology in fields where no technology existed has now been largely completed. The challenge now is to find better technologies to replace the existing ones. In some cases this is achieved by building on layers of already in place technology: the software developer assumes the hardware and the operating environment in which their product will run. Information technology needs to be brought into use for technology management.
- diversity of competitors  
makes it hard to know who the competitors are. The root of this is the substitution issue. This is driven by the detailed knowledge of performance and reliability characteristics of a whole set of technologies. From this comes the ability to attack where the competition is weak, and may not recognize the existence of a new competitor.

## 5. New Product screening model

A number of models have been produced to provide initial screening of concepts and high level plans. The likely success of a new product is based on the perceived fit to some key characteristics. These are assessed by asking groups or individuals who have some reasonable level of information a series of questions and then combining their answers in a systematic fashion.

The typical characteristics cover:-

- product advantage
- economic advantage to user
- fit with company
- technology fit
- project newness to firm
- market need, size, growth
- market competitiveness
- project scope

## 6. Types of risk and risk management

If the goal is deemed to be desirable then another process that can be used is a risk assessment. At the initial stage the level of change that is being proposed can be assessed through a table such as that which follows.

	Customer groups	Functionality	Distribution channel
Level 1	Existing	Existing	Existing
Level 2	New Existing Existing	Existing New Existing	Existing Existing New
Level 2	New New Existing	New Existing New	Existing New New`
Level 4	New	New	New

Level of change table

The higher the level of change the more risky the project becomes. A more complete view is achieved by assessing the level of change against the technology change. This produces a new grid:-

Key technology status				
New, unrelated				Unfocused (Wide diversity)
New, related			Mixed	
Major enhancement		Focused		
Minor enhancement	Highly constrained			
	Level 1	Level 2	Level 3	Level 4

Product innovation grid

The terms "Highly constrained" refer to the risk perceived by matching the level change for the product and the technology change. Above this line the technology risk is greatest: below it the product risk is greatest.

As a project progresses the risk should decline, in all risk categories, but the investment rises. The commensurate nature of these changes should be monitored.

## 6.1 Risk factors assessment

Risk is assessed on the basis of three factors:-

- technology i.e. will the technology do what it is required to do and what edge does it present over other technologies.
- implementation i.e. can the company provide the management strengths required.
- business risk i.e. will the market accept the product.

These factors have multiple characteristics associated with them which is shown in the following analysis.

### 6.1.1 Technology Risk Assessment

The definitions behind technology assessment are as follows:

1. Is the technology change incremental, radical or fundamental? Radical means a complete change to a sub-system for example: fundamental means a change of the technology platform.

The technical risk is Low for incremental, Medium for radical and High for fundamental.

2. Is the technology base, key or pacing?

This measures the competitive positioning of the proposed technology . Base technology is deemed to be widely available and thus confers no competitive advantage, key technology enables product differentiation and must be protected for competitive advantage, the pacing technology has the potential to change the entire basis of competition but have not yet been embedded in products and processes.

3. Is the technology embryonic, growing, mature or aging?

In general, the technical uncertainty decreases as the technology arena moves from embryonic (very high) to aging (Low) through growth (high) and maturity (modest).

4. Is Patent/ license protection available or likely to be available?

Patent protection can provide durable competitive advantage.

<b>Factors</b>	<b>Example</b>
1. Is the technology change/ improvement incremental, radical or fundamental?	The technology is new to the market but in use elsewhere  Risk: Low
2. Is the technology base, key or pacing?	Key technologies are being used, with early use of new products  Risk: Medium
3. Is the technology embryonic, growing, mature or aging?	Mature  Risk: Low
4. Is Patent/ license protection available or likely to be available?	Yes, as a "process" style patent.  Risk: Low
5. What are the competing technologies and how do the proposed technologies rate against them?	Competing technologies are aging  Risk: Low
6. How are the risks posed by standards problems dealt with?	The emerging standards are part of the design  Risk: Low
7. What is probability of technical success?	High, with some possibilities of time overrun  Risk: Medium
8. What is the risk of cost escalation?	Low, and development cost is not a key factor  Risk: Low
9. What is the risk associated with manufacturing?	Customization  Risk: Low

If the risks are scored 1 for low, 2 for medium and 3 for high and equal weighting used then a composite score of 11 is obtained. 9 is the minimum score. The overall risk is therefore low.

## 6.1.2 The Implementation Risk Assessment

<b>Factors</b>	<b>Example</b>
1 Adequacy of financial resources:	The company has a broad base of financial resource and is taking steps to ensure that expenses are kept to a minimum  Risk: Low
2 Adequacy of engineering skills:	A well qualified team has been recruited and is backed by identified consulting resources if they should be needed. Limited experience of commercial product delivery.  Risk: Medium
3. Adequacy of management skills:	A core team with good experience is in place and outside directors have been identified to provide support as needed  Risk: Low
4. Complexity of product:	The product is complex in terms of function but these are provided on mature platforms  Risk: Low
5. Knowledge of the technical problems:	A major part of the development project is to address any technical problems that arise. There is the safety of alternative technologies which can easily be introduced through the modular design  Risk: Low
6. Standardization of product:	The product is intended to be flexible and able to cope with emerging standards which the competition cannot address.  Risk: Low

Overall there is one medium risk area associated with the development team. All other risks are low.

## 6.1.3 Business Risk Assessment

<b>Factors</b>	<b>Example</b>
1 Ability to develop products for the markets:	The company is new in this field. The market understanding is high which compensates. Competition is weak.  Risk: Medium
2 Adequacy of management skills:	The core management team is strong and the sales team well experienced in the main market  Risk: Low
3 Adequacy of market research skills:	Extensive market research has been completed  Risk: Low
4. Fit of product to the market:	Product meets actual market needs, but is in advance of market at present.  Risk: Medium
5. Technology level:	Advanced use of up to date technology.  Risk: Low
6. Pricing of product:	There is considerable margin and the pricing can be less than existing product and provide higher functionality  Risk: Low
7. Complexity of product:	High  Risk: High
8 Clarity of product specifications:	The specification addresses all the key concern areas of the market.  Risk: Low
9 Knowledge of customers:	Considerable research has been put into the market in general and the leading innovators in particular.  Risk: Low
10 Knowledge of product:	The team leader is extremely well versed in this.  Risk: Medium
11 Differentiation of products:	The product will be the leading one in the field in terms of specifications and functionality.  Risk: Low
12. Time of entry into the	If the schedule is met timing is excellent with an aging

market:	base needing replacement and a sales cycle at start. Risk: Low
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How much risk is accepted? What risk mitigation strategies can be put in place? these are the issues to be assessed through the business plan at the outset and the stage gates as the project progresses.

## 7. Multiple Technologies

Many new products require the integration of existing and new technologies. There may be a category of risk which can be termed integration risk, or complexity. The following table gives a case of many technologies being needed for a single product.

<b>Technology component</b>	<b>Technology Requirements</b>	<b>Relationship</b>
Real-time operating control environment	Modular operating system with built-in functions to allow passing of information between modules and standard interfaces	Possible exclusive agreement for specific applications
Real-time application environment	Development tools which allow rapid creation of functioning prototypes	Value-Added Reseller agreement
High performance graphics workstations	Ability to create accurate images with safeguards against intrusion	Value-Added Reseller agreement
Pen and touch surface Computers	Mobile Computing devices <ul style="list-style-type: none"> <li>• rugged</li> <li>• easy to use</li> <li>• simple i.e. stylus or finger touch</li> <li>• low-cost</li> </ul>	Commodity product and competitive environment offering volume discounts and OEM level discounts through special manufacturing runs.
Pen computer operating environment	Ability to access functions without writing special code	Industry standard product with enhancements
Pen computer application development software	Application development kit environment to allow high productivity	Industry standard product.
Wireless data transfer	Network which can support data transfer anywhere in the US	Possible application exclusive licence
Data modems	RF portable data modems connected to RS232 or PCMCIA port.	Commodity product and competitive environment offering volume discounts
Data Security	Encoding and encryption. (DES FED/C)	
Local networking	LAN's for Precinct Voting Stations and for Election Central.	
Service response centre	Immediate system problem identification and resolution regardless of vendor or type of problem	Agreement to provide service shows the eligibility of the requirement i.e. an indirect endorsement.

## 8. Conclusions

1. The plan to address the entire project must be treated as an ongoing and improving document. It guides the whole undertaking.
2. The market, the team and the finances are each as important as the technology. The acquisition of appropriate skills is crucial to success.
3. Decision made early confer most benefit. They limit the waste of resources and they permit resources to be freed up for profitable undertakings.
4. The individual case for technology commercialization is not the only perspective. Technology can be used as a strategic method of conferring competitive advantage.
5. The risk perspective provides considerable insight into the health of the project. All types of risk need to be clearly delineated and managed.