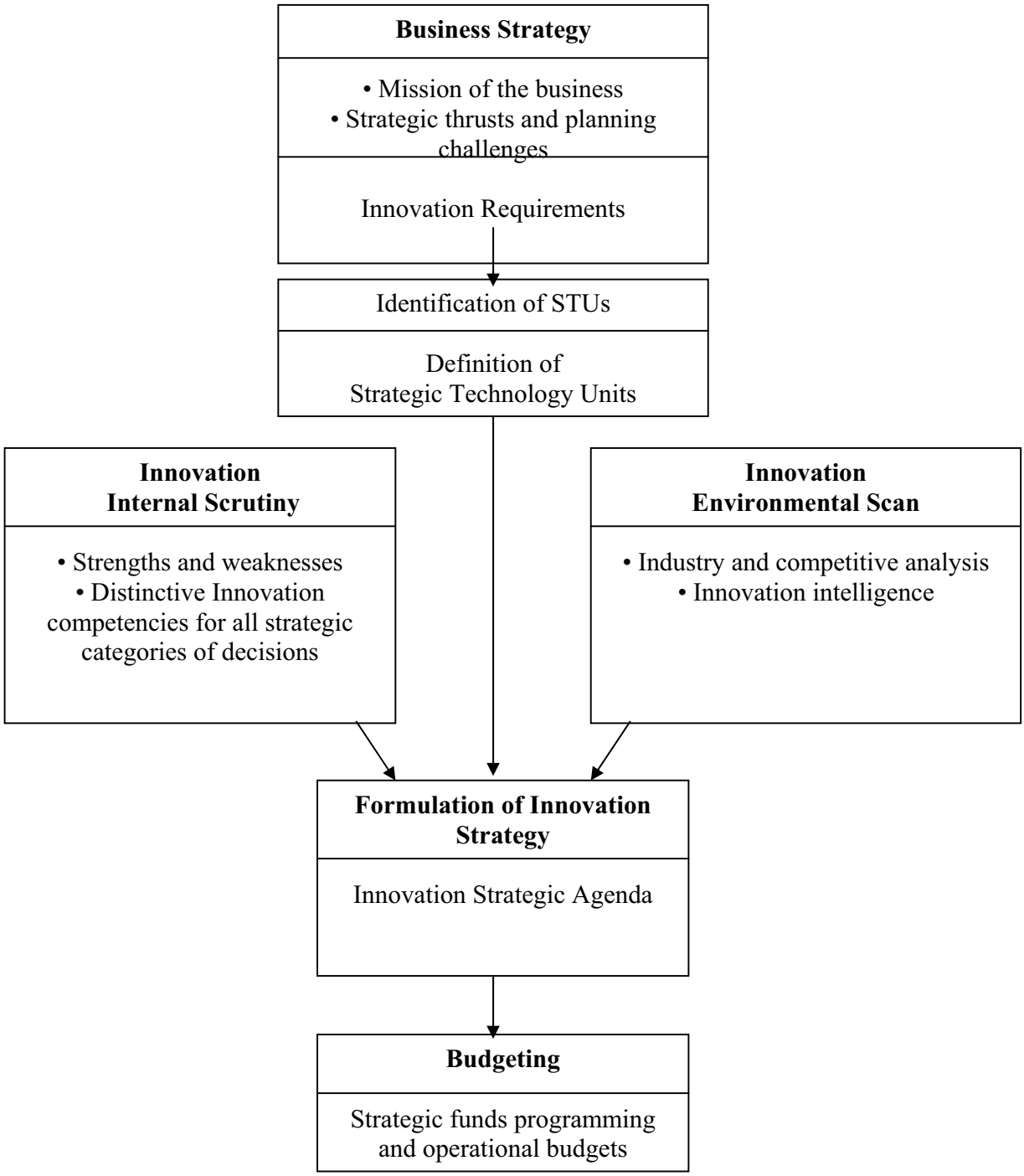
WORKSHOP

INNOVATION (TECHNOLOGY) STRATEGY

THE FUNDAMENTAL ELEMENTS OF THE DEFINITION OF AN INNOVATION STRATEGY



MAJOR CATEGORIES OF STRATEGIC DECISIONS LINKED TO INNOVATION (TECHNOLOGY)

1. INNOVATION INTELLIGENCE

An effort oriented at gathering information concerning the current and future state of technology development. Some of the tasks associated with it are: identification of strategic technical units (STUs), evaluation of competitive technical strengths by STU, detection of the focus of innovation by key product areas (users, manufacturers, suppliers, others), collection and comparison of expenditures in technology by key competitive firms.

2. PRODUCT SCOPE AND INTRODUCTION OF NEW PRODUCTS

Including issues such as: the definition of the breadth of product lines, the rate and mode of new product introductions, and the desirable length of the product life-cycle.

3. TECHNOLOGY SELECTION

It addresses the issue of selecting the technologies in which the firm will specialize, and the ways in which they will be embodied in the firm's products and processes. Some of the issues to be recognized are: selection of the technologies needed for product and process innovation, assuring the congruency of technology development with the business life cycle and with the desired business strategy, and assigning the appropriate priorities to resulting technological efforts.

4. TIMING OF NEW TECHNOLOGY INTRODUCTION

It involves the decision as o whether to lead or to lag behind competitors in process and product innovations. Issues to be addressed are: identifying the benefits and risks associated with a leadership and followership strategy, and assuring the congruency of the selected technology strategy with the generic business strategy.

5. MODES OF TECHNOLOGY ACQUISITION

The extent to which the firm will rely on its own internal efforts in developing internal capabilities, versus resorting to external sources. The options available for the modes of technology acquisition of products and processes are: internal development, acquisition, licensing, internal

ventures, joint ventures or alliances, venture capital, and education acquisition.

6. HORIZONTAL STRATEGY OF TECHNOLOGY

It consists of identifying and exploiting technological interrelationships that exist across distinct but related businesses. It is a mechanism by which a diversified firm enhances the competitive advantage of its business units. Sources of technological interrelationships are: common product technologies, common process technologies, common technologies in other value-added activities, one product incorporated into another, and interface among products.

7. PROJECT SELECTION, EVALUATION, RESOURCE ALLOCATION, AND CONTROL

The principal concern in this case is the appropriate allocate of resources to support the desired technological strategy. Issues to be addressed are: criteria for resource allocation, project-oriented resources versus loosely controlled funds to support and plan projects, the degree of fluctuation in technology funding, and magnitude in the profit gap to be filled by new products.

8. INNOVATION ORGANIZATION AND MANAGERIAL INFRASTRUCTURE

It is oriented toward the definition of the organizational structure of the technology function. It includes the identification of the horizontal coordinating mechanisms needed to exploit the technological interrelationships existing among the various business units and the activities of the value chain. Issues to be considered are: centralization versus decentralization of the technology function, development of career paths for scientists and technical professionals, use of project team, use of lateral mechanisms to facilitate sharing technological resources, design of motivational and reward systems for scientists and technical professionals, degree of involvement of top managers in technological decisions, decision-making process for resource allocation to technological projects, protection of technological know-how, patents policies, and publication policies.

MEASURES OF PERFORMANCE RELATED TO INNOVATION (TECHNOLOGY) STRATEGY

1. **RATE OF TECHNOLOGICAL INNOVATION**
   This implies selecting one or more measures of technological performance for key products and processes, and tracking their progress through time. The S-curve is a good graphical portrayal of the rate of technological innovation.

2. **R&D PRODUCTIVITY**
   As any measure of productivity, it can be defined as the ratio of the change in output to the change in input, i.e., the improvement in the performance of the product or process divided by the incremental investment in R&D.

3. **RATE OF RETURN IN R&D INVESTMENT**
   This, also referred to as R&D yield, measures the profit generated by the amount of R&D investment.

4. **RESOURCES ALLOCATED TO R&D**
   This measurement monitors the level of expenditures being allocated to the various projects and businesses and at the level of the firm as a whole.

5. **RATE OF NEW PRODUCT INTRODUCTION**
   This can be measured by the number of new products introduced per year, the number of patents obtained, or the percentage of sales derived from new products.

6. TECHNOLOGY-BASED DIVERSIFICATION

Whenever the technology strategy is at least partly oriented toward a diversification objective, it is important to measure the degree of success in achieving this goal via, for example, the percentage of sales resulting from related or unrelated diversification efforts.

7. OTHER APPROPRIATE MEASUREMENTS

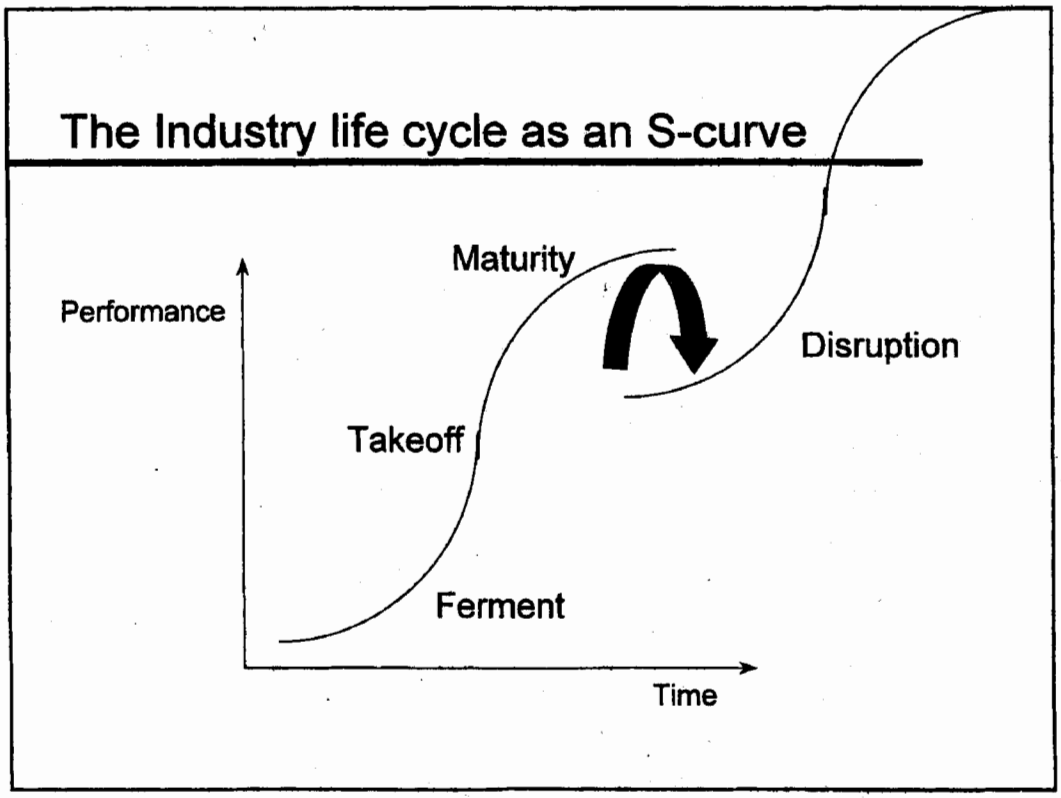
Depending on he nature of the firm other measurements can be used, such as: royalties or sales of technology, training time of people on new technology, cycle time of product development, developmental cost per stage, and level of technological competence.

THE SOURCES OF INNOVATION

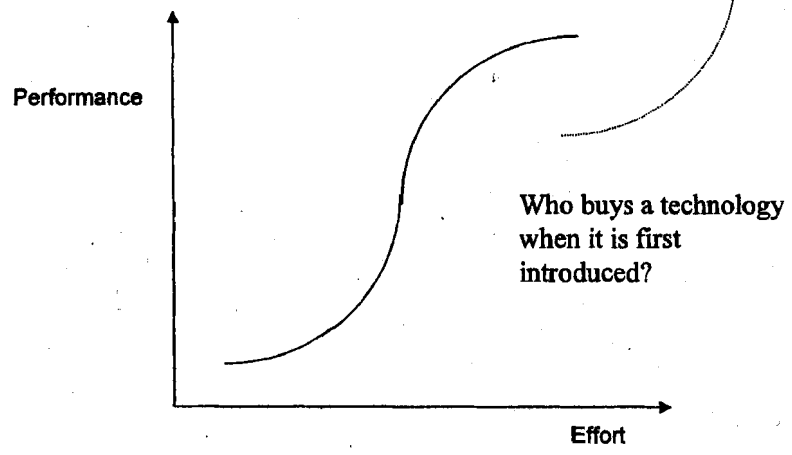
The functional source of innovation differs significantly between innovation categories.

SUMMARY OF FUNCTIONAL SOURCE OF INNOVATION DATA

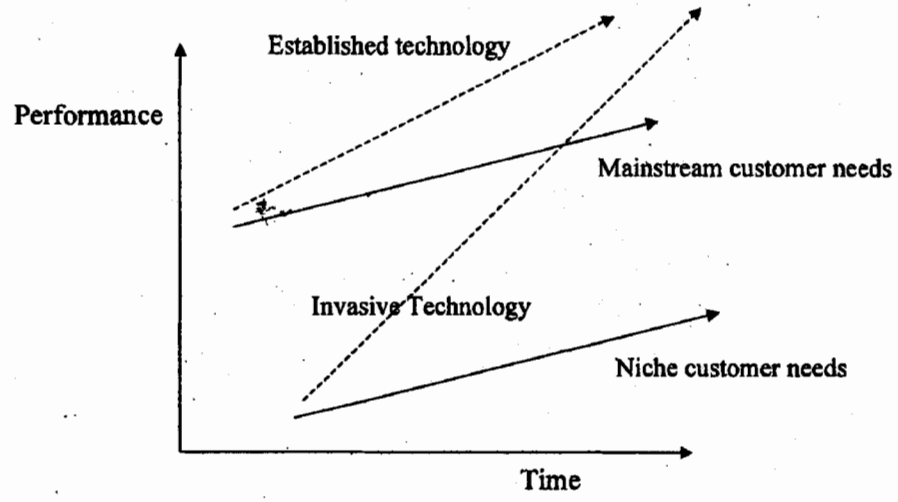
Innovations Sampled	Innovations Developed By					
	User	Manuf	Supp	Other	NA	Total
Scientific Instruments	77%	23%	-	-	17	111
Semicon & PC Crd Process	67%	21%	-	12%	6	49
Pultrusion Process	90%	10%	-	-	-	10
Tractor Shovel Related	6%	94%	-	-	-	11
Engineering Plastics	10%	90%	-	-	-	5
Plastic Additives	8%	92%	-	-	4	16
Industrial Gas-Using	42%	17%	33%	8%	-	12
Thermoplastic-Using	43%	14%	36%	7%	-	14
Wire Stripping Equip	25%	13%	83%	-	-	12


The Industry life cycle as an S-curve
Maturity
Performance
Disruption
Takeoff
Ferment
Time

The "Innovator's Dilemma": *Do existing customers understand discontinuities?*



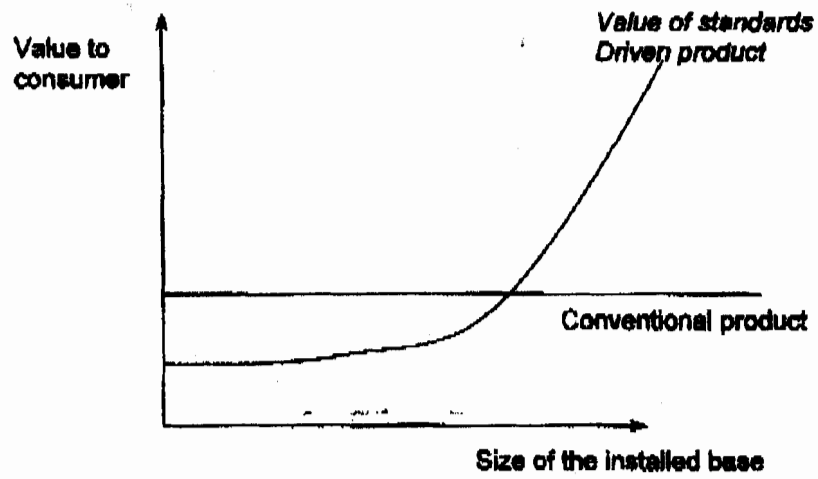
Mapping the S-curve to customer needs: Christensen's Insight



- **The pace of technological progress exceeds the pace that the customer can absorb.**
- **The dynamics of overshooting allows a new company to catch up with the customer requirements over time.**
- **The invasive technology invariably brings lower profitability to the established business.**
- **Disruption innovation has been ignored or opposed by leading institutions for rational reasons.**

The PC was a disruption technology for DEC. It is not that DEC engineers could not design a PC. It is that the business model required sales and service efforts for the mini-computer quite different from the PC.

With Strong Network Effects Market Share Creates Value



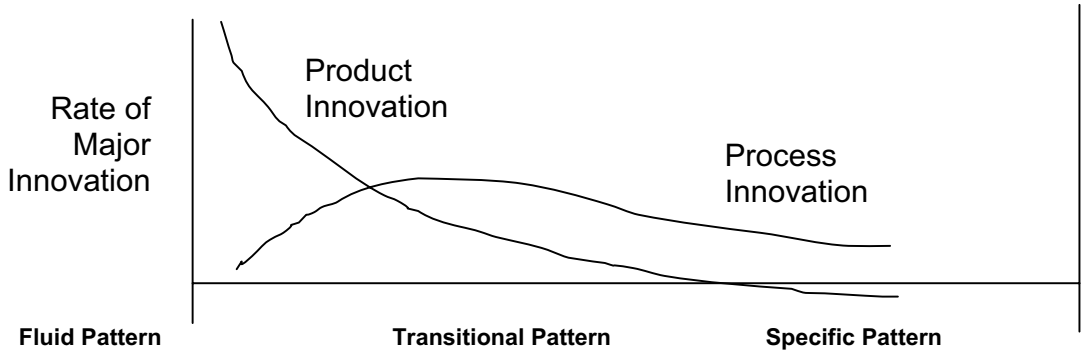
How are standards established?

- Standards "win" when a critical mass of consumers have adopted them
- OR:
- *When a critical mass of key players believe that the standard will be adopted.*

Or by:

- The sheer power of the concept, design or delivery of the product
- Coming to market ahead of competition
- Building expectations
- Very aggressive pricing: "giving the product away"
- Developing, or encouraging the development of, Collateral products and services

THE RELATIONSHIP OF PRODUCT INNOVATION AND PRODUCTION PROCESS CHARACTERISTICS



Fluid Pattern

Product Innovation
• Emphasis on maximizing product performance
• Stimulated by information on user needs
• Novelty or radicalness high
• Frequency of product innovation is rapid
• Predominant type is product rather than process

Production Process
• Flexible and inefficient
• Small size or scale
• General purpose equipment used
• Available materials used as inputs
• Product is frequently changed or custom designed

Transitional Pattern

Product Innovation
• Emphasis on product variation
• Increasingly stimulated by opportunities created through an expanding technical capability
• Predominant type is process required by rising volume
• Demands placed on suppliers for specialized components, materials, and equipment

Production Process
• Some sub-processes are automated creating "islands of automation
• Production tasks and control become more specialized
• Process changes tend to be major and discontinuous involving new methods of organization and changed product design
• At least one product design is stable enough to have significant production volume

Specific Pattern

Product Innovation
• Emphasizes cost reduction
• Predominant mode is incremental for product and process
• Effect is cumulative
• Novel or radical innovations occur infrequently and originate outside productive unit
• Stimulation arises from disruptive external forces

Production Process
• Efficient, system-like, capital-intensive
• Cost of change is high
• Scale and facility market share is large
• Special purpose process equipment used
• Specialized input materials or extensive vertical integration
• Products are commodity-likely and largely undifferentiated

TECHNOLOGY AND THE BUSINESS LIFE CYCLE

	CONCEPT DEVELOPMENT		LAB FEASIBILITY		PILOT PLANT FEASIBILITY		FINAL PRODUCTION	
	EARLIER STAGES	FINAL STAGES	EARLIER STAGES	FINAL STAGES	EARLIER STAGES	FINAL STAGES	GROWTH & MATURITY STAGES	AGING
R&D and ENGINEERING	•Assess initial technical Feasibility •Strong inter-action with marketing	Demonstrate design feasibility	Design product to meet objectives	•Prove design, build prototypes •Strong inter-action with manufacturing	•Transfer team to manufacturing •Adjust design to meet manu-facturing requirements	Adjust design to meet marketing and manu-facturing requirements	Adjust design as required	Adjust design as required
MARKETING	•Define product concept •Investigate market potential	Update marketing information	•Refine product concept •Assess market & estimate price •Develop service strategy	•Prepare all material for product intro-duction •Train people	•Test product in market area •Define pricing, advertising, packaging	Final definition of marketing strategy	Marketing follow up	Adjust market-ing as required
MANU-FACTURING	Check general consistency of product concept with manufac-turing strategy	Collect manu-facturing information	Update manu-facturing information	Develop and run manufacturing process at the lab level	Develop pilot plant	•Optimize manu-facturing process •Cost vs. quality trade-offs	•Build manu-facturing facilities •Check quality & productivity •Manage operations	Adjust opera-tions as required
FINANCE		Minor commit-ment of resources	•Prefeasibility study •Some commit-ment of resources	Economic and financial feasibility	•Analysis of pilot run data •More important commitment of resources	•Detailed study of project •In-depth economic & financial analysis	•Major commit-ment of resources •Manage for growth, profit-ability & cash generation	•Position for harvest or divestment •Review project profitability

MANAGERIAL DECISIONS

SHOULD DEVELOPMENT PROCEED?

IS PRODUCT FEASIBLE?

ARE PRODUCT SPECIFICATIONS COMPLETE?

CAN PRODUCT BE MANUFACTURED?

ARE MANUFACTURING SPECFII-CATIONS COMPLETE?

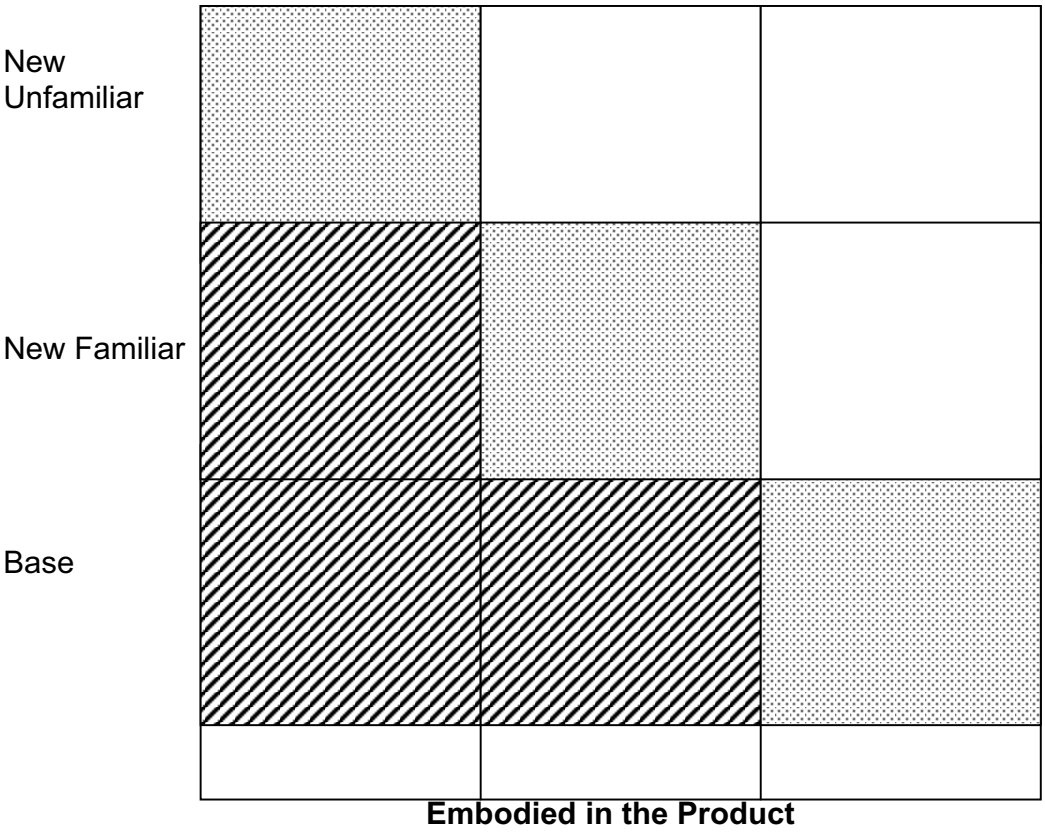
ARE COST & QUALITY GOALS BEING MET WITH REGARD TO THE MARKET?

IS PRODUCT BECOMING OBSOLETE?

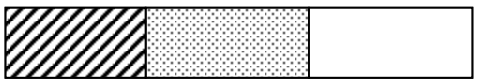
SHOULD THE INVESTMENT BE MADE?

THE FAMILIARITY MATRIX

Market Factors



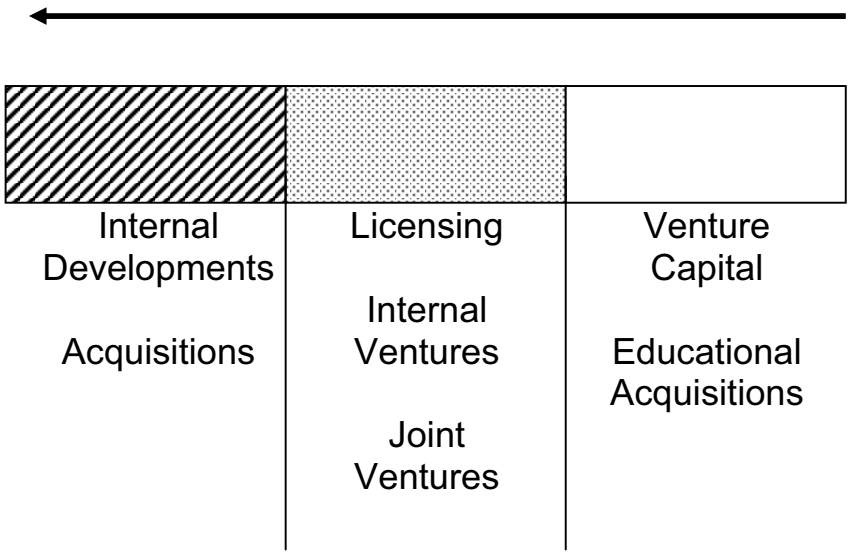
Key



Increasing Corporate Familiarity

SPECTRUM OF ENTRY STRATEGIES

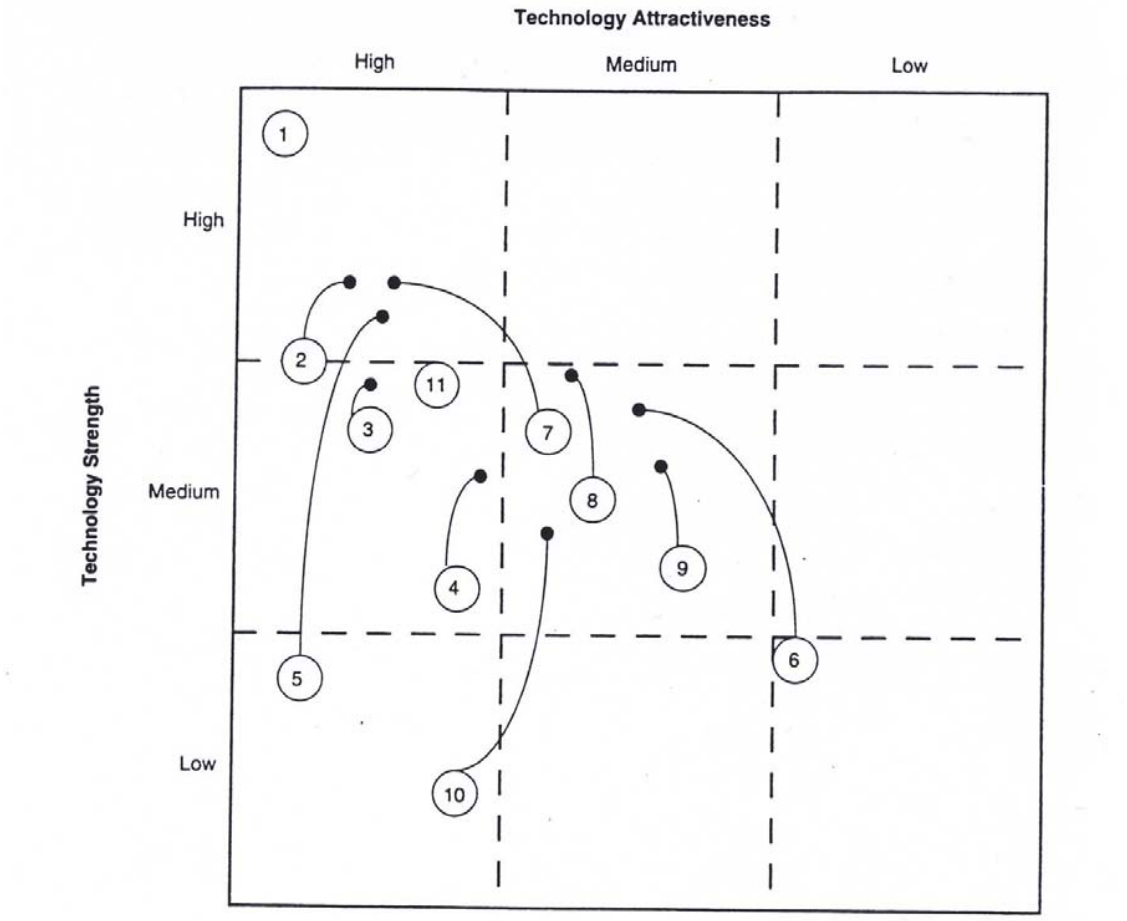
Increasing Corporate Involvement Request



A KEY FOCUS OF ANALYSIS FOR TECHNOLOGY STRATEGY IS THE STRATEGIC TECHNOLOGY UNIT (STU)

An STU includes the skills or disciplines that are applied to a particular product, service, or process addressing a specific market need. Identifying all the relevant STUs of the firm is a critical task in the development of technology strategies. It produces the full portfolio of the key technologies the firm needs to embody in its products and processes in order to achieve competitive advantage. This leads to a critical question: which technologies do we possess, and which ones should we acquire in order to protect and enhance our competitive capabilities? Defining all of the relevant technologies is the core of the STU segmentation. Next, we have to analyze the strengths of the resulting technology portfolio.

TECHNOLOGY PORTFOLIO MATRIX



STU Representation:

1. Systems architecture
2. Chip design and engineering
3. Board and system design and engineering
4. Support software
5. Application software
6. Management of information systems
7. Process technologies
8. Testing technologies
9. Demonstration technologies
10. Peripherals
11. Service

INNOVATION (TECHNOLOGY) REQUIREMENTS FROM THE BUSINESS STRATEGIC THRUSTS

Strategic Thrust	Innovation (Technology) Requirements

IDENTIFICATION OF ALL RELEVANT STUs TO SUPPORT COMPETITIVE ADVANTAGE

1. **System architecture: Technologies related to the definition of the basic architecture of the computer.**

2. **Chip design and engineering: Technologies related o chip design and manufacturing. It includes alternative technologies to the one used right now.**

3. **Board and system design and engineering: Board and system design and manufacturing.**

4. **Support software: Includes microcodes, compilers, and basic libraries.**

5. **Application software: Technologies to support companies that develop software to run in Masscalc machines.**

6. **Management of information systems: Information systems to support all activities of the company, including marketing, sales, and service.**

7. **Process technologies: Procurement and control of suppliers' production processes as well as in-house assembly.**

8. **Testing technology: Technologies used to test subassemblies and the whole system.**

9. **Demonstration technologies: Includes video and communications vehicles to help in preparing and delivering shows, demonstrations, etc.**

10. **Peripherals: Technologies required to design or subcontract the design of high-speed peripherals for visualization and image processing.**

11. **Service: Technologies and methodologies for delivering service to the computer industry (e.g., remote diagnosis, education of technicians, etc.).**

TECHNOLOGY ATTRACTIVENESS

Factors contributing to Technology Attractiveness:

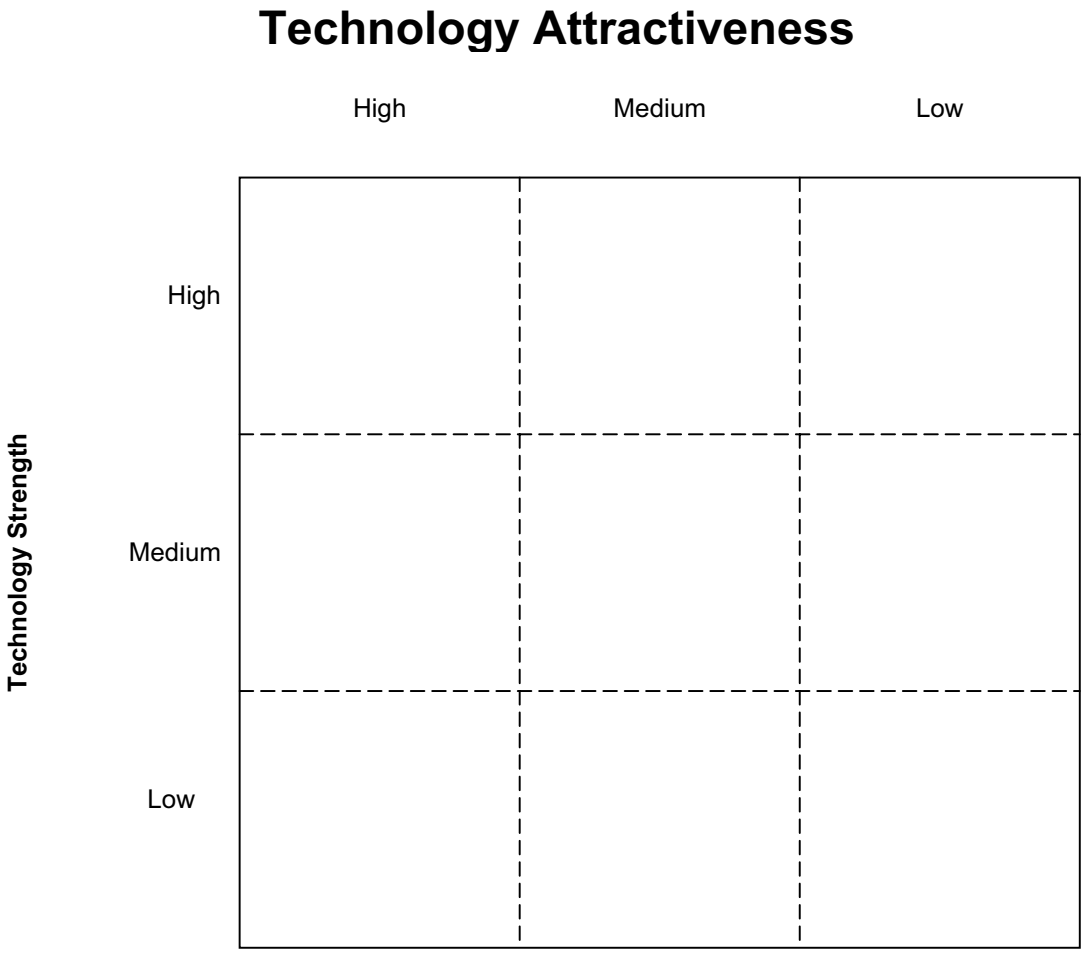
	Highly Unatt.	Mildly Unatt.	Neutral	Mildly Att.	Highly Att.
Potential for enhancing competitive advantage in: **• Product application** **• Process application**					
Impact on value-added chain **• Cost** **• Performance** **• Quality** **• Differentiation**					
Proprietary positions available					
Rate of technological change					
Impact on entry barriers					
Impact of alternative technologies **• Maturity and volatility** **• Complexity**					

TECHNOLOLGY STRENGTHS

Factors Contributing to Technology Strengths

	Very Weak	Weak	Even	Strong	Very Strong
Rate of technological innovation					
Technology productivity					
Rate of return in technology investment					
Resources allocated to technology					
Impact on rate of new product introduction					
Impact on process capabilities					
Impact on technology-based diversification • Royalties or sales of technology • Training time of people on new technology					
Level of technological competence					
Human resources					
Patent positioning					

TECHNOLOGY PORTFOLIO MATRIX



STU OPTIONS

STU	Lead	Compete	Sustain	Harvest	Purchase	Abandon

COMPETITIVE STANDING. STRATEGIC PERFORMANCE MEASUREMENT OF INNOVATION (TECHNOLOGY)

Relevant Competitor _____

Indicators	Very Weak	Weak	Even	Strong	Very Strong
1, Rate of technological innovation 2. Technology productivity 3. Rate of return in technology investment 4. Resources allocated 5. Impact of rate of new product introduction 6. Impact on process capabilities 7. Impact on technology-based diversification • Royalties or sales of technology • Training time of people on new technology 8. Level of technological competence 9. Human resources 10. Patent positioning					

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Market Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Competitive Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Economic Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Government and Political Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Regulatory Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Technological Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Legal Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Human Resources and and Labor Factors		

INNOVATION (TECHNOLOGY) ENVIRONMENTAL SCAN - IDENTIFICATION OF OPPORTUNITIES AND THREATS

Critical External Factors	Impact	
	Positive (Opportunities)	Negative (Threats)
• Environmental Factors		

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
1. Technology Intelligence			

Note: In the assessment of strengths and weaknesses try to have relevant competitors in mind and use proper strategic performance measurement.

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
2. Technology Selection			

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
3. Timing of New Techno-logy Introduction			

YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
4. Modes of Technology Acquisition			

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

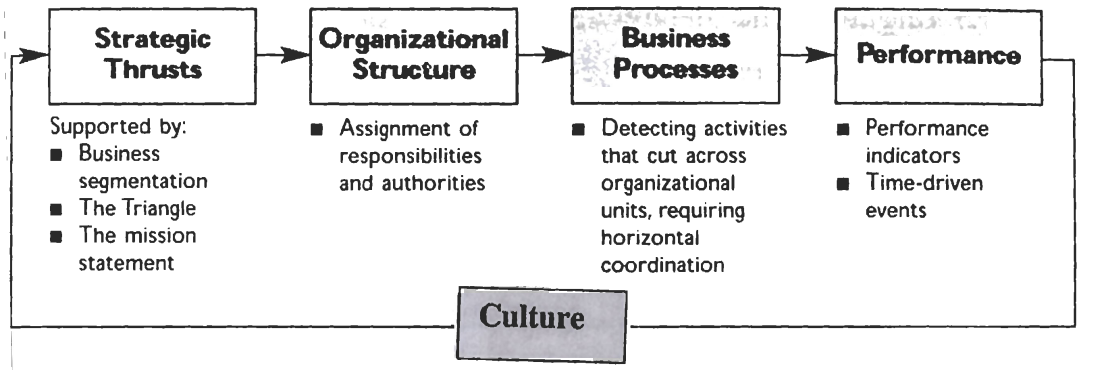
Decision Category	Description of Policy	Strengths	Weaknesses
5. Horizontal Strategy of Technology			

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
6. Project Selection, Evaluation, Resource Allocation, and Control			

CHARACTERIZE YOUR PRESENT INNOVATION (TECHNOLOGY) POLICIES REGARDING THE MAJOR DECISION MAKING CATEGORIES

Decision Category	Description of Policy	Strengths	Weaknesses
7. Technology Organization and Managerial Infrastructure			



The components of the Strategic Agenda

INNOVATION (TECHNOLOGY) STRATEGIC AGENDA

Strategic Thrusts	Organizational Units																										Business Processes	Performance Measurements

1 - Key role in formulation and implementation
2 - Important role of support and concurrence
(1) - Identifies the 'Champion', who takes leadership for the strategic thrust execution

CT - Customer Targeting

B - Business Model
OE - Operational effectiveness
I - Innovation

ASSIGNMENT OF PRIORITIES TO STRATEGIC THRUSTS

Strategic Thrusts	Priorities			
	A	B	C	Weight

A - Absolute first priority (postponement will hurt competitive position significantly).
B - Highly desirable (postponement will affect competitive position adversely).
C - Desirable (if funds were available, competitive position could be enhanced).

DEFINITION OF STRATEGIC THRUSTS

Name _____

Description

Responsible Manager

Other Key Participants

Other Important Contributors

Key Indicators for Management Control and Targets

First Major Milestone Description

First Major Milestone Date

Resources Required

Statement of Benefits

TESTS TO EVALUATE THE QUALITY OF THE STRATEGIC AGENDA

1. Comprehensiveness

2. Stretch

3. Monitoring and Control- Ease of Implementation

4. Motivation- Quality of Working Environment

5. Vulnerability