Technology Management

Training Manual

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Cover page insets include pictures of:
Photo 1: Business-related
Photo 2: Innovation

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Acronyms

TM	Technology Management
SMEs	Small and Medium Size Enterprises
R&D	Research and Development
CSF	Critical Success Factors
NDP	New Product Development
TT	Technology Transfer
NIE	Newly Industrializing Economies
FDI	Foreign Direct Investments
OEM	Original Equipment Manufacturer

Introduction

The importance of technological activity and innovation for competitiveness is widely accepted in the context of developed industrial countries. It is less well understood that intentional technological efforts are equally important for developing countries, despite their being essentially importers of technologies rather than innovators. Much of the efforts of developing countries are directed towards the acquisition of technological capabilities which can be defined as the skills – technical, managerial, and organizational – required by enterprises to set up and efficiently operate, improve and expand plants over time, and develop new products and processes. Technological capabilities comprise a broad range of functions, from routines needed for factory shop floor operations, to sophisticated jobs involving advanced research. However, technological capabilities are not sufficient on their own to assure competitive advantage; it is also necessary to have the ability to exploit them within a strategic framework.

Technology management (TM), the subject of this manual, refers to all those activities involved in developing and exploiting technological capabilities for sustainable competitive advantage. TM is a necessary and integral part of the efficient industrial development process, and many of the factors that affect the latter determine the former.

The appropriate TM content varies depending on the level of development. In advanced industrial countries it might mean the ability to enter the high-technology industry sector or to push forward the frontiers of innovation. In many developing countries it often implies the ability to become more efficient and competitive in technologies imported across a range of manufacturing activity. However, there are wide variations in TM requirements in the developing world. In the least developed countries with new and relatively shallow industrial structures, TM refers to the mastery of simple and well-diffused technologies and some adaptation of imported technologies to local conditions. In the more advanced newly-industrializing economies, TM involves mastering complex, scale- and skill-intensive technologies and entering into more advanced technological areas of activity within each technology.

For two reasons, the process of successful industrial development necessarily involves the deepening of TM capabilities over time. First, industrial progress involves entry into higher value-added activities. Countries embarking on the industrialization process begin with low technology, low wage activities such as final assembly, or the manufacture of simple items such as garments. Gradually, more complex activities that require greater skills and know-how are tackled. This requires the extension of capabilities across new, more difficult industrial processes. Second, it implies more complex and demanding TM tasks within the technologies currently in use in that country. In other words, it implies progress from simple assembly or final touch manufacturing, to adaptation, improvement, design, development, and finally innovation activities. This requires progressively greater understanding of the principles underlying TM.

The efforts by firms to improve TM capabilities do not occur in isolation. Each enterprise invests in capabilities development within an intricate linkage of information, skills and product exchange with the external environment, which includes other manufacturers, service firms, buyers and suppliers, consultants and a variety of institutions dealing in finance, skills and technology support. Effective TM development requires that the intensity and ease of interchange improve as each of the actors becomes more specialized in its own area of competence. The strength of the links, and the level of development and dynamism of the enterprises and institutions involved, are critical to the development of TM capabilities within individual firms.

This manual on TM is an educational tool. It is meant to guide local educators in TM in developing countries. Because of the significant variations in the level of development and therefore, the managerial skills required to master the technologies, it is recommended that the educator should extrapolate and possibly adapt those topics in this manual to suit the local environment.

The manual consists of eight sections. The first three sections establish a link between corporate strategy and technology strategy. Any company to some extent formalized has a strategy; thus, the technology strategy serves the firm's corporate strategy and technology decisions must be coherent with the corporate strategy. These sections define the concept of corporate strategy and define the technology strategy leading to the identification of the company's technology needs. Once the firm has identified its technology needs it is faced with a 'make' or 'buy' decision. If it decides to make the technology, it will need to accomplish a process of product/process development; this constitutes the second section. If the company decides to buy the technology it engages in a technology acquisition process, the topic of the third section. Strategic business alliances are a particular means of acquiring technologies. Whether the decision is to make or to buy, the company may engage in a business alliance to achieve its goal. The management of business alliances from a technology perspective is the subject of Section 5.

Section 6 examines the product and technology development cycle considering different TM issues. The managing of the technology transfer is analysed in Section 7. The most important risk determinants of such process are also examined. Section 8 deals with the different types of business alliances for achieving higher levels of competitiveness for the firms creating them.

1. Identification of Technology Needs

When effectively utilized, technology is a powerful instrument that can enhance competitiveness. Technology Management is the application of managerial techniques that ensure that the utilization of the technology achieves the firm's goals. The efficient implementation of practices related to technology and innovation management at the enterprise level are critical. A prerequisite for improved competitiveness is identification of technology needs.

This manual provides some guidelines on how to identify the technology requirements in small and medium size enterprises (SMEs), analysing goals, strengths and weaknesses, opportunities, threats and strategies. An appropriate TM strategy can only be formulated after the firm's requirements in terms of technology have been identified. The technology strategy must take into consideration:

- how the technology would support the business strategy;
- whether and how the technology can become a source of competitive advantage;
- technological developments and acquisitions required to achieve the firm's objectives.

The identification of technology provides a structural framework for assessing and analysing information in order to define a technology strategy. For SMEs there are two major considerations:

1. The business strategy establishes the scope and target of three functions within the firm: marketing, finance and technology. In many small firms there may not be an explicit business strategy; we propose a simplified set of instruments to assist management to properly define an enterprise business strategy. This will allow a linking between the identification of critical technology needs and the technology strategy, and the enterprise strategy and enable the firm to implement strategic management in a more organized way through the linking of technology strategy to business strategy.

2. Research and development (R&D) should be understood mainly as development and engineering activities, given that SMEs rarely perform research. The methodology proposed needs to be adapted to address specific enterprises. For many small firms, a technology strategy means deciding about what kind of improvements to make to the manufacturing process and/or what equipment to purchase. Thus, a technology project may merely be the purchase of a new machine for a particular project. Sometimes the purchase is made in relation to a particular project; in technologically more advanced enterprises, a machine might be purchased with a view to embarking in the future on more advanced work. In this latter case, the technology decision is more complex and probably involves evaluation of different machines, and different methods of acquisition related to the firm's portfolio of technical projects.

The first Sections are in the form of a sequence of steps. Firms can follow this methodology, applying steps that are appropriate and relevant to its level of complexity.

The Section has the following three sections:

- Development of the business strategy - a simplified methodology to formulate a business strategy, comprising:

- product-market segmentation and context analysis
- customer demand analysis and identification of competitive factors
- identification of critical success factors and priority actions based on a simple methodology, which can be used as the basis for any functional strategy, including a technology strategy;

- identification of technological needs and technology strategy formulation which addresses of how to identify critical technological needs and develops the basic dimensions of a technology strategy. It consists of:
    - technology assessment
    - technology selection
    - technology portfolio analysis;

- TM audit to identify whether the appropriate managerial processes and organization are in place to manage technology and innovation.

It will be necessary to establish whether the enterprise possesses an awareness of the benefits of technology for competing in the market and whether the firm has the necessary understanding and TM capabilities.

1.1 Is Enough Attention Paid to Technology?

It is important to understand the necessity for a well designed technology plan, and good management of technological capabilities in all areas of the firm, including (where applicable) R&D, marketing, production, finance and general management. A problem common in TM is lack of communication between different corporate functions and the need for collaborative management. The instrument provided below is designed to discover whether the firm puts sufficient emphasis on technology.

It consists of a number of statements, which should be ranked in importance or applicability to the firm, from 1 (low) to 10 (high). The next step involves groups of 5 or 6, including a member of management and technical staff employees, discussing the results of this questionnaire and identifying strengths and weaknesses. This is important for the formulation of a technology strategy. The objective is to evaluate how efficiently the firm uses technology to increase competitiveness.

The final result is a snapshot of the actual firm situation in terms of its ability to utilize its technological potential to achieve its strategic objectives.

Table 1. Rating several issues related to technology management

Statements	Rate
• People, in general, will support changes that are necessary to implement better management of technology	
• Top management demand information about the status of the main technological projects at least twice a year	
• All the sections of the enterprise understand clearly the relevance of technology for competitiveness	
• The enterprise strategy is clearly defined	
• Technological activities are consistent with the enterprise's overall strategy	
• The technology sources utilized (internal R&D, licensing, R&D contracting, joint ventures, consortia) are consistent with the deadlines demanded by the strategic guidelines	
• There is a clear identification of the strategic technological areas	
• There is a clear definition of the strengths and weaknesses of the enterprise regarding the strategic technological areas	
• There is an adequate balance between short-term and long-term orientation in technological projects	
• There is an adequate level of consensus regarding the trends of the life cycle of the strategic technologies for the enterprise	
• The authority and responsibilities of the project managers are clearly defined and adequate to the needs of the enterprise	
• There is sufficient information on the budgets and deadlines of each project	
• The enterprise protects intellectual property where necessary	
• There is an adequate evaluation system to assess the contribution of technology to the enterprise goals	
• There is an adequate monitoring and information system to identify technological threats and opportunities	
• There is adequate integration between the different sections of the enterprise regarding innovation of products and processes	
• There is an adequate use of technological alliances	
• There is adequate information on university research teams and research institutes developing activities related to the enterprise's strategic technologies	
• The budget for technological development as a percentage of the total sales is consistent with competitors	

2. Development of an Enterprise Business Strategy

This section describes a simplified methodology for a business level strategy, which involves three main steps:

- product-market segmentation and context analysis
- analysis of customer demand analysis and identification of competitive factors
- identification of critical success factors and prioritized actions.

For companies with large sets of businesses it is necessary to develop a corporate level strategy.

Corporate Strategy
A company that operates a number of businesses has to start strategy formulation from the corporate level, i.e. the set of businesses, which involves investigating:

- which current businesses are critical for future company survival
- which new businesses need to be entered or created
- what are the critical inter-relations among businesses based on a subset of core businesses

This enables the company's core businesses to be highlighted and enables allocation of resources among businesses. A more formal and structured approach to identification of the core businesses in terms of key segments within the business can also be applied.

SMEs often operate only as one business or only a small number of related businesses, thus we concentrate on business rather than corporate strategy in this document.

Development of the Business Strategy
The aim of a business strategy is to define the activities that respond effectively to customer needs and are competitive with other offerings. In deciding where to position themselves within the competitive environment, firms must take account of the structural factors affecting the dynamics of competition in a specific industry, and the factors determining the relative advantage of their business with respect to competitors.

This analysis identifies critical success factors, i.e. factors needed for business survival and success, on which decisions and priority initiatives and actions will be based. These might include:

- defining key objectives for existing and potential new businesses
- deciding actions to achieve these objectives.

2.1 Product-market segmentation and context analysis

The business strategy formulation informs the technology strategy. The same analytical approach should be applied to each product-market segment within the business. A product-market segment is defined as the distinct product or service being offered to a group of customers, within a context of competition, from products or services that could be substitutes.

The segmentation of business into product-market segments can be based on whatever criteria are considered critical to identify a sub sector of the industry that is well defined, in which there is product offerings that are very similar. Once the product-market segments are identified, their characteristics can be analysed.

Table 2 provides a pro forma for recording these characteristics

	TURN-OVER	GROWTH RATE AND FUTURE POTENTIAL	CONTRIBUTION TO PROFIT (CURRENT AND FUTURE)	MARKET SHARE	OVERALL EVALUATION AND PRIORITY
PRODUCT-MARKET A					
PRODUCT-MARKET B					
PRODUCT-MARKET C					

Table 2: Key variables in product markets

Turnover (total sales of the product in that market segment)
Growth (average growth in sales of the product in that market segment over the previous 2 years)
Contribution to Profit (percentage of profit generated by the product relative to the firm's total profit)
Market Share (of the product in that market segment)

This matrix allows identification of product/market pairs that are most important for the success of the company. This analysis can be used to forecast future product-market segments based on projections.

Once key segments have been identified, further analysis of the major trends affecting these segments and their profitability in the future is required.
This should lead to identification of:

- threats: factors that could undermine the profitability of the segment and/or the profitability of the company within the segment
- opportunities: factors related to opportunities for growth of the segment and/or the firm within the segment
- trends: whether changes in the competitive context could affect future profitability and competitive position.

Table 3 provides a matrix for identifying major threats, opportunities and trends in order to assess the future profitability of the segment.

	THREATS, OPPORTUNITIES, TRENDS
MARKET	
COMPETITORS	
DISTRIBUTION	
SUPPLIERS	
TECHNOLOGIES	
REGULATION	

Table 3 Analysis of the product-market segment

The importance of these factors will vary from company to company.
Market: major customer groups, potential customers, size and trends in terms of growth or reduction of the market, product differentiation, new niches, potential substitute products, opening of new markets.

Competitors: number, concentration and size, potential new competitors, intensity of

competition, barriers to entry/exit, cost structure (fixed costs, variable costs), economies of scale.

Distribution: number, size and concentration of distribution channels, potential distribution channels, bargaining power of distribution channels.

Suppliers: number, size, concentration, dependency level, bargaining power of suppliers.

Technologies: technological trends, substituting technologies, access to latest technologies.

Regulation: trends in national and international regulation that affect the product-market characteristics, government actions (protection), foreign exchange and customs duties, capital movements among countries.

2.2 Analysis of Customer Demand and Identification of Competitive Factors

An evaluation of customer behaviour should be made for each priority factor. Customer behaviour can be defined through the identification of certain factors: an example list is provided in Table 4.
Key questions related to the identification of competitive factors are set out below.

Critical Questions

What are the key criteria used by customers to make their choices among products?
How can the firm help customers while at the same time benefiting from competition?
What are the factors that affect our industry and deserve special attention?
Which competitive factors should be reduced well below industry standards?
Which competitive factors should be raised well above industry standards?
Which competitive factors, not previously considered/offered by the industry, should be created?
How do potential customers become aware of the need for your product or service?
How do consumers find what you offer?
How do consumers order and purchase your product or service?
How is your product or service delivered?
How is your product installed?
How is your product or service paid for?
How is your product stored?
What is the customer really using your product for?
What do customers need help with when they use your product?
What about returns or exchanges?
How is your product repaired or serviced?
What happens when your product is disposed of or no longer used?

Priority from the Point of View of the Customer: 1 (low importance) to 4 (extreme importance)

Position Regarding Competitors: + (better) / = (same) / - (worse)

The above should be applied to each critical product-market pair. Note that customers' opinions should be taken into account when filling in the table. Customers may not have precise ideas of what they want. Therefore, their view should be interpreted with care.
High priority competitive factors should be used as the basis for the firm's strategy in that product-market segment.

Table 4 – Competitive factors, position cf. competitors and priorities

COMPETITIVE FACTOR	CURRENT IMPORTANCE	FUTURE IMPORTANCE	CURRENT POSITION OF. COMPETITORS	OVERALL PRIORITY
Quality (compliance)				
Variety Range of products offered; customization				
Product performance Functional performance; durability; reliability; packaging				
After-sales service Education and training; speed of repair; guarantees; maintenance				
Environmental performance Reduction of raw materials; reduction of energy consumption; reduction of toxic materials; use of renewable materials; recyclable materials; reprocessing; clean emissions; reduction of other inputs; disassembly; re-use; safe disposal				
Costs Cost of raw materials; salaries; in-plant handling of materials; inventory; training; maintenance; downtime; stock-outs; energy; material waste; reworks; product and waste disposal; commercialization costs; life cycle costs; distribution costs				
Service Distribution; delivery (timing, reliability, flexibility)				
Speed of new product development and introduction				

3. Identification of critical success factors and priority actions

On the basis of the information obtained from the context analysis, critical success factors can be identified and strategic priority actions formulated for each product-market segment (see Table 4). This should be related to existing and potential product-market segments. This identification will provide shape for the firm's business strategy. Table 4 presents the critical success factors and priority actions for each existing or potential product-market segment, based on the major strategic trends and key competitive factors.

FIRM'S FUNCTION/AREAS	CRITICAL FACTORS
Procurement	Selection, evaluation and development of suppliers Quality management of purchased goods Materials management of purchased goods
Manufacturing	Number, size and location of plants Specialisation of facilities Capacity Vertical integration Process technologies Quality management Human resources skills
Marketing	Product Price Promotion Advertising
Distribution and service	Distribution channel Material handling Transport Location Warehousing Customer service

Table 5 – Priority actions

One way to identify critical success factors would be to consider the resources critical to the firm's main competitive factors, and/or the resources needed to face threats and exploit opportunities.
Below we give some examples for the areas of procurement, manufacturing, marketing and distribution.

Not all the priorities and actions identified will be feasible. Refinements to suit budget and other conditions may be necessary. Once the strategy has been finalized, the critical competitive factors and associated actions become the reference point for any functional strategies within the firm, including the technology strategy, manufacturing strategy, marketing strategy, etc. Here we focus on technology strategy.

3.1 Identification of Technological Needs and Technology Strategy Formulation

This process involves three steps:

- Technology assessment, which includes, Identification of the technologies, competitive impact of the technology, technological capability assessment.
- Technology selection
- Technology portfolio analysis.

These steps are fundamental to the definition of a technology strategy, i.e. the technological areas in which to invest and the actions to be taken.

Technology Assessment

The process of technology assessment involves collecting information on the current and future state of technology development, evaluating the importance of each technology in the context of competition, and the strength of the enterprise in each technology, i.e. technological capability.

Identification of the technologies involved

The technologies are the set of technological knowledge and skills that affect the overall competitive position of the enterprise in the marketplace at present and in the future. Their identification involves:

1. Detailed analysis of the enterprise's technological structure, including:

- product technologies, i.e. to identify the technologies embodied in products, including the tools used to develop new products (e.g. design technologies)
- production process technologies, i.e. to analyse the production process and identify the technologies used
- support technologies, i.e. those technologies used to perform activities in the enterprise, which are not embodied in the product or production process (typical support technologies are IT tools, software packages, networks). To identify the enterprise's technologies it may be helpful to map the technologies used in the activities along the enterprise's value chain, i.e. inbound logistics, outbound logistics, distribution, sales, after-sales service, customer relationships, supplier relationships, etc.

2. Assessment of those technologies that may have an impact in the future.

These are sometimes defined as emerging or pacing technologies, i.e. technologies not yet in use but whose potential could be significant in substituting for technologies in current products or in generating new products. Technology forecasting techniques can be used to identify emerging technologies. This will enable identification of the technologies that will become the basis of a technology strategy.

Table 6 presents a synthesis of the information on the enterprise’s technologies, including the sources for each technology, which will enable identification of whether current resources are sufficient to access or acquire the technology. This will enable a detailed list of the technologies relevant to the enterprise's business.

Type of technology	Technologies	Sources
Product technologies		
Production/Process Technologies		
Support Technologies - inbound logistics - outbound logistics - distribution - sale - after-sale services - customer relationship - supplier relationship		

Table 6 - Identification of the technologies involved

3. Impact on Competition of Technology (assessment of technology relevance)
This analysis aims to evaluate the importance and relevance of each technology to the firm's competitive position in the market. It takes account of:

- relevance of the technologies for sustaining the firm's competitiveness
- importance of the technologies and technological competence for future competition.

Table 6 presents a matrix of key competitiveness factors in relation to each technology. The scores should reflect the impact of the particular technology on a particular factor, on a scale of 1 to 5, where 1 is no impact and 5 means that it is critical for that factor.

In order to obtain representative results it is important to involve people from different divisions of the firm, on different levels (sales, technical assistance, technicians, engineers, production, etc.) and, where possible, suppliers and customers. The critical success factors should be placed in a matrix as the one Table 7 represents.

Critical Success Factors (CSF)	**Techn. 1**	**Techn. 2**	**Techn. 3**
CSF1			
CSF2			
etc.			

Table 7 – Critical success factors/ technologies matrix

This will enable identification of critical technologies, i.e. those technologies that have the greatest impact on the firm's critical success factors. This competitive impact analysis enables an overall assessment of the competitive importance of each technology, supports the selection of technologies for the firm's business (see technology selection), and prioritizes them. The output of this exercise is a list of technologies and priorities.

Assessment of Technological Capability (technology risk assessment)
This assessment is aimed at defining the firms' capabilities in each technology by evaluating the capabilities in each technology in relation to the previously identified major competitors. It provides a measure of the risk associated with the development of the technology: the lower the level of capability, the higher the risk involved in adopting the technology.

Variables to be considered are:

- funds (for R&D and other functions)
- human resources (breadth and depth of skills available)
- equipment, devices, laboratory facilities
- patents
- other

The evaluation can be done using a matrix that takes account of the dimensions of the firm's technological capability in relation to each technology. The cells report a score value from 1 to 5, where 1 is very weak, 2 weak, 3 average, 4 fairly strong, and 5 is strong. The strength of the enterprise in a specific technology can then evaluated, either qualitatively or by constructing a merit figure as a weighted average.

This assessment should involve managing directors/senior management, and technical manager(s).

Technological capability dimensions	Techn. 1	Techn. 2	Techn. 3	Comments
Level of funding Human resources: - breadth - depth Equipment and labs Patents Other				

Table 8 - Technological capability assessment

Technology Selection
Technology selection refers to identification of critical technologies for the firm for which investment should be prioritized. A competitive impact-capability (relevance-risk) matrix can be built on the results of this analysis. Selection of which technologies to develop will be based on the relevance and the risks related to each, based on the matrix provided in Figure 1.

This selection will need to take account of the costs of the new technologies. To construct an estimate, the activities related to each technology need to be explicitly defined, a development project prepared and a list made of the resources required. In the matrix each technology is represented by a circle whose diameter is proportional to the cost of developing the technology.

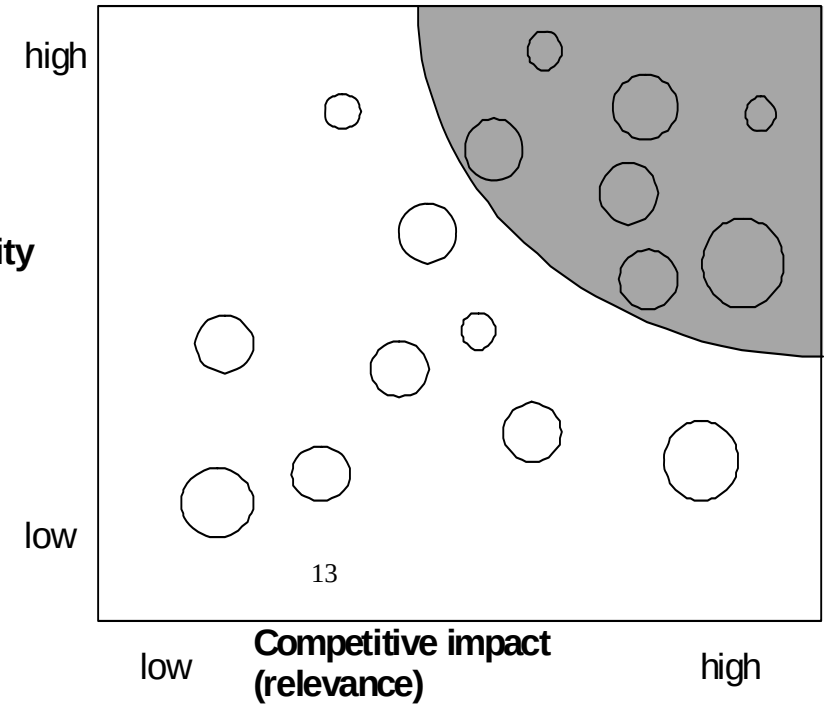


Figure 1 - Selection of the core technologies.

The matrix is built on three factors related to the technology:

- competitive impact or relevance (obtained from the technology assessment)
- capability or risk (obtained from the technology assessment)
- cost

The grey area (high competitive impact-high capability) indicates future core technologies, i.e. the technologies that will be needed to maintain leadership. It is based on the budget available for technology development. Moving from the top-right corner to the bottom-left of the matrix we can identify the highest relevance and lowest risk technologies and their progressive use of the available budget. Progress stops when the available budget is exhausted. If the enterprise is strong in non-critical technologies, then these can be obtained through licensing.

The matrix enables the formulation of a technology strategy, i.e. decisions about which technologies take priority in the allocation of resources. The technology capability assessment identifies areas for technology improvement in terms of equipment, human resources, patents, etc.

The competitive impact-capability matrix helps in decisions about whether to become a technology leader (being first in the market, developing new technologies, keeping abreast of the technology frontier) or a follower (imitating leaders, bringing new products to the market later). If the firm is weaker than competitors in the most important technologies the former strategy will not be viable. However, as capabilities are accumulated and the gap with competitors is reduced, then the strategy could change. This key matrix which will be the basis for important decisions, should involve top management and technical experts in the firm.

Technology Portfolio Analysis

The outcome of the previous exercise could result in the selection of only a small number of technologies, or of technologies that are oriented to the long-term. This will be established by conducting a technology portfolio analysis, i.e. an analysis of the technologies selected.

The results of this analysis may indicate the following actions:

- increasing the available budget to enable development of a wider range of technologies
- development of several projects to encompass both short term and longer term objectives
- reducing the amount of money allocated to a particular technology (indicated by the diameter of the circle in the relevance-risk matrix) by considering different external sources for its acquisition.

External acquisition could be via:

- research consortia
- contract research with a research institute or university
- acquisition of firms with the required competencies
- licensing
- joint venture
- alliance
- hiring human resources with the required capabilities/skills.

The most important variables related to modes of acquisition are:

- availability of external sources of each technology (as indicated by the competitive impact analysis)
- external acquisition cost

- demands and restrictions imposed by the external sources
- time spent on searching possibilities for external acquisition
- appropriateness (i.e. the extent to which technological knowledge needs to be kept proprietary and difficult to imitate): where appropriability is an important issue, internal development is recommended
- degree of familiarity of the firm with the new technology; weak capabilities indicate appropriateness of external sourcing
- degree of familiarity of the firm with the market (if investment in a new technology implies new product line creation): lack of familiarity would indicate that establishing agreements with firms with existing market knowledge would be preferred.

External acquisition of technology is dealt with in more depth in the next section.

4. TECHNOLOGY MANAGEMENT AUDIT

Definition of a technology strategy should include analysis and definition of the organization and management. The previous section defined the content of a technology strategy, i.e. which technologies to develop. However, it is also important to establish whether appropriate procedures and routines are in place. There are several instruments that can be used to analyse the processes involved in the management of technology. Here, we describe the Innovation Self-assessment and Benchmarking Framework (ISBF) (Chiesa et al., 1996).

4.1 ISBF

The ISBF provides a scheme to benchmark or self-assess technological innovation, based on seven key processes.
Four core processes for technological innovation:

- product concept generation
- product development
- production process development
- technology acquisition,

and three support processes:

- leadership
- resource provision
- adoption and use of systems and tools.

Product concept generation focuses on how product concepts and enhancements to products are generated, how customer requirements are identified, opportunities prioritized, innovation and creativity encouraged, and exploitation of the new product planned. Product development is the process of effectively developing new product concepts through the stages of testing and manufacture to successful launch in the market and continuing support of the product.

Production process development focuses on the processes required to ensure that new (improved) production processes are developed, that there is appropriate implementation, and continuous improvement.

Technology acquisition involves the monitoring, acquisition and exploiting of technologies, either through internal development or from external sources. Leadership looks at how management sets goals and priorities for innovation, champions the efforts to achieve best practice processes for technological innovation, and creates an environment that encourages innovation. Resource provision examines how the company ensures that there are sufficient and appropriately qualified human resources and that innovation is properly funded. Lastly, systems and tools provision relates to how methodologies, systems and tools are used to support the innovation process.

Tables 9 to 15 present best practice related to each process.

Table 9. Product concept generation process

Process element	Implications for audit
Generating new product concept	- systematically monitoring market needs, - putting up mechanisms for functional groups to meet the customer - use of feedback from functions that meet the customer - building long term relationships with customers and especially lead users - cross-functional screening of new product concept ideas - matching technological capabilities to market needs
Product innovation planning	- linking the product innovation plan to the business plan - market led planning process - prioritising product development projects - establishing procedures for selecting new or enhanced products - integrating processes for generating new product concepts, planning product innovation and realising new products
Innovativeness and creativity	- eliciting and supporting new product ideas and initiatives from employees - rewarding entrepreneurial behaviour - supporting unplanned product initiatives - circulating new product ideas - structuring organisation for favouring creativity and inventiveness - creating innovative roles
Exploiting innovation	- evaluating alternatives for developing new business opportunities - selecting ventures alternatives for entering a new business - assessing the relatedness of entrepreneurial initiatives to core competencies - using governmental funding mechanisms

Table 10. Product process development

Process element	Implications for audit
Product development process	- managing product development projects from concept to launch, establishing the scope of the process, phases, gates, reviews, sign off procedures - integrating all relevant functions in the product development process - early involvement of the key internal functions and external organisations - facilitating communication among the different groups involved in the development process - degree of parallelism, integration of steps and task interdependence built into the process - establishing role and priority of project progress reviews
Transfer to manufacturing and distribution	- linking manufacturing and engineering - handling engineering changes - rapid feedback from manufacturing to design and engineering
Teamwork and Organisation	- Use of cross-functional teams - Defining the status of project managers in the organisation - Use of organisational integration mechanisms at the initial stages
Industrial Design	- Incorporation of industrial design into product development - Use of inside or outside design consultancy teams - Creating mechanisms for customer requirement information to be integrated into product design

Table 11. Production process development

Process element	Implications for audit
Formulating a manufacturing strategy	- evaluating the capabilities of existing production processes - establishing a formal procedure for generating a manufacturing strategy - matching process capabilities to the requirements of the marketplace - linking process innovation to product innovation - allocating resources for developing new process technologies - monitoring sources of process innovations
Implementation of new processes	- matching technology complexity to the capability to adopt - managing the links with suppliers in the development and implementation - accompanying production process innovations with the appropriate changes to the organisation - modifying performance measures to reflect the capabilities of new processes
Continuous improvement	- identifying opportunities for improvement in processes - integrating process improvement with quality control - benchmarking production process performance - involving manufacturing process developers in improvement after installation

Table 12. Technology acquisition process

Process element	Implications for audit
Formulating a technology strategy	- systematically monitoring trends in existing and future technologies - assessing competitors' technological capabilities - identifying emerging technologies - understanding core technologies and competencies of the firm - building the required core competencies based on the technological capabilities - relating technology to business objectives and strategies
Selection, generation and sourcing of technology	- choosing sources of technologies (in-house R&D, licensing, partnering, external alliances) - use of both quantitative and qualitative methods to evaluate R&D projects - choosing a portfolio balancing risk and reward, and project timescales - identifying key issues in R&D organisation supporting the firm's technology policy - favouring communication, creating structural interfaces of R&D with other functions
Management of intellectual property	- protecting intellectual property rights (patenting, trade-secrets) - exploiting intellectual property (licensing out)
Environment and regulation	- anticipating and proactively deal with environmental and regulatory issues - embodying the minimisation of environmental impact into the design of new products

Table 13. Leadership process

Process element	Implications for audit
Goals for innovation	- defining the firm mission in technology and innovation - building innovation strategies into business strategies and plans - identifying the core distinctive competencies - including representatives of innovation and technical functions on the board
Processes for innovation	- evaluating processes for generating and implementing innovations - benchmarking processes for innovation against best practices - making innovation processes visible to top management
Climate for innovation	- encouraging new idea development, risk taking and entrepreneurship - making innovation policies shared and understood in the organisation - defining performance measurement system encouraging innovation

Table 14. Resource provision process

Process element	Implications for audit
Human resources	- identifying the key roles needed for managing the innovation process - recruiting, developing, evaluating and rewarding technical human resources - establishing career development paths for technical people (dual ladder, career developments, cross-functional developments)
Funding	- stability of funding of R&D activities and technology acquisition - flexibility of funding of product and process development - sharing risks and reducing costs of innovation through alliance networks

Table 15. Systems and tools provision process

Process element	Implications for audit
Systems	- information and product systems used to support the processes for product development - information systems enhancing communication in the innovation process
Tools	- use of tools for capturing customer needs - use of tools for design of new products - use of tools for promoting creativity
Quality assurance	- managing quality in the design process - use of methods to analyse and improve the quality of innovation processes. - integrating process improvement and product innovation with quality management

The ISBF can be used to benchmark the position of the firm against the state of the art. It will allow the firm to identify the processes that are fundamental for effective TM and innovation and assess whether it is level with the best practice or falls behind. This will highlight the firm's strengths and weaknesses, i.e. the areas that require managerial and organizational intervention.

Conclusions and Final Recommendations

Technology strategy formulation and technology audit are both important stages in developing a strategy for technology. The objective of both these phases is to evaluate to what extent the

firm is using technology as a tool for competitiveness. The final outcome of these processes is a snapshot of the firm's current position and its technological potential.

Prerequisites for an effective technology strategy formulation and technology audit include:

- support and participation of top management
- a task force to coordinate the processes that includes people from all the strategic areas in the firm
- appointment of a coordinator to apply the methodology, plus the assistance of a trained consultant
- assurance that the recommendations of the technological audit, which will contribute to the firm's success, will be implemented
- periodic repetition of these processes
- avoidance of complex tools that may obstruct the process. The aim is to reach a conclusion, which may need refining, but is preferable to a process that does not end
- adaptation of the methodology to suit the specific case of the company.

5. Management of Internal Technology Development

Vertical integration
Definition
Vertical integration is the number of stages in the industry chain in which the firm operates. A firm is fully integrated when it is an actor in all the stages of the industry chain; it is partially integrated when it operates in only some of the phases involved in the range of the industry's activities.

Vertical integration is often studied from the point of view of a "make or buy" choice, which is mostly based on the economic convenience of going forward or backward in the industry value chain. When a third party is able to manage a specific phase(s) of the industry chain more efficiently, it is better to rely on them than to conduct the activities in house. In addition, over time it may be possible to gain even greater advantages from integration, e.g. through reductions in price.

An example of a fully integrated firm is provided in *My Life and Work*, by Henry Ford, first published in 1922:

> Ford Motor Co. is the symbol of the fully integrated factory, and in particular its River Rouge plant, which produced a single standardized product, Model A. At one side of the plant Ford ships docked in loaded with coal and iron ore (both extracted from Ford mines) at the opposite side cars and tractors came out.

Make or Buy Strategy
In 1991 Hax and Majluf[1] identified the main advantages related to vertical integration:

- cost reduction (internalization of economies of scale and economies of scope, avoiding transaction costs in imperfect markets)
- defensive market power (autonomy of supply and protection of valuable assets and know-how)
- offensive market power (access to technologies, to new business opportunities, and specialized know-how)
- administrative and managerial advantages.

Benefits of Vertical Integration
Cost reductions

- Economies of scale are internalized, resulting in lower costs than using outside suppliers and distributors
- Avoids high transaction costs: e.g. expensive physical transfer of goods and services, writing and monitoring contracts with external providers, excessive coordination and heavy administrative burden
- Eliminates cost penalties from unpredictable changes in volume, product design, or technology that are often conditions within contracts with providers
- Generates economies from combined operations, sharing of activities and maintenance of stable throughput in an extended segment of the value chain.

Defensive market power

- Provides autonomy of supply or demand that protects the firm from foreclosures, inequitable exchange relationships, opportunistic behaviour and overpricing on the part of upstream or downstream providers of goods and services
- Provides protection for valuable assets and know-how from unwanted imitation or diffusion

[1] Hax A. and Majluf N., *The Strategy Concept and Process - A Pragmatic Approach*, Prentice Hall, Englewood Cliffs, New Jersey, 1991

- Grants exclusive rights to the use of specialized assets
- Protects the firm from poor service from external suppliers which may have incentives to favour competitors
- Guards against important attributes being degraded, distorted, ignored, or impaired by badly managed distribution, marketing or service operations
- Raises entry and mobility barriers.

Offensive market power

- Increases new business opportunities, upstream or downstream
- Makes new forms of technology available for existing business base
- Promotes differentiation through control of the interface with final customers
- Improves market intelligence.

Administrative and managerial advantages

- Imposes market discipline throughout the firm by dealing directly with providers up and downstream
- Increases interchanges of information with external sources
- Simplifies organizational structure and reduces the numbers of personnel involved.

Costs of Vertical Integration

Cost increase

- More efficient operation implies a larger fraction of fixed costs and correspondingly higher business risk
- Higher capital investment requirements
- Possibility of increased overhead costs.

Reduced flexibility

- Reduced flexibility to diversify
- Reduced ability to tap different distributors and suppliers
- Makes competition more difficult if conditions change
- Imposes higher exit barriers and greater volatility in earnings
- Makes it more difficult to discontinue obsolete processes.

Balance requirements

- Vertical integration forces the firm to maintain a balance among the various stages in the value chain to avoid external shocks resulting in cost penalties, e.g. simultaneous excess capacity and unfulfilled demand.

Administrative and managerial penalties

- Vertical integration forces the use of internal rather than market incentives, which are more arbitrary and could result in major distortions if not properly applied
- Vertical integration can adversely affect the flow of information to the firm from customers and suppliers
- Vertical integration may impose an additional burden on the organizational structure and the managerial processes and systems for dealing effectively with increased heterogeneity and complexity.

THE 'MAKE OR BUY' APPROACH

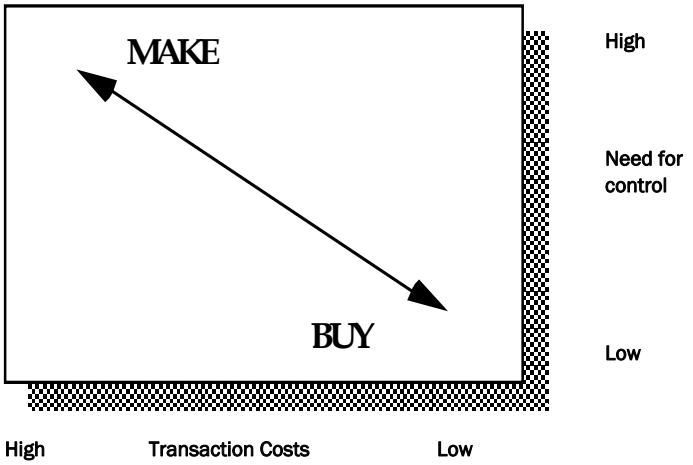


Figure 2 - The make or buy approach
Source: Hax A. and Majluf N., The Strategy Concept and Process - A Pragmatic Approach, Prentice Hall, Englewood Cliffs, New Jersey, 1991

The make or buy approach is appropriate for a stable market environment, but less so if market conditions change, which can lead to a change in competition rules. Decision to buy limits the capability of manufacturers to keep pace with innovation and customers' needs in every phase of the industrial production chain.

In some industries (cars, motorcycles, etc.) many manufacturers have realized that it is difficult to master technological innovation in the conception and production of every component in a complex product. It is difficult to for firms to encompass all the capabilities required to be at the top in very different and dynamic technologies such as mechanical, electrical, electronic, aerodynamic and chemical. It is also too expensive for many producers to conduct in depth R&D and engineering activities in a broad range of fields. In addition, for companies that produce every part of a complex product, it is also difficult to generate economies of specialization to foster productivity.

Nevertheless, the market demands state-of-the-art products in every technology which points to de-integration as a way of achieving this goal of continuous technological innovation and customer satisfaction.

In many cases, manufacturers retain in-house only design and assembly, leaving other specialized activities to suppliers in order to maintain competitiveness levels. However, the strategic relevance of many of the components in a complex product suggests that even within this type of strategy, it is better if the manufacturer manages the entire range of activities by coordinating a cooperative development process (Figure 2). This is supported by the many case studies of SMEs and large enterprises, which all tend towards higher levels of cooperation. What is important is for the manufacturer to control the production of strategic components, rather than of every component. The strategic relevance of a component is directly related to its strategic risks:

- appropriability of the component
- appropriability of the know-how
- market visibility
- supply reliability
- time to market.

For all these reasons, the strategic risk area is growing and includes an increasing number of parts and components which used to be considered of minor importance (Figure 3).

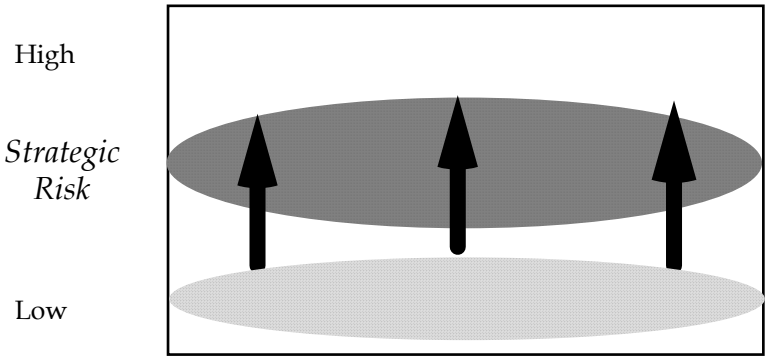


Figure 3 - The strategic risk

Manufacturers, however, cannot afford to produce every strategic component in-house given that the pace of technological innovation makes it very difficult for any firm to keep abreast of the know-how. The case of automotive electronic control systems demonstrates that car manufacturers are seeking to spread more of the R&D related to advanced products to component manufacturers. The leading suppliers are thus taking on the role of systems producers rather than suppliers of individual parts.

Leading manufacturers are being forced to retain the capabilities required to concentrate their design, engineering and production efforts on parts that have a significant level of strategic relevance. Their competitiveness is related to specific know-how including:

- specific product technology
- specific process technology
- organization
- R&D.

One example is FIAT and how its strategy has evolved in recent years. Up to 1987 this Italian company had increased its level of vertical integration by buying a number of supplier companies. It then embarked on a series of joint venture agreements with suppliers with specific know-how. The most important ones were with Nippondenso (air conditioning), Motorola (electronic devices), SGS (electronics), and Bertrand Faure (seats). All of these agreements were aimed at achieving a superior level of efficiency, learning from state-of-the-art producers, and maintaining quality. Meanwhile, FIAT has given its constellation of suppliers, which mostly operated within the captive FIAT market, access to the market. Confirmation of the trend for manufacturers to concentrate on their core activities comes from FIAT's decision to sell off some of its internal seat, seat belt and accumulator sections to specialized component suppliers (respectively to Lear Seating, Allied-Signal and Exide Corp.). However, it still maintains close relationships with all of them.

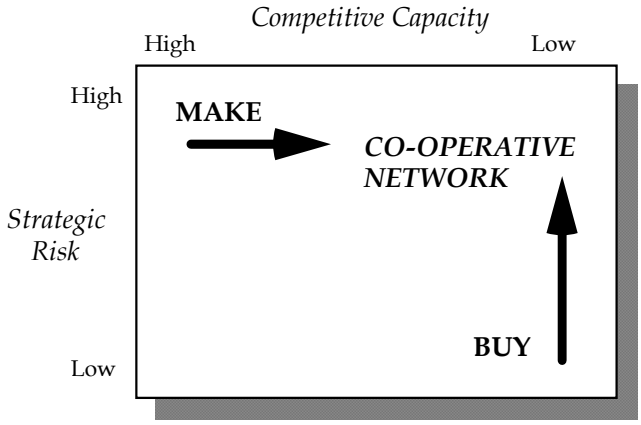


Figure 4 - Make or buy strategy

The automotive industry was formerly characterized by the make or buy dichotomy (Figure 4). This situation has changed with most car makers now entering into co-partnerships as a strategy for components supplies. This highly strategic segment requires specific competences which are not held by most of today's car manufacturers. Some of the car parts and components are bought in from suppliers with specific competences (Bosch, Valeo, etc.) including ABS, electronic ignition, tyres, air bags and some plastic parts and metal items that are bought from the lowest priced source. In the case of specialty commodities, car manufacturers tend to need customized components that need to be co-designed from the earliest stages of new model development. For example, tyres were traditionally developed independently of car models; the new 'green' tyres, which are made from silica, need to be developed in conjunction with the cars they are intended for to ensure that ride and handling complement the weight distribution, suspension and other characteristics of the model.

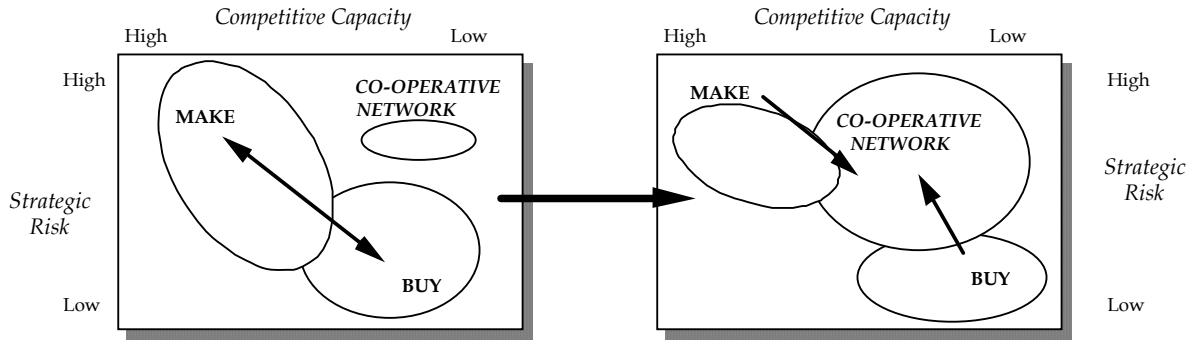


Figure 5 - Evolution of make or buy strategy

Within this matrix, which maps suppliers, there are fuzzy boundaries because suppliers might be invited to enter into strategic cooperation arrangements. Their position in the matrix changes according to the strategic relevance of a specific component over time. At the same time, a stable framework is required in order to evaluate these suppliers.

De-integration, cooperative networking and the role of the strategic supplier

Many industries are moving towards de-integration in which there will be virtual leaders, which are the coordinators of networks of suppliers and assemblers that are dispersed worldwide and linked to the home-base company through strategic relationships. The leader will be a lean company, or hollow corporation,[2] that can be likened to the conductor of an orchestra. The suppliers are like the members of the orchestra, each having distinctive competencies and know-how, but needing to follow a score and obey the conductor's baton. However, suppliers also need to be soloists and to be able to excel in the market by always being aware

[2] "A car company in the year 2000 is not going to be making very many parts. The question is, How fast do we get there?" J. Womack, one of the authors of The Machine that Changed the World.

of and anticipating requirements. A good understanding of the needs of the final customer is crucial to understanding and meeting the needs of the company they are supplying. The creation of a cooperative network enables:

- reduction in the number of suppliers per component (in some cases only one)
- higher specialization among suppliers
- lower production costs than in vertically integrated manufacture
- better quality
- shorter delivery times
- supplier involvement from the development phase, which implies co-engineering, co-manufacture, and risk sharing
- development of a global outsourcing plan.

In order to achieve these goals, leaders need strategic suppliers that will compete not on the basis of lowest cost, but on skills and competencies. A strategic supplier will be able to:

- design, engineer and produce a component
- integrate the component with related ones
- cooperate with other suppliers in the industry chain
- deliver the component (in the case of a global source) wherever in the world the assembly plant is located
- incrementally and radically innovate in order to increase quality and productivity.

Leaders will have to develop the capability to identify those components that are strategic, and those few suppliers that have all the required competencies and skills necessary for their production. It is as if the supplier *sector* is dividing. In Figure 6 (depicting an egg timer) the upper part is composed of component producers capable of increasing their leadership through technological, organizational, and marketing innovation (TOM). These firms will be able to improve their competitive position which allows them to remain at the top. The subcontractors without distinctive competences will continue to compete on a lowest cost basis. Their position is very weak and if they cannot develop specific skills, they will have little chance of survival.

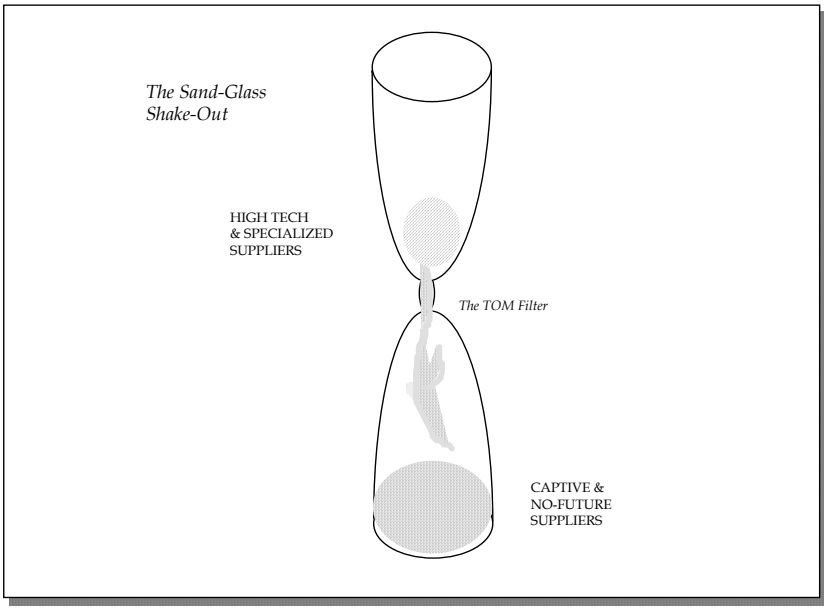


Figure 6 - The sandglass metaphor

Those suppliers that undertake TOM will become members of cooperative networks and strategic suppliers (Figure 6).

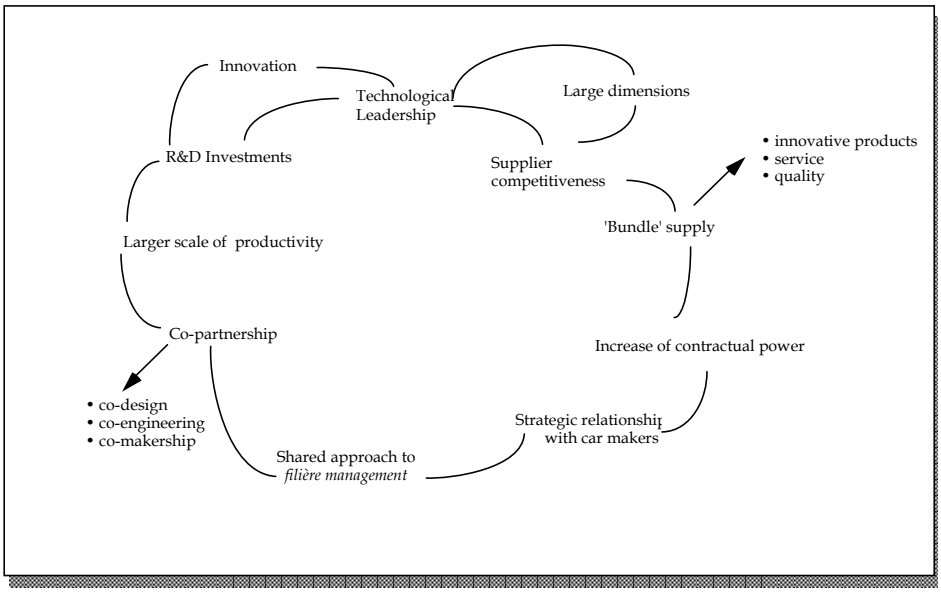


Figure 7 - An example: The virtuous circle of automotive suppliers

6. Internal Development

New Product Development (NDP)

Introduction
New product development (NPD) is a costly and complex process that requires high quality human resources and significant financial investment. It involves a set of actions or steps that produce partial outcomes, which, if successful, result in a new product. Wheelwright and Clark (1992) propose the metaphor of a funnel to represent the NPD process (Figure 8).

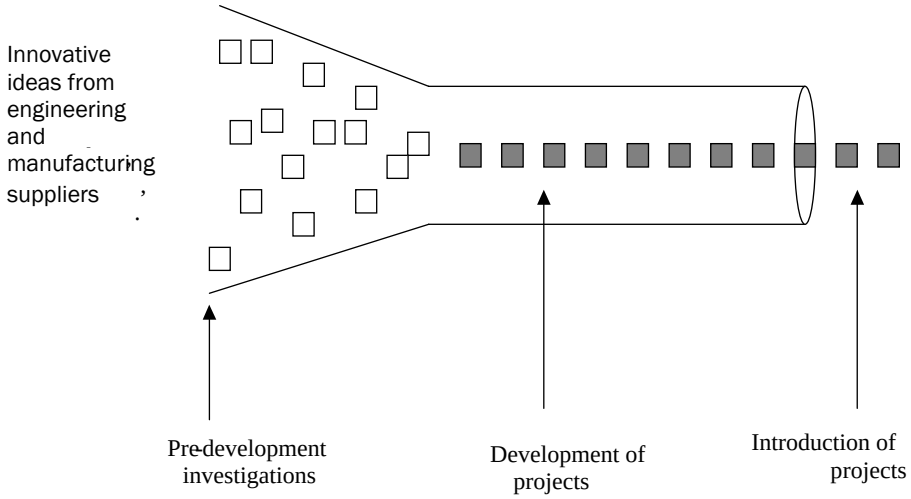


Figure 8- The NPD development funnel (Wheelwright and Clark, 1992)

According to Ulrich and Eppinger (1995)[3] there are five main steps involved in the creation and launch of a new product:

- Concept development
- System-level design
- Detailed design
- Testing and refinement
- Production ramp-up.

Concept development
In the concept development phase the needs of the target market are identified, alternative product concepts are generated and evaluated, and a single concept is selected for further development. A concept is a description of the form, function, and features of a product and is usually accompanied by a set of specifications, an analysis of competitive products, and an economic justification of the project.

System-level design
The system-level design phase includes the definition of the product architecture and the division of the product into sub-systems and components. The final assembly scheme for the production system is usually defined during this phase as well. The output of this phase is usually a geometric "layout" of the product, a functional specification of each of product's sub system, and a preliminary process flow diagram for the final assembly process.
Detail design
The detail design phase includes the complete specifications of the geometry, materials, and tolerances of all the unique parts and the identification of all the standard parts to be purchased from suppliers. A process plan is established and tooling is designed for each part

[3] Ulrich K.T., Eppinger S.D, Product Design and Development, Mc Graw-Hill Inc., New York, 1995

to be fabricated within the production system. The output of this phase is the control documentation for the product – the drawings or computer files describing the geometry of each part and its production tooling, the specifications of the purchased parts, and the process plans for the fabrication and assembly of the product.

Testing and refinement
Testing and refinement involves the construction and evaluation of multiple preproduction versions of the product. Early prototypes (alpha models) are usually built with production-intent parts, i.e. parts with the same geometry and materials properties as intended for the production version of the product, but not necessarily fabricated using the processes that will be used for final production. Alpha prototypes are tested to determine whether or not the product will work as designed and whether or not it satisfies customers' requirements. Beta prototypes are usually constructed from parts supplied by the intended production processes, but not necessarily using the intended final assembly process. Beta prototypes are evaluated extensively in-house and also are tested by customers in the working environment. The objective of beta prototypes is to check performance and reliability in order to identify any changes required for production of the final product.

Production ramp up
In the production ramp up phase, the product is made using the intended production system. The objective is to train the work force and to iron out any remaining problems in the production process. The artefacts produced during the production ramp up phase are sometimes given to selected customers for evaluation in order to identify any remaining flaws. The transition from production ramp up to ongoing production is usually gradual and continuous. At some point in this transition, the product is launched and becomes available for widespread distribution.

The use of a schematic approach to new product development is helpful since it supports effectively managers in the development process.

In particular, it is generally accepted that a good structure of the process helps the coordination_efforts among the different functional areas involved in the development. If everyone knows that there is a reliable procedure, everyone will have to respect it.

Another reason for using the NPD standardized process is quality. An experimented procedure like NPD approach represents a good and reliable method which brings to demonstrated good results. The standardization guarantees that team development members are all aware of the lower limits that a new product must at least reach. The process forces a continuous reporting of the activities. Such reports represent a powerful information base for avoiding errors made in the past and for updating the original process to a more effective approach.

Also communication is enforced by the NPD approach. When a standardized procedure is used and known company-wide it is as if everyone spoke the same language. The communication process has no frictions and hurdles.

The standardized procedure is also a good planning tool; it forces managers to follow a precise flow characterized by a clear timeline and with precise inter-process evaluation moments.

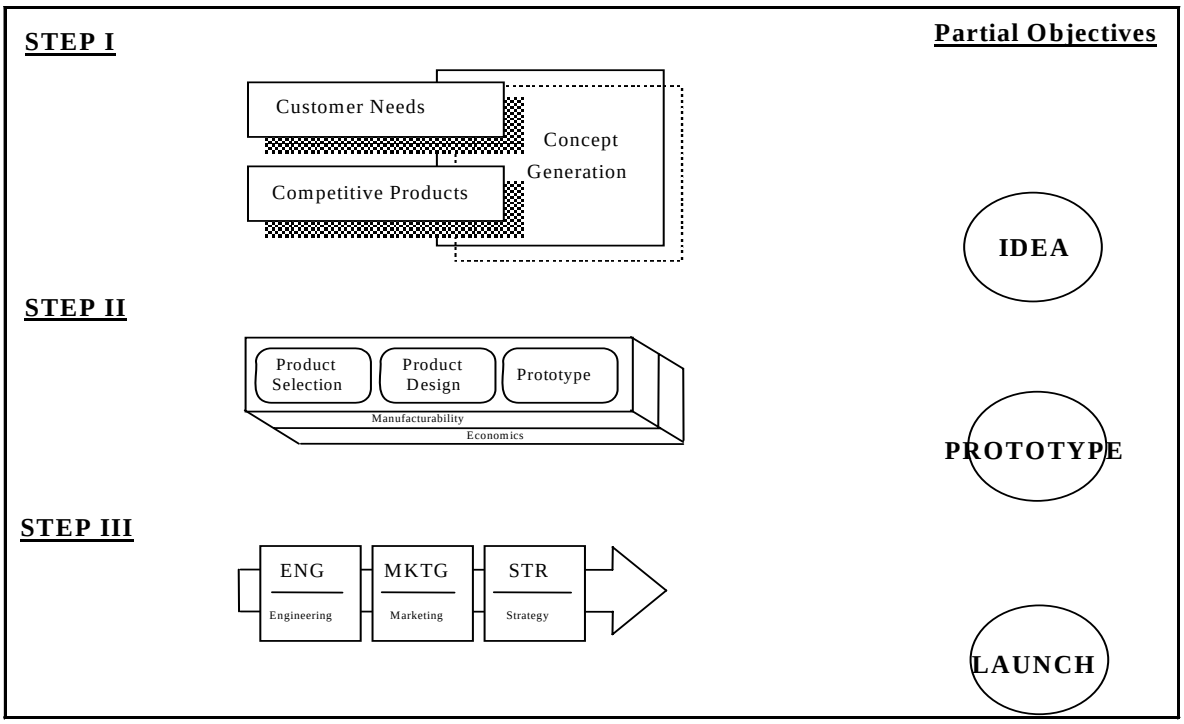
NPD procedure is a benchmarking tool since it offers the opportunity to constantly compare the process results to the established procedure.

The NPD process
The input of the NPD process is represented by the mission statement. This is a brief document (table 1) which includes the elements necessary to define a general framework for the product to be developed.

Mission Statement
Brief product description
Clear market targets
Primary market
Secondary market
Basic technological and market assumptions
Stakeholders

The mission statement should be in line with the general strategy of the developing firm. In other words, the new product should be consistent with the company's marketing, technical, operations skills.
Following the mission statement there are three main phases which can be summarized in the Figure 9.

Figure 9. First idea development



1° Step - Idea development

Customer Needs identification and Competitive Products Analysis
The first step of the NPD process is the identification of customer needs. The identification of needs is focused on the target market selected in the *mission statement*.
In this phase the managers have goal to identify the product/services which can best match customer needs. In particular the managers have to:

- identify hidden and latent needs as well as explicit ones
- provide a clear definition of such needs so that it is possible to define product specifications
- create a database which can be utilized also in future NPD occasions

Data can be collected with basic tools (individual interviews, focus groups, customer observation during new products use, etc.) and by hearing the point of view of different stakeholders who can provide additional information helpful in better defining new product solutions and specifics. Managers can interview lead users, retailers, service centers, heavy users.

After data collection is completed, data analysis phase starts. During this phase the goal is to understand the characteristics which the new product must include in order to better satisfy customer needs. Since a product may often include too many attributes, it is then necessary to define a priority scale aimed at selecting those product attributes which must to be included in the new product and those which are not necessary. The prioritization is based on the experience of the managers involved in the process but it can also be realized using management tools like the Quality Function Deployment model, the Service Quality Model (Zeitmal et al., 1989).

The first output of customer needs identification step is represented by a clear definition of target market expectations and needs.

These outputs are used to implement the competitive products analyses. This activity is very helpful in understanding the solutions adopted by other firms for satisfying similar needs. These analyses can be done utilizing the benchmarking methodology.

The output of these phases represents the input of the following NPD process step: concept generation

Concept generation
The *concept* is a brief description of the product which explains how it will be able to satisfy specific customer needs. The concept description is usually accompanied by hand designed sketches.
The *concept generation* is a fundamental phase of the NPD process since most of the characteristics of the product will be selected in this phase: the extent to which the future product will be able to satisfy customer needs mostly depends on the quality of the *concept*.

Concept generation is one of the fastest and less expensive phases of the NPD process. It usually costs around 5% of the NPD budget and it uses approximately 15% of the time allocated to the entire process. In spite of its low cost, concept generation step requires a rigorous discipline in its development. Any choice made in this step will bind up the entire NPD process because it represents the core of its strategic relevance.
The concept generation phase is based on the following inputs:

- mission statement
- list of customers needs
- preliminary description and product specifics

The information used in this step makes evident what will be the problems related to the different product solutions (i.e. technical, manufacturing, materials problems). For solving problems it is usually helpful to fractionate complex dilemmas in little and more manageable ones. There are different methodological approaches to problem decomposition. One is represented by the functional decomposition of problems. After the definition of product functions, these are de-composed into sub-functions by the NPD team who will decide which are the most relevant sub-problems on which concentrate the solution efforts. Solutions can be found internally or out of the firm.

External research is aimed at finding solutions already experimented elsewhere with success. The implementation of external solution is generally less demanding in terms of costs and time.
Information collection from external sources can be realized by interviewing lead users, by doing literature research and by doing benchmarking against best in class.

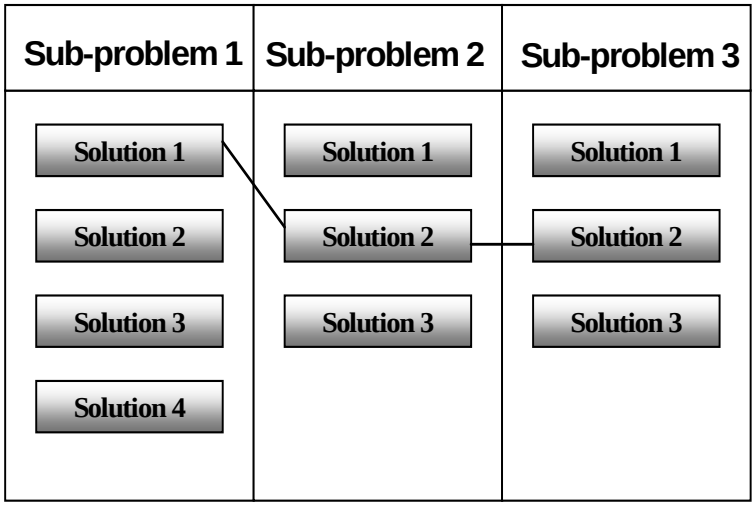
Internal research is based upon the problem solving skills of NPD team members. Traditional problem solving techniques includes brainstorming, Ishikawa diagram, process flow analysis, etc.

After research completion, the team has to combine solutions to sub-problems; support tools which can be used in this phase are the so called concept classification tree and concept combination tables.

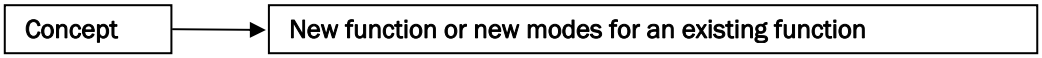
The *concept classification tree* is used to divide all the possible solutions in different and comparable branches so that it is possible to choose, among similar solutions, those ones that appear to be more effective.
The *concept combination tables* are tools that allow considering solution systemically.

The different combinations of solutions are obtained analyzing the specific sub-problems approaches as it is represented in the following table:

Table 16. Relationships between problems and solutions



The different combinations let managers understand how a product can satisfy a specific function, in this way more then one concept can be identified.



2° Step - Prototyping

Prototyping is the phase that refers to the realization of different prototypes. Simple products are often realized directly from physical prototypes made of low-cost materials (wood, plastic, metal, etc.). Physical prototyping is very helpful for highlighting difficulties that might be encountered in manufacture. For complex and costly products developers will often start with digital mock ups (modern software can simulate three dimensional designs and test the product in virtual working conditions). A digital mock up can also be transformed into a non-working physical mock up. Working prototypes are usually the final step before the final decision to produce. The objective of prototyping is to measure the degree of correspondence between product concept and customer needs, and the high volume manufacturability of the concept.

Product design phase refers to the aesthetic appearance of the product. It is a creative activity. The goal of product design is to reach a compromise between design/style and functionality. The shape of a final product may be related to fashion, and to practicality of manufacture.

Concept selection is where managers decide on which concept best satisfies customer needs. The concept selection step enables the strengths and the weaknesses of the different concepts developed to be compared, and for up to three concepts to be studied in detail. Concept selection is an iterative process which usually does not lead to a dominant design, but produces a limited number of solutions.

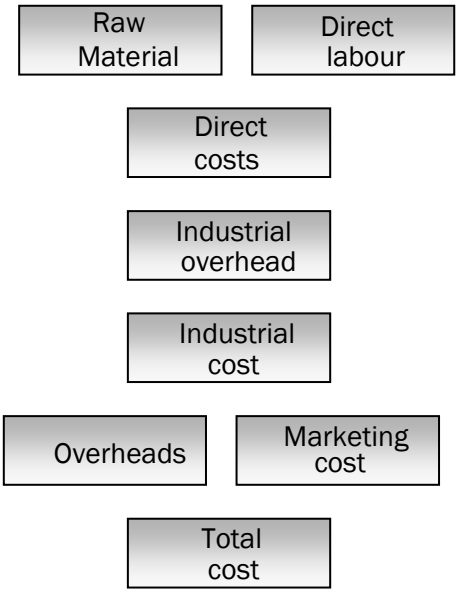
Decision matrixes are often used for the selection of concepts. These tools try to combine customer needs with product manufacturability. Concept selection criteria are decided by NPD team members, who use concept screening matrixes and concept scoring matrixes to filter out the various options.

Manufacturability
Many of the problems that emerge in production are related to the difficulties in understanding

the real life problems of making a new product. In this phase, whenever possible, dedicated pilot production shops should work on testing and problem solving prior to production ramp up. The manufacturability phase should be used to correct design and materials problems that will only emerge in shop floor testing.

Cost analysis
The previous phases will provide the information required to make reliable cost estimates. Cost analyses can be conducted by comparing the costs of the new product with existing ones based on information gathered or held by the firm.

Figure 10 - Cost structure



3° Step - Product launch

The final step in new product development leads to the introduction of the product on the market. This step involves:

- Engineering
- Marketing strategy
- Business strategy.

Engineering refers to the development of the production line for the new artefact. In the NPD process, the engineering phase involves design of the new industrial system, and highlights any potential problems related to a new product including:

- manufacturability - definition of the best combination of appealing design, ease of production, and low-cost raw materials

- integration among product designers, process designers and operations managers in order to understand problems that potentially could emerge in the new design and when production is ramped up. The engineering phase should enable coordination of input from various experts, reduce friction among the functional areas involved in NPD, and facilitate good communication

- value analysis – detailed analysis to establish any characteristics of the new product that do not add value in terms of satisfying customer needs. These areas represent ways of reducing processing and production costs.

Marketing strategy
As we have seen, Step 3 is important to establish the market position of the new product. The strategic positioning of the new product can be identified by use of positioning matrixes. To define market position certain factors must be considered including price, quality, market segments, distribution channels, and level of service.

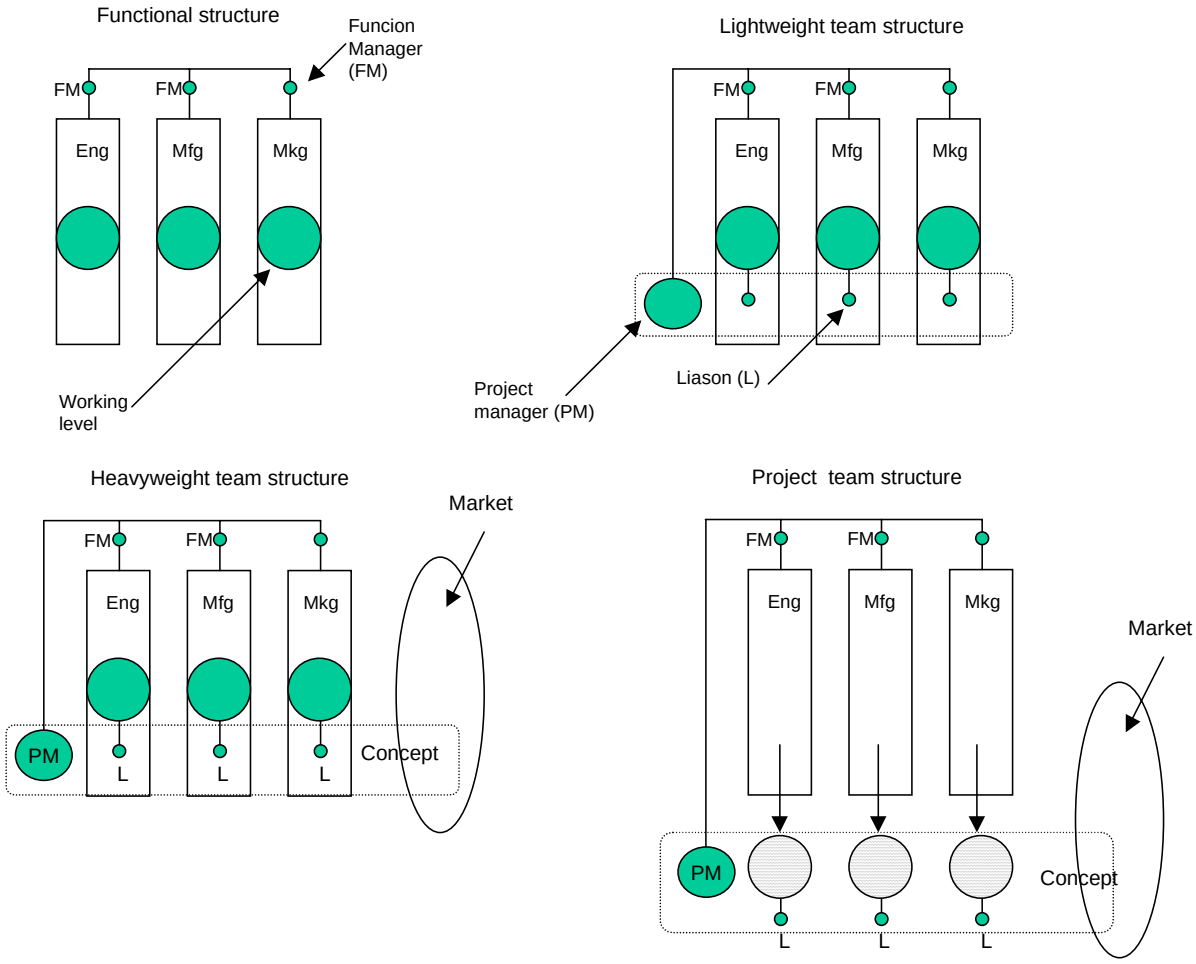
Comparisons must be made with competitors in order to identify the position of the new product in the market and to maximize firm performance. In addition, it is necessary to define in detail the marketing mix, price, distribution channels, promotional budgets and product versions.

7. Characteristics of Different Organisational Structures

Organizational structure of innovation
The success of the development process depends not only on the effectiveness of the NPD approach, but also on the organization of the process itself. Below we describe some of the organizational structures that could be adopted.

Project organization
Increasing competition, the need to overcome functional barriers and achieve high performance product development, the speed with which some products and markets change require team work devoted to resolving problems as soon as they appear, to team learning and to enabling roles to be exchanged. The diffusion of team working in project organization has dramatically increased and created the conditions for the functional organization to change. However, not all organizations that call themselves project teams work as teams.

Abernathy and Clark identified four dominant team structures for conducting project activities. Each structure is dependent on the project leader (see also Wheelwright and Clark, 1992).
Figure 11. Different organisational structures



Functional teams
The functional organization is the traditional structure of research centres in large organizations. Its main characteristic is that its resources are specialized in the same field of research. This type of organization reproduces the organizational model based on clear separation of different scientific disciplines, often adopted by universities and research institutions (Sobrero, 1999). For example, in the Polytechnic of Milan (Sobrero, 1999) there are applied chemistry, chemical engineering, industrial design, and operations management departments, among others. Each department is an organizational unit focusing on a specific

research area to achieve increased specialization.

This structure has several advantages:

- the resources have the same culture and profile, which facilitates easy and effective communication
- the high level of specialization of resources guarantees front line innovations and is the basis for in depth research
- the concentration of similar expertise enables critical mass, which, in turn, enables efficient coverage of a specific discipline
- it is particularly effective for coping with research issues that require highly specialized competencies
- it favours the accumulation and stratification of knowledge which endows the research team with huge credibility and motivation.

However, it also has some weaknesses:

- the functional approach does not foster inter-departmental communication. When an innovation requires the involvement of different organizational units, it is difficult to coordinate people from different cultures
- when involvement of other functional units is required, the perceptions of the relevance of the project may be asymmetric and may reduce the level of support provided. Where another function is required to make only a small input to an innovative project, this can be seen as low priority, which might slow the entire development process
- functional organization is not very flexible, which makes adaptations to cope with changes to programmes more difficult. The highly focused nature of each functional unit makes it 'function centric' and less able to accept changes to roles or involvement
- separation of functions is not conducive to timely and effective problem solving. Resolution of problems may have to involve several functions all used to working in a particular way
- increased product diversification makes coordination among different research areas more complex. Complexity is higher for highly differentiated products in which overlaps in research areas are limited.

Lightweight teams

In this structure, as in the functional organization, team innovation members mainly work within their original function and report to the functional manager (the senior manager). Team members may be assigned temporarily to innovation teams by their functional manager, which might coordinate interdepartmental activities. Team members are usually middle or junior managers with low levels of credibility, leadership and organizational experience. Their assignment to product development teams is an opportunity for them to obtain experience and acquire an interdepartmental view.

The strengths of this type of organization are generally the same as in the basic functional organization with the addition that in the lightweight project team structure there is someone responsible for the coordination of the innovation effort, who pushes for timely execution of tasks and is responsible for interdepartmental communication.

The weakness of this type of structure is that the project manager (the manager in charge of the one project) has little negotiating power or credibility in the firm. That is, such a structure is weak and usually does not lead to significant results.

Heavyweight team structure

The heavyweight team structure is another variation of the traditional functional organization. In this case, however, temporary development teams are given responsibility for and control over specific development activities. Team members are usually located in the same office and work together until the project is completed.

Their assignment to the development team is only temporary and does not count for much in terms of their career development because they are not part of the innovation area staff.

This type of structure is considered heavyweight because:

- Project managers have direct control over innovation team resources and temporary assignments are still directly responsible to the project manager for the duration of the task;
- The team manager is a senior manager with long experience and good credibility, who is able to guide team members and interact with functional managers.
-

The advantages of this structure are linked to the power given by top management to the team and to the high quality of the project manager and his assistants.

Project organization

The fourth form of organization is the pure project structure – the so called tiger team (Hayes et al., 1988) – where representatives from different functions are "formally assigned and dedicated to the project team" and located in the same office.

The team manager (the principal or functional manager) within the project organization is a '"heavyweight in the organization and has full control over the resources contributed by the different functional groups" (Wheelwright et al., 1992). The project manager controls his development team and takes full responsibility for their results.

The project organization has complete autonomy for the management of the project. It does not have to follow established functional practices and procedures, but can devise its own in relation to budget, reward system and career development.

The strengths of project organization are linked to the high level of autonomy of the team and its focus. The team and its efforts are all concentrated on a specific task, which enables rapid recognition of problems and their effective resolution. Inter-functional integration is very efficient because team managers can freely select and 'hire' individuals from different functional areas.

The disadvantages of project structure are also related to its autonomy. It is possible that time is spent solving problems that have been resolved elsewhere in the organization. Also team members may find it difficult to integrate into their original functional areas when the project finishes. Project teams often become the basis for a new business unit.

Table 17. Characteristics of different organizational structures

	Functional organization	Lightweight organization	Heavyweight organization	Project organization
STRENGHTS	• Fosters development and deep specialization and expertise	• Coordination and administration of projects is explicitly assigned to a single project manager • Maintains development of specialization and expertise	• Provides integration and speed benefits of the project organization • Some of the specialization of a functional organization is retained	• Resources can be called optimally within the project team • Technical and market trade-offs can be evaluated quickly
WEAKNESSES	• Coordination among different functional groups can be slow and bureaucratic	• Requires more managers and administrators than a non-matrix organization	• Requires more managers and administrators than a non-matrix organization	• Individuals may have difficulty maintaining "cutting edge" functional capabilities
TYPICAL EXAMPLES	• Customization development – firms in which development involves slight variations to a standard design (e.g. custom motors, bearings, packaging)	• Traditional automobile, electronics, and aerospace companies	• Many recently successful projects in automobile, electronics and aerospace companies	• Start-up companies • Tiger teams and "skunkworks" intended to achieve breakthroughs • Firms competing in extremely dynamic markets
MAJOR ISSUES	• How to integrate different functions to achieve common goals 1995	• How to balance functions and projects • How to evaluate simultaneously projects and functional performance	• How to balance functions and projects • How to evaluate simultaneously projects and functional performance	• How to maintain functional specialization over product generations • How to share technical learning from one project to another

7. Managing Technology Transfer

7.1 Introduction

We have analysed the process that starts with corporate strategy and leads to identification of technology needs, and discussed the make or buy alternatives. In this Section we examine the process of acquiring technology externally, often described as technology transfer (TT).

TT management is too extensive to cover in a single Section of a TM course. We focus on those aspects of TT that are more relevant to developing and transition economies. Here we adopt a 'zooming in' approach, going from the broad picture and focusing down on the more specific aspects.

Then, this Section reflects the macro to micro dynamic perspective. We start with a general view of TT and its implications for economic development. We then explore various modes of TT, focusing on 'intentional transfer'. We try to answer the question of why companies would want to transfer technology and which modes of transfer are most common. We concentrate on the most explicit form of intentional TT, i.e. licensing, and analyse the particularities of the technology market. We adopt the position of licensee, focusing on the main steps in the licensing process. We briefly examine the licensor's perspective because some developing or transition economy country companies may have technology that is sufficiently developed to be licensed out. Also this insight may be useful to potential licensees when negotiating licensing agreements.

TT: implications for developing countries

In developing countries, economic development means the growth of real per capita national income coupled with fundamental changes in the structure of their economies and the important social and political transformations that these changes produce. The dynamics of economic development in any country depend directly on the amount of resources available, the quality and productivity of resources, the extent to which they are exploited, and their growth in quantitative and qualitative terms.

Resources cannot be envisaged as given. They are developed through a cumulative process that relies on the skills, commitment and ingenuity of individuals. As Schumpeter (1982) put it, "development consists primarily in employing existing human resources in a different way, in doing new things with them, irrespective of whether these resources increase or not".

Technology Transfer is one means of pursuing technological innovation. Imported technology can directly affect the economic development of the recipient country in three partly interrelated ways:

- TT may increase the physical stock of productive factors (resources) available. Such factors include expatriate personnel rendering technical services or holding key managerial posts in local companies, imported machinery and equipment, imported raw materials, components and parts not available in the host country and accompanying TT contracts. The increase may be short-term (e.g. through temporary employment of foreign experts) or long-term.

- Foreign technology can contribute by exploiting existing resources, e.g. it may generate job opportunities for the previously unemployed, decrease idle capacity in some sectors of the economy, extend arable land for new crops. This could include cases where TT enables employment of local resources that were unexploited due to the weakness in indigenous entrepreneurship or limited technical capabilities.

- Transfer of foreign technology may result in substantial growth in the productivity of existing factors (labour, capital and natural resources, including land) by (a) increasing the volume of outputs for the same amount of inputs, or (b) decreasing the volume of inputs for the same volume of outputs . The challenge is not just to increase

productivity or utilize technology in the short term, but to bring about long-term technological change and updates without which the gap between technology importer and the world technology frontier will increase rather than narrow. The imported technology must be used to generate technological change at an internationally competitive rate.

Foreign technology has been a major contributor to the industrial capabilities of most, if not all, newly industrializing economies (NIEs). Evidence shows that NIE firms have exploited foreign investments, technology and marketing channels to their advantage, gradually assimilating and adapting imported know-how and developing the skills needed to compete internationally. Foreign direct investments (FDI), joint ventures, licensing agreements, subcontracting and similar arrangements are instrumental to industrial success in NIEs. Technology imports are used by NIEs to a large extent as learning devices and as leverage for further innovation.

Technology Transfer, if it is used as a learning device and interacts effectively with domestic technological efforts, may play a similar role in enhancing the economic development of developing countries by improving the competitiveness of firms in international markets.

Modes of TT

Technology crosses national and organizational boundaries through a variety of channels, both formal and informal. A firm seeking to exploit its technological advantage abroad can choose among: (i) exporting products from its home base; (ii) selling production know-how to foreign firms; or (iii) investing in production facilities abroad. Firms seeking to acquire innovations from abroad face similar choices of importing goods or technology, or attracting investment. The decisions made will depend on the characteristics of the technology, the firm's competitive strategy, the global environment (including government policies), and the capabilities of foreign firms. We describe some features of the ways that technology crosses borders and indicate some of the motivations for TT from the points of view of participating firms.

Transfer of technology can be classified according to whether or not the technology supplier intends the transfer to take place; i.e. whether TT takes the form of a commercial or a non-commercial transaction. Unintentional transfers usually do not yield profit to the innovator and may adversely affect its business. Intentional transfers are usually part of a competitive strategy and generally provide a return to the supplier.

Unintentional transfer

Technology often crosses international borders without any deliberate actions on the part of firms and governments. Ideas for new products and processes spread internationally through the scientific and technical literature, conferences and personal communication among researchers worldwide. Technical know-how and practices that are not easily described in print or communicated explicitly are often transferred through hiring-in foreign engineers and managers, training in universities abroad, and recruiting local engineers trained in foreign companies. These channels can also be used in intentional transfers.

Another form of transfer that is more or less outside the control of the supplier firms is reverse engineering. In this process, which is common in the electronics industry, the recipient firm buys the innovator's product on the market, takes it apart in order to find how it is made and designs a copy that it can manufacture. The original innovative firm does not actively promote the transfer; and the copying firm usually has to devote considerable effort to producing a replica. Some types of technologies, such as chemical processes, however, are hard to reverse engineer.

Innovating firms often try to guard against unintentional transfers of technology by patenting their products or keeping key ingredients and manufacturing processes secret. But not all technological ideas can be patented and even when they are, international enforcement of patents may be difficult. Furthermore, the patent application, which is easily available, provides details of the innovation. Firms therefore retain some technologies in house as trade

secrets; their transfer would involve industrial espionage.

7.2. Intentional transfers

The main forms of commercial TT in developing countries are via:

1. Trade in capital goods
2. FDI
3. Joint ventures
4. Licensing
5. Franchising
6. Management contracts
7. Technical services contracts
8. Turnkey contracts
9. International subcontracting

There is some degree of overlap among these categories and a single transaction may include more than one form of TT.

The literature makes another distinction among the various forms of intentional TT in terms of 'internalized' and 'externalized' modes. The former involve continuing direct ownership, control and use of the technological assets within the context of the transnational corporation's (TNC) foreign production operations; the latter do not. Broadly speaking, FDI and joint ventures fall into the first category (depending on the degree of control over technology, which does not necessarily correspond to the share of equity). All other forms are in the second category. A working definition of each of these forms is provided below.

Trade in capital goods

Capital goods imports are regarded as a form of TT, in so far as they imply the absorption of the know-how incorporated within them. This absorption does not need to include the capacity to imitate them. An understanding of the structural linkages of the new technology with the other components in the product or process system is undoubtedly relevant to technological development. Improvement of the system of which the acquired technology constitutes an input or component, would be tangible evidence of such development. The acquisition of a particular technology in the form of a capital good may be problematic in situations of monopoly of supply, or when scarce complementary assets or specific technical skills are required for its implementation.

Foreign Direct Investment (FDI)

FDI is the establishment by a TNC of an affiliate abroad through the acquisition of an existing enterprise or the organization of a new one. The parent company is assumed to exercise effective control over the subsidiary through whole or majority ownership, or even minority equity participation through special arrangements. The technology is provided as part of a package that could include capital goods, intellectual property rights or secret know-how. Because of the effective control of the parent company the inclusion of FDI as a form of TT is questionable. However, there are potential externalities in FDI, such as turnover of trained and experienced personnel, stimulation of local technological activities or training of local suppliers. For this reason the establishment, in particular, of R&D facilities is especially welcomed by developing countries. The factors determining FDI are: the size of the local markets and the degree of adaptation/customization that would be required; the local science infrastructure and availability of qualified personnel; the degree of appropriateness of the technology and the potential spillovers; the policies and regulation in of the host-country (some of the drugs introduced onto Western markets by Western companies were developed and tested abroad to avoid the strict regulations imposed by of Western drug administrations).

Joint ventures

Within a joint-venture agreement the technology proprietor agrees to share with one or more

local private or state-owned enterprises the equity capital, investment risk, control, and profits of the operation. The elements of the technology provided by TNCs under joint venture arrangements are the same as those provided under FDI. The difference between the two arrangements is that because control and benefits are shared, the nature and quality of the technology supplied is more explicitly defined, in the form of contractual arrangements.

Licensing
Through a licensing agreement the TNC confers on the local company the rights to use certain intellectual property, such as patents, trade marks, copyrights, etc. which usually includes the transfer of the know-how required for its exploitation. In return the TNC receives payments, which can be in the form of a fixed fee, royalties, share of profits, equity representing the capitalization of technology, or counter-trade whereby the payment takes the form of merchandise (it is estimated that 30% of world trade involves this form of compensation). In order to protect the technology from undesired spillovers and capitalize on the monopoly granted by the proprietary rights, licensors usually impose restrictive clauses on the use of the actual technology. We discuss this in more detail in the section on the determinants and costs of TT. The expression 'selling technology' is often used in the context of licensing agreements; this is an inaccurate description because what is sold is the right to the future returns from the use of the technology, not the technology itself.

Franchising
Franchising is a type of licensing agreement in which the TNC provides rights that usually include the use of a trade mark or brand name, together with technical assistance services, training, etc. in return for certain payments.

Management contracts
Through management contracts TNCs can retain operational control of local enterprises, or a function of their activities, generally exercised through the actions of a board of directors elected by their owners, in return for a fee. TT in this case takes the form of managerial skills and know-how, through responsibility for the technical and engineering aspects of production.

Technical service contracts
Under a technical service contract the TNC agrees to provide technical services associated with one particular aspect of the local firm's operations, in return for a fee. Examples of these are maintenance and repair of machinery, or advice on process know-how and quality control. The service and the TT are provided by an individual(s)

Turnkey contracts
In a turnkey contract the TNC undertakes responsibility for the development of a productive system. It provides an integrated package of the assets and services required to make the new productive unit operative. These services range from feasibility study and design of the project to provision of technology and know-how, and plant construction. Responsibility ends when the plant is fully operative. Marketing contracts can integrate turnkey contracts to help the local company market the product, especially in the initial phase. Turnkey contracts provide for a complete once for all physical transfer of technology as a package. They are common in cases where the foreign company does not have an ongoing interest in the management of operations, as in the case of engineering firms, or when other forms of investment are not possible or do not appear profitable.

International subcontracting
In this arrangement, the TNC places orders with a local enterprise for components or assembles finished products, using inputs and technology supplied by the TNC. The technology provided consists of specifications, production know-how and sometimes equipment. This form of productive decentralization, especially of the more labour-intensive phases of production, became more frequent in the second half of the 1960s, supported by policies and incentives in the recipient's and sometimes the TNC's home countries.

7.3. Determinants of TT

Foreign investment in developing countries and the form of this investment in the context of TT are determined by the dynamic interaction of a number of factors rather than their individual impacts. Among the exogenous determinants are: inter-firm competition and industry structure; attractiveness of the market; stage of life of the technology; and host- and home-government policies. Among the endogenous determinants are: culture, history and strategy of the Trans-National Corporations (TNC); level of technical sophistication of the local firm. We analyse how these factors interact to influence TNCs' decisions as to one type of investment and TT, rather than another.

Many firms prefer to produce and export from their home countries, with TT limited to the technology embodied in their product, and the training and technical assistance associated with its supply. Export is usually the first stage in a firm's internationalization process, and is likely to be followed by later more intensive involvement. The determinants of firms' abilities and willingness to service foreign markets via production abroad rather than via exports have been studied by several scholars. Caves (1982) refers to these determinants as "intangible assets" which arise when, for various reasons, markets for the sale of the services of these assets do not or cannot exist, and the firm tries to internalize these markets through FDI. Dunning (1981) refers to the interaction of two sets of variables in affecting the degree of foreign involvement of TNCs: the "location-specific" advantages of different countries and the "ownership-specific" advantages of different corporations.

In most cases, technology is the major component of Caves' intangible assets and one of the main sources of Dunning's ownership-specific advantages. The advantages related to technology are of two types: those intrinsic to the technology itself, such as ownership of intellectual property rights, secret know-how, or product and process differentiation; and those extrinsic to the technology, which are revealed through synergies with other elements of the organization, such as economies of scale and scope, vertical and horizontal integration, or opportunities to internalize capital markets. The main difference between the two types of advantages is that the technology-intrinsic ones are marketable while the synergistic ones, because they are firm-specific, are not.

With all other factors constant it is possible to predict the form of foreign involvement of a TNC in developing countries by assessing the interplay of the advantages previously defined. 'Internalized' modes of investment will be more likely when there is a preponderance of 'internalization' advantages, i.e. when there are synergistic advantages from using technology within the context of the firm's global operations; when the regime of technology appropriability is weak and the risks of spillovers are high; or when there are difficulties, intrinsic to the potential recipients, in the transfer and absorption of the technological assets. In the first case, the synergistic advantages of internalized use are significant; in the latter two, the transaction costs of 'externalized' forms of TT are too high. Conversely, externalized modes are more likely when the synergistic advantages are less relevant and the degree of appropriability of technology is strong.

The willingness of a TNC to transfer technology depends on the expected returns from the transfer and the opportunity costs. The decision to use internalized or externalized modes is the result of an analysis of the relative benefits and costs of the alternatives. This analysis is complicated in terms of the number of variables to be considered and the uncertainty related to them. The alternatives also have to be evaluated against their strategic implications in terms of competitors' reactions.

In the 1970s, externalized modes of TT became more popular than traditional FDI (Oman, 1984). A number of developments which affect the relative costs and benefits of externalized versus internalized forms of TT might account for this trend.

First, the changing international division of risks and responsibility reflects a tendency for some TNCs to modify their views on the advantages and disadvantages of FDI over externalized modes of investment. The latter reduce the exposure to commercial and political risks and require lower capital involvement as start-up costs are absorbed by the local entity.

Second, on the demand side, the low real interest rates in the first half of the 1970s and the expansion in international banking made it easier for developing countries to pursue strategies of debt-financed growth, and overcome the barriers to accessing capital for technological self-reliance. The consequent restrictive and discriminatory policies limiting FDI and favouring indigenous companies very often leave TNCs with little alternative but to adopt externalized modes of investment.

Third, the increasing competition in international industries brought new entrants to the market. Those that followed an offensive strategy were more willing than the incumbents to concede to the host government's requests for shared ownership and greater access to technology in return for preferred access to markets from which they were otherwise precluded. Those that followed a defensive strategy preferred forms other than FDI in order that their managerial skills and financial resources should not be further diluted by the increased pressures from competition to invest in numerous markets. In either case the result was a preference for externalized forms of foreign investment. The repercussions for the strategies of incumbents further enhanced this phenomenon. The best option for TNCs was not to concede, but rather to maintain direct control over technology, as long as the newcomers did the same. These new entrants, in most cases could not find any other way to enter foreign markets than by sharing technology, which meant it was better for the incumbents to follow suit in the interests of damage limitation.

Fourth, the advent on the international scene of Japanese produces introduced smaller corporations and a different operating philosophy. Smaller firms generally have advantages that are less synergistic and firm specific, and therefore more marketable. Kojima and Ozava (1985) report the phenomenon of "industrial restructuring" in Japan where the government (Ministry of International Trade and Industry - MITI) - either because of changing comparative advantage or for environmental reasons - joined forces with firms and large trading companies to transfer entire industries or industry segments to developing countries using externalized forms of investment.

Fifth, as technologies diffuse and products mature and become increasingly price competitive; TNCs will begin to use licensing as part of a divestment strategy. As a company perceives its control over a particular technology to be fading, it may decide to license it and invest the returns in new, higher return activities. The rapid pace of technology development in many industries and the increased pervasiveness of technology across industries have contributed to shortening the life cycles of products and made the phenomenon more relevant.

Finally, the bargaining power of many developing country governments has increased because of their accumulated experience in negotiation and the development of local technical infrastructures that enable the selection and absorption of foreign technology.

Acquiring technology through a commercial transaction

Here, the focus is particularly on licensing. We start with an analysis of the technology market to highlight the main differences between the markets for goods and services.

Nature of the technology market

The properties of the international market for technology derive to a substantial degree from the nature of the commodity being traded, i.e. technical knowledge. Technical knowledge may be more or less difficult to assimilate. At one extreme is 'public' knowledge, i.e. knowledge that flows freely among potential users. At the other is 'tacit' knowledge, i.e. non-explicit knowledge, which is embedded in the people or organizations that own it, and cannot be teased out from the tangible forms in which it is incorporated. Compared to other goods,

technical knowledge has some distinctive features. It is:

- intangible
- cumulative
- not consumable
- easily transmitted if public
- transnational if public

The peculiar nature of technology stems from the fact that, unlike material goods, it constitutes an intellectual commodity. Its essence is information which enables the production process. Whereas the physical content and structure largely determine the utility of material goods, the utility of technology is an ever-increasing knowledge base that enables the production of a continuous stream of new products and services.

The process of generating technical knowledge differs substantially from the process of producing material commodities. It is cumulative in character, which means that the present stock and level of technologies result directly from the scientific and technical developments of earlier generations. In other words, the 'production' of technical knowledge has been made possible by the creation and accumulation of resources that are not consumable, either now or in the past. The cumulativeness of technology means that it is sometimes difficult to directly link a discovery that extends our understanding of the surrounding world with the material innovation that derives from the general idea. This contrasts with the manufacturing process where we can easily identify the origin and components of material products.

Technology as a production factor does not wear out physically. However, because technical knowledge accumulates continuously, existing technology becomes obsolete and is replaced regularly. In other words, technical knowledge wears out only economically, whereas material goods wear out both physically and economically. That technical knowledge is not physically consumable highlights one other feature of this commodity that is particularly important from the perspective of its market value: a given technology can be sold and used a virtually unlimited number of times without its substance diminishing. Depending on the number of transactions, sales revenues may be many times greater than the costs of technology 'production'. In other words, the elasticity of supply of technical knowledge is, in the short term, close to infinity, which is not the case for any other commodity.

The ever-growing scale and rate of technology dissemination outside national boundaries stems from the ease with which it is transmitted. Owing to the rapid development of telecommunications and computer communication networks, technology has become even more mobile. As a result, the lag-time between discovery or technical development and worldwide dissemination of relevant information has shortened dramatically. Indeed, the flow of information around the world today is so much faster, cheaper and easier, that many refer to the world as 'the global village'.

The cumulative process of technical knowledge generation is transnational and global in nature. Technology flows around the world through many channels. Almost any technology is available to almost any firm with the money and skills to use it. Ideas developed in one place can be appropriated and developed by people in other places. This dynamic process involves both proprietary and non-proprietary technical knowledge. Despite the differing degrees of access to them in the short-term (non-proprietary knowledge flows freely between countries whereas proprietary knowledge is strongly protected), in the long-term technology is diffused on an international scale, either when it is sold or when competitors develop similar innovations or introduce improved versions.

These are the advantages; in the context of proprietary technology there are disadvantages. The market for technology is characterized by asymmetric information. The technology proprietor has a more detailed knowledge of the technology than the potential licensee. Because of secrecy and proprietary protection, the market frequently approximates a monopoly or an oligopoly, making the price of technology higher than in a competitive market.

Also, because technology is transferred under terms that are the outcome of negotiations between buyers and sellers, the final returns and their distribution largely depend upon the relative powers of the negotiating parties, which is generally unfavourable to developing countries. Finally, the limited development of local capital markets and limited availability of foreign currency are additional obstacles to TT.

7.4. Protection of technology

Acquiring technology through licensing should more correctly be defined as acquiring a particular right associated to a technology.

The extent to which an innovator can capture the profits from an innovation depends on the appropriability regime. The tighter the appropriability regime, the better for the innovator. The most important dimensions of such a regime are the nature of the technology and the efficacy of the legal protection mechanisms. The extent to which knowledge is tacit or codified also affects the ease of imitation. Codified knowledge is easier to transmit and receive and is more exposed to industrial espionage. Tacit knowledge, by definition, is difficult to articulate; its transfer requires that the individual with the know-how demonstrates it to someone else. We will discuss the main forms of intellectual property protection available: patents, utility models, trade-marks, copyright and trade secrets.

Patents

A patent is a document issued upon application, by a government or regional office acting for several countries. The document describes the invention and creates a situation under which it may be legally exploited (manufactured, used, sold or even imported) with the authorization of the title-holder. The protection provided by a patent is limited to around 20 years depending on the product, technology and regime.

For an invention to be patentable it must:

- be novel
- involve an inventive step, i.e. not be obvious
- be industrially applicable.

An invention is novel if it has not become state-of-the-art, the latter being defined as everything that has been publicly disclosed prior to the patent application. An inventive step means that, given the prior art, the invention must not be obvious to anyone with ordinary skills in the art. In other words, it must not be possible for the average specialist to make the invention through routine exercise of his or her standard skills. Industrial application is understood in the broad sense to include application in manufacturing and agriculture, services, handicrafts, etc.

For inventions in the form of products most laws acknowledge exclusive rights with regard to:

- making the product
- using the product
- selling the product.

For inventions contained in processes protection is granted with respect to the following acts:

- making the product directly obtained through the process
- using the product directly obtained through the process
- selling the product directly obtained through the process.

In some countries there are three exceptions to the exclusivity of the patentee’s rights:

- public interest
- scientific research
- prior use in manufacture.

In these cases a patented invention may be exploited without the patentee's authorization by

or on behalf of a government when the public interest justifies it or when, on the basis of a compulsory licence, the title-holder has failed to exploit the invention within the period of time specified by law. Another exception is when the patented product is to be made or used for the sole purpose of scientific research and experimentation. The third exception applies if an entity or person, other than the applicant, has begun to make or use a product or process before the patent is filed.

Patents are granted after the application has undergone a formal procedure governed by a set of legal provisions. The most important condition is that the invention is clearly and fully described so that persons with ordinary skills in the art involved are able to use the invention. A significant number of countries publish applications 18 months after their filing. Publication means offering copies for sale on the market.

Utility models

The main difference between utility models and patents is that the technological progress required for the first is less than the technological progress (inventive step) required for patents. Utility models are mainly used in the mechanical field. Examples of utility models are plastic boxes for storing photographic slides, folding chairs, etc.

The scope of protection conferred by utility models is similar to that conferred by patents, but the maximum term of protection provided is normally much shorter than for a patented invention, i.e. 5, 8 or 10 years.

Trademarks

A trademark is a sign that is used or intended to be used by a manufacturer, producer or trader to distinguish its products or services from those of others. A mark may consist of any of the following elements:

- fanciful denominations: Kodak, Coca-Cola, Pepsi
- arbitrary denominations: Blaupunkt, Camel
- surnames: Ford, Benetton
- numbers: Chanel 5
- letters: RCA, BMW
- emblems: the Mercedes Benz star
- images or symbols: the Lacoste crocodile
- combinations or arrangements of colours: the red spot on the heel of Kickers' shoes
- characteristic shapes: the Coca-Cola bottle
- slogans.

The exclusive right to use a trademark is typically acquired by registration. In some countries the exclusive right is attained by first use. The duration provided for in national laws is usually 10 years.

Copyright

Copyright law protects the form of expression of ideas, not the ideas themselves. The subject-matter of copyright protection includes:

- literary works (novels, poems, dramatic works, advertisements, etc.)
- musical works (songs, choruses, operas, etc.)
- photographic works (portraits, landscapes, current affairs, etc.)
- film (television, cinema fiction, documentaries, etc.)

In general the duration of copyright is 50 years after the death of the author, with the exception of movies which is 50 years from the first showing, and photographs, where it is 25 years.

Protection is independent of the quality of the work or the value attached to it or even of the purpose for which it is intended. The acts requiring authorization of the copyright ownership are usually spelt out in copyright laws. They are:

- The right of reproduction
- The right of public performance
- The right of broadcasting and communication to the public
- Translation and adaptation rights.

Under particular circumstances defined by national copyright law, certain uses prohibited by copyright may be enacted without the authorization from the copyright owner. This is usually referred to as fair use. In several countries fair use includes:

- reproduction of a work exclusively for the personal or private use of the person who makes the reproduction
- quoting from a work protected by copyright, provided that the source is acknowledged.

Trade secrets

There are secrets in every business and technological field that people want to protect from misappropriation by others. Technical and commercial secrets include information that may influence the commercial results of an enterprise, that is neither well-known nor in the public domain, and that the holder does not intend to disclose because of legitimate interest.

The basic elements of a trade secret are that:

- it is information
- it is a secret, but not necessarily an absolute one
- there is an intent to keep the secret
- it has industrial application
- it has economic value

A trade secret must possess at least a modicum of originality compared to everyday knowledge. Furthermore, a substantial element of secrecy must exist such that it would be difficult to acquire the information except by improper means. Secrecy is not absolute; the business proprietor may communicate it to employees without losing any protection. However, the intention to maintain its protection must be evident, e.g. by the imposition of confidentiality on employees.

The duration of trade secrets protection depends on whether the originator wants to disclose the secret or not. If applied, trade secrets protection refers to a contractual relationship that prohibits disclosure to third parties. There may be a contractual relationship between employer and employee(s) in joint ventures, partnerships and licensing agreements.

Third-party acquisition of secret knowledge becomes actionable only if the knowledge is obtained by improper means. If a competitor independently develops another's trade secret, e.g. through reverse engineering, the trade secret owner has no right to enjoin that competitor from using the information. Therefore, companies use this form of protection when they are able to put their products before the public and still keep the underlying technology secret. This generally applies to chemical formulas and industrial processes, such as cosmetics and recipes (for instance Coca-Cola). In these cases, trade secrets are preferable to alternative forms of protection, such as patents, because the duration of the protection has no time limit.

International agreements

Worldwide intellectual property law is governed by the principle of territoriality, i.e., a nation can grant intellectual property rights only in its own territory. As trade and industry develop more complex international links and transactions, the principle of territoriality becomes an impediment to effective patent protection. This was acknowledged in the 19th century. Efforts towards international cooperation in the field resulted in various multilateral agreements.

The latest set of major basic principles that member countries must abide by is:

- National treatment - each member country must grant the same protection to nationals of the other member countries as it grants its own nationals.
- Right of priority - ensuring that if an applicant files industrial property rights in one member country the same applicant may, within a specified period of time (six months in the case of trade marks or one year in the case of patents), apply for protection in (all) the other member countries. Such applications will be considered as if they had been filed the same day as the first (or earlier) application.
- Independence of patent rules - granting or refusing a patent in one country does not bind any other member country to grant or refuse a patent for the same invention.
- Compulsory licences - acknowledging the right of each member country to take legislative measures providing for the grant of compulsory licences.
- Most-favoured-nation-clause - ensuring non-discrimination, between foreigners and nationals and among nationals from different countries.

Licensing in

We describe the main steps involved in licensing in, from establishing a technology acquisition team to formulating a licence agreement, through the intermediate phases of locating the technology, determining cost, scanning financing sources and negotiating the licence. It is important to consider the pros and cons of acquiring technology from outside and on the meaning of appropriating the technology.

A prospective licensor needs to carefully consider both the advantages and risks of licensing in technology.

Advantages of acquiring technology

The potential advantages of licensing in technology are that:

- it can be the fastest, least expensive way to increase competitiveness, expand current business, enter a new market, offer new products, or upgrade existing operations to be more cost-efficient
- it avoids the high cost of R&D, the time from product concept to commercialization, the risk of failure in the marketplace, and/or the high cost of re-design
- a licence, in addition to exclusive or non-exclusive protection, can provide technical, manufacturing and marketing assistance, training, and improvements to the licensed product, if they are included in the agreement, etc.

Risks of acquiring technology

There are a number of potential disadvantages to buying technology:

- acquiring technology from a respected industry leader does not guarantee success. The licensor must know how to transfer the technology to fit the licensee's needs, and the licensee must have the necessary personnel, capital, sales ability and overall expertise to make the technology acquisition a success
- patents can be infringed or become obsolete. Even when patents are carefully evaluated, unforeseen competition is always a risk
- the existence of a patent does not ensure technological superiority. It helps to purchase the latest generation of a given technology, one that is used by the

licensor. Improvements generated should be included in the licence to ensure the technology remains at the forefront

- licensees dependent on licensors for raw materials can be severely affected if supply is disrupted, e.g. by strikes or shortages in the licensor's country
- technology is usually purchased under a licensing agreement subject to various terms and conditions. If the relationship sours the agreement can usually be terminated but the compensatory payments may be costly
- a licensee (especially a developing country licensee) of 'secret' technology is at a disadvantage. Lack of knowledge of the technology, lack of appropriate skills and experience, and the nature of the supplier's technological monopoly makes the licensee vulnerable to extra (hidden) costs and, sometimes, to disadvantageous terms and conditions. Overpriced imported technology and other unfavourable acquisition terms may negatively affect the efficiency and profitability of both the recipient company and the economy of the country.

Acquiring appropriate technology

In discussing the advantages to the technology licensee it is assumed that the technology is 'appropriate technology'. This term emerged in the 1970s and originally referred to whether the technology satisfied the licensee's needs and conditions. Appropriateness now includes to a much wider range of considerations such as low workplace investment costs, organizational simplicity, appropriate use of natural resources and potential for new employment. A developing country chooses an appropriate technology based on its development goals, resources endowment and conditions under which the imported technology will be used. Companies need only to evaluate the technology to determine whether it meets the company's needs and whether the company has the staff, raw materials, capital and plant to enable the use of the acquired technology. Appropriateness of technology depends on objectives, situation and time in the business and technology cycle.

Establishing a technology acquisition team

The process of technology acquisition by a company requires various types of expertise - technical, legal, financial - often not available in the firm. Hiring licensing consultants is generally a good investment. Setting up a technology acquisition team is extremely important. Its members should be chosen on the basis of their functional expertise and strategic roles. Three roles are particularly important: the gatekeeper' (innately bright, verbal and curious, possesses a wide circle of contacts, is popular and does not pose a threat to anyone); the 'coach' (a relatively senior, technical person within the organization); the 'team leader'. One individual can take on more than one role.

Search, evaluate and select technology

Developing countries have traditionally been at a disadvantage in collecting, assessing and effectively using information. The internet has overcome many barriers to these tasks. There are many sources of industrial and technological information, but knowing that information exists and finding it, can be difficult. Here is a list of possible sources.

- Technical/patent literature
- Universities/research institutions
- Technical associations
- Technology/patents directories/data bases
- Contacts with other companies
- Suppliers/distributors
- Technology fairs, trade shows and exhibitions
- Trade and professional associations
- Government trade representatives
- Technology brokers/consultants

Determining the costs and conditions of acquiring technology

Determining the conditions, which may indirectly affect the costs, is necessary because it is crucial to determine financing needs and it is a prerequisite for formulating a negotiating

strategy. There are tangible costs, which include fees, royalties or other forms of compensation, and less explicit costs which are embedded in restrictive clauses in the agreement for the provision of the technology.

The most common types of compensation in licensing agreements are fixed fees, royalties - mainly a percentage of sales and, less frequently, of production, or a combination of the two. Sometimes they include equity issues, payments on an "as-used" basis, or forms of barter and counter-trade such as buy-back whereby the payment is partially or totally represented by the product of the acquired technology. If payment is only available in local currencies which may be weak or non negotiable in international currency markets or if taxes on monetary payments are very high, licensors will usually prefer non-monetary forms of compensation.

Monetary payments

Fixed fee

Fixed fees involve payment of a predetermined amount. This is advantageous to the licensee in so far as the cost of technology does not increase with increased returns from sales due to upward movements in the selling price of the product or increases in the demand for the product. However, given this predetermined level of compensation, it may be difficult to keep the licensor engaged in the success of the project leaving the licensee with the risk that the technology purchased and the good produced will perform well in the market. The licensee can get partial protection by obtaining an ‘adequate performance guarantee’ from the licensor, thus ensuring continued interest in a smooth running manufacturing process.

Royalty payments

Royalties as a form of compensation make it imperative that the licensor shares the risk of the project with the licensee. The licensor will likely provide all possible help to the licensee (both in manufacturing and marketing the product) in order to maximize the royalty. Royalty payments also provide an incentive to the licensor to create monopolistic or oligopolistic market conditions. It may apply intellectual property rights and restrictive trade practices to promote its interests. Another feature of royalty payments as a mode of compensation is that the amount payable increases as sales of the product increase due to increases in the size of the market or in the selling price per unit. This increases the licensor’s income without any further contribution to the enterprise, but also increases the cost of the technology for the licensee.

Royalties can range from 2% to 5% or 6% and in rare cases to 10% or 15%. Royalty scales by sector are available, but should be used only for reference; every payment agreement should be based on the current arrangement.

Pricing strategies

Where market prospects are good and the licensee is capable, licensor’s will normally prefer royalty payments. Taxes on royalties are usually not high, and it should be possible to monitor production easily and relatively cheaply. In order to hedge against the risks of a downturn in the market the licensor may require a minimum royalty rate, to be paid regardless of the licensee’s production/sales, and an additional rate to be paid in the case of production above a predetermined threshold.

If the market for the product is uncertain, limited or competitive in character; if confidence in the licensee's technical and marketing capabilities is low or the costs of monitoring its production are too high, the licensor will prefer a fixed fee arrangement rather than a royalty. The licensee will prefer a royalty to a fixed fee if the project requires continuous technical assistance/cooperation from the licensor.

In a typical bargaining model, the licensor has a minimum (floor) price constituted by the direct costs and the opportunity costs (such as loss of marketing opportunity) affecting the TT. The local firm in the developing country has a maximum (ceiling) price that it is willing to pay, which can be equivalent to (a) the cost of developing the technology on its own, (b) the cost of

obtaining the technology from an alternative supplier, or (c) the incremental returns (or cost savings) to be derived from using the technology, whichever is the lowest. The actual price will be somewhere between the licensor's minimum and the licensee's ceiling price and will depend on the bargaining powers of the two parties.

Restrictive clauses

In the licences for patents only, patents plus know-how, or patents as part of an entire investment package, licensors usually insist on the inclusion of certain restrictive clauses which affect the exploitation of their technologies. Licensors try to retain their monopolistic supplier position by limiting the actual transfer, assimilation and use of the know-how supplied, and preventing external spillovers which could reduce the value of their technology and their competitive edge; they try to extract as much monopoly rent as possible. There are several examples of such clauses

a) Grant Back Clause. This obliges the licensee to grant to the licensor the rights to the use improvements, variations or other innovations that are developed by the licensee in the process of utilizing the technology. This clause may be mutual, where there is a reciprocal exchange of improvements or absolute, as described above. In its absolute form it seems unfair; it is wrong for the inventor to demand an exclusive right to improvements based on its work, which was an improvement or an invention based on the work of others.

b) Export Prohibition. This clause restricts production and sale to the territory or country of the licensee only. In its non-absolute form, production and sale can be extended to other specified countries. Licensors impose this clause either to preserve other markets in which they compete from the licensee's competition or to be able to license their technology in as many territories as possible. Such a clause prevents the licensee from fully exploiting the technology, realizing potential economies of scale, developing exporting capacity to compete in international markets, and earning hard foreign currency. It also prevents the integration of neighbouring economies through intra-regional trade.

c) Tie-in Clause. This clause requires the licensee to acquire non-patented goods in addition to the technology from the licensor. This practice may be justified when the licensor's inputs alone allow a satisfactory working of the process or when brand names are involved so that certain quality standards are required by the licensor to protect its image. In many cases licensors impose this type of clause essentially to maximize their profit margins. The consequences for developing countries are not only higher purchasing costs, but also disruption to domestic economies when alternative sources for the tied-in inputs are local.

d) Price-fixing Clause. This clause imposes restrictions on the sale price of patented products, or products manufactured by the patented technology or process. The imposed price may reflect neither the production costs of the licensee nor its internal market conditions. The effects may be damaging if this price is higher than that for competing products, e.g. the licensor's.

e) Field of Use Restriction. This clause restricts the scope of the field of use of the licensed technology. This prevents economies of scope and inhibits development activities which go beyond the original application.

f) Minimum Royalty Payments. This clause has already been defined. It is generally imposed in exclusive licensing agreements.

Finance the licence

After identifying the explicit and implicit costs of a technology licence, the licensee has to investigate financing sources such as:

- own resources
- additional profits from the licence
- financial lending institutions
- development banks/governments
- business groups and partners
- stock issues
- divestments
- barter arrangements
- cross-licensing
- joint venture arrangement

Negotiating strategy

Once the technology is identified and funding is located, negotiation can begin. Although the object of the negotiation is a technology licence the approach is usually based on the relationship between the parties. Successful TT requires a satisfactory long-term relationship between the parties that includes, but is not limited to the technology licence. The parties should aim for a win-win situation in which the agreement provides benefits for both. Two other points are important in the planning and execution of negotiations:

- when making international agreements it is essential to have a good understanding of the culture of the other party in order that the arguments put forward and interests of each are clear. This will avoid embarrassment or unintended insult;
- in any type of agreement, national or international, it is essential that both parties understand the style, preferences, performance, financial conditions, ethics, expectations from the deals of the other party. This will help in formulating objectives and negotiating strategy.

Planning stage

For a successful agreement there are certain prerequisites to negotiations including:

- determining your particular objectives - this may seem elementary but is necessary to have a clear understanding of the nature and scope of a future contractual relationship. This will avoid ambiguity, misunderstanding and distrust between the parties as the negotiations proceed
- determining alternatives to completing the agreement. Even one alternative improves your negotiating strategy. This is known as a BATNA - Best Alternative to a Negotiated Agreement
- considering the long-term benefits of the agreement rather than becoming overly concerned with the short-term implications
- looking for areas of agreement rather than areas of conflict between the parties
- planning major issues as independent not sequential units. This will avoid confusion if issues are raised out of sequence
- setting ranges rather than specific points for your objectives

The negotiating team

Once a preliminary agreement structure has been agreed a negotiating team should be selected.

Composition

The negotiating team should include members of the technology acquisition team. The type of expertise required will be technical, financial and legal. The team for negotiating TT

agreements should be small. If the team is appointed too late in proceedings there will not be sufficient opportunity to study the proposed transaction and background information, in order for effective input into the positions that the chief negotiator will present. Last minute appointment of the negotiating team should be avoided.

The team leader

The chief negotiator's role is important. He/she should command respect, be confident, articulate and patient, able to control a meeting, able to lead and have the support of superiors. The chief negotiator must understand the subject, be ready to listen to others opinions and not take offence if contradicted. He or she must be experienced in the business being negotiated and able to make decisions.

Team members

The technical expert(s) should know the technology and understand its technical advantages and disadvantages. They must know about alternative technologies and their costs. The financial expert must be familiar with all aspects of financial arrangements, including potential sources and terms of both domestic and international financing. He/she must be able to calculate during the negotiation and on an ongoing basis, the long-term financial returns and cash flows.

The legal expert must have experience in drafting contracts and be knowledgeable about the terms and conditions of TT agreements. Knowledge of technical, engineering or management service agreements may be required. The legal expert's role needs to be clearly defined. Some firms prefer the legal expert to be more of an observer in the actual negotiating sessions; others have the opposite view, reasoning that agreements are legal contracts and should have input from legal staff. Whether the legal expert plays a primary or secondary role, he/she will be responsible for drafting the agreement and its specific provisions to reflect what the parties have agreed to orally. It is important to be aware of terms and conditions that might be unfavourable to the client and detect subtleties that might be beyond the knowledge of the chief negotiator.

Team discipline

A negotiating team should generally speak through the lead negotiator. Team members should speak only if the principal spokesperson invites them to do so. The leader should try to engage all members of the team while maintaining authority over the team. Experienced negotiators watch for any disagreement among the members of the opposing team and try to exploit it to their advantage. Open disagreement, and explicit body language from team members should be avoided. Team members should maintain a calm demeanour and try to avoid revealing differences of opinion. If an issue is of sufficient importance and disagreement is substantial the chief negotiator should ask for a recess in order to discuss the issue.

Organizational aspects of negotiations

In arranging negotiating sessions, a number of organizational aspects need to be considered; these can have an impact on the negotiation. We outline some aspects worth considering.

Physical arrangements

The physical and psychological state of the negotiators can affect the dynamics of the negotiation process. These can be influenced by the physical arrangements inside and outside the negotiating room. Physical arrangements outside the negotiating room include satisfactory hotel accommodation, familiar and high quality food and logistical facilities such as secretarial services and access to telephone and fax services.

Physical arrangements inside the negotiating room include the size of the room, and the seating arrangement. If the outside physical arrangements are inadequate or unfamiliar negotiators will be uncomfortable and uneasy which may lead to impatience and irritability. This makes the search for compromise solutions and eventual agreement more difficult. Similarly being substantially outnumbered by the opposing negotiators or being forced to

negotiate in a room that is small will be a cause of irritation and will affect the dynamics of the negotiation process.

Meeting length and frequency
Negotiating sessions may go on for as long as 10 hours in a day. Sessions of this length are not sensible. Fatigue will cloud judgement. The length and frequency of meetings will have an effect on the state of mind of the negotiators and could speed up or delay agreement. Sessions of no more than 8 hours per day are recommended with several breaks for review.

Informal meetings
Informal meetings, such as lunch or dinner with members of the opposing negotiating teams, are usually extremely useful. They allow team members to get to know one another and develop some sort of relationship that may facilitate communication and understanding. Discussing the actual business should be avoided at these times. Team discipline should preclude occurrence of 'side discussions' among other team members than the chief negotiator.

Conduct during negotiations
Negotiators' views vary on the conduct of negotiations. Some see it as an adversarial process with both sides defending their interests until a mutually acceptable position is achieved. Others see it as a process in which the mutual interest is paramount. Whatever the approach taken, the following may contribute to reaching agreement:

- setting the right tone at the outset, dispelling rumours, being candid
- engendering trust - being open about feelings and motives
- highlighting the most important issues, which should be kept to a minimum
- starting with general propositions
- agreeing in principle before deciding specific language
- avoiding any appearance of rushing the negotiations or working to a deadline, to reduce the chances of needless concessions.

Making frequent summaries to ensure understanding by all present

- structuring the negotiation
- presenting arguments in a measured, logical and impersonal way
- avoiding personalization in arguments
- avoiding ultimatums and other non-negotiable statements
- conceding the validity of the other party's arguments.

The goal of good negotiation should be to conclude an agreement that is equitable, recognizing the interests of both parties and optimizing the benefits as measured by objective standards. Successful negotiation can bring about long-term relationships that enable both parties to profit. In the case that one party benefits at the expense of the other, although the agreement may be forged based on the need for technology, the results will often be less than optimum performance and bad relations between the parties.

General structure of a licence agreement
The final outcome of the negotiation stage is a licensing agreement. This is frequently preceded by a non-disclosure agreement which commits the licensee to not disclosing to any other parties patented information provided by the technology proprietor. A letter of intent, setting out the broad outline of the proposed agreement is generally signed by the parties before the licensing agreement is drafted. Below we provide a framework for a general licensing agreement.

Through the licensing agreement, the technology owner (licensor) allows another entity (licensee) to use or exercise rights to the technology conditions that otherwise would be reserved to the owner, under mutually agreed terms and conditions. If an individual or a company uses protected technology without the owner's consent, that party would be risking a

suit for infringement.

A license agreement should contain the following sections.

- Preliminary statements. Details of the identity of the parties, the purpose of the agreement, pertinent background information leading to the licence, the effective date and the definitions of the key terms of the agreement.
- Subject matter. The grants of the patents, payments and the terms of the licence and terms and conditions of the know-how rights, including trade secrets and technical assistance.
- Boilerplate, commonly used to describe the detailed operational obligations of the licensor and the licensee, as well as obligations that are common to both. These operational agreements include the provisions for governing law, reporting responsibilities, notices, assignments, etc., and are included as part of most licensing agreements.

Careful drafting is required to incorporate the above into a clear, legally binding agreement. There is no precise international format for a licensing agreement since procedures and content vary from country to country. Below we provide some elements for consideration.

Preliminary statements

Identification of the parties
The first paragraph should identify the parties to the agreement in terms of their official names, addresses and, when applicable, the location of their governing law of incorporation. Corporations should be identified as either parent and subsidiary or parent or subsidiary, and their legal capacity or authority should be provided. Attention to specification of the parties to an agreement ensures precise identification of the licensing and licensed parties. For the licensor, this precludes the possibility of extending the licence beyond the intended entity or of not including all of the intended entity. For the licensee, it ensures that the identity and commitments of the licensing party extend to the entire intended entity.

Purpose
A paragraph stating the purpose of an agreement is necessary. It could be as simple as "This agreement is to permit company A to make, use of and sell product X in the territory as defined in the agreement, with the help of the technical assistance and the know-how licensed under this agreement by company B and under the licensed patents as defined in this agreement". A statement can also be included here or in the ‘whereas’ clauses, as to the economic aim of the contract, i.e. to produce the licensed goods economically and competitively.

Effective date of the agreement
The date when the agreement comes into effect is usually included as a separate paragraph. It may be before or after the date of signing (execution) of the agreement. Some countries require government approval after the parties to an agreement have agreed to all of the provisions and have executed the document. In this case the date of government approval would become the effective date.

‘Whereas’ clauses (recitals, preamble)
The ‘whereas’ clauses give the background and rationale for completing the agreement. They should be worded carefully to clarify the terms and conditions for people from either party not involved in negotiating the agreement but that will be involved in the resolution of any conflicts that may arise between the parties. Clarity is important in the event that legal action is taken by one party against the other.

Licensor representations
This clause states that the licensor owns the subject technology of the licence (patents, patent applications, know-how, trade secrets, trademarks and/or copyrights), that it has the right to grant the licence and that it has not granted a prior conflicting licence.

Licensee representations
This clause indicates why the licensee wants to obtain the rights to the subject technology. Where applicable, it indicates the patents, patent applications, know-how, trade secrets, trademarks and/or copyrights the licensee owns in the field of the licensed technology.

Background to the agreement
When applicable, there should be clauses that include details about any prior relationship between the parties and any prior agreements that may relate, dominate or in any way affect the present agreement. Cancelled or suspended agreements should be included.

Definition of terms
To preclude misunderstandings between the parties, all subject matter and key words that could have an impact on the agreement require definition. The most important are:

- Licensed patents (this generally includes the patents and patent applications that relate to the patented technology)
- Licensed know-how/trade secrets (technology included in the know-how should be described in broad terms, but with enough specificity to avoid misunderstandings)
- Licensed improvements (if the licensor's improvements are part of the licence, they should be clearly defined)
- Grant-back (if the licensee agrees to grant improvements back to the licensor, the scope of such improvements should be defined)
- Licensed product/process/apparatus (definition of these terms should be tied to the patent rights and the know-how to be exchanged under the licence as they represent the basis for collecting royalty payments)
- Net sales (when royalties are based on a percentage of net sales, the parties must decide and stipulate what the term means)
- Territory (the geographical area where the licence will be effective should be clearly specified, each country covered must be named. If the exclusivity rights or sales vs manufacturing rights or any other rights, vary by country, details should be provided (a tabular presentation is often useful).

Subject matter of the licence
The licence grant
The grant is probably the most important part of the licence. Its provisions, outlined below, require careful thought. To protect all parties, they should be drafted unambiguously, leaving no doubts or open questions regarding the rights being granted. The grant specifies exclusivity, territory, rights conferred, limitations, maintenance and protection of patents, infringement, and patent marking.

Exclusivity
The grant can be exclusive, sole (exclusive except for the licensor) or non-exclusive. Typically, a licensee seeks an exclusive licence at least for the country concerned, and possibly for the neighbouring regions as a means of securing the market.

Territory
Territory is normally defined in the definitions section of the licence.

Rights conferred
It is proper for the grant to set forth exactly what a licensee is free to do under the patent rights. Depending on the claims in the patents, the licensee can be given the right to manufacture, have manufactured, use and/or sell the subject matter of the licence.

Limitations
Depending on the coverage within the claims of the patents, the licensor may wish to impose limitations. These have been described in an earlier section.

Maintenance and prosecution of the patents
The licensor usually bears responsibility for the cost of filing, prosecuting and maintaining licensed patents. This includes future patent applications if improvements are included in the agreement.

Infringement
Licensor and licensee rights in infringement suits may vary from country to country due to differences in the applicable laws. Parties to a patent licensing agreement should check infringement clauses carefully against what is allowable in the countries covered by the agreement.

Patent marking
The licensor often insists on the licensee marking patented products with the patent number.

Know-how/trade secrets/confidential information
Know-how alone can be the basis for a TT licensing agreement. In that case the licence will have no references to patents. However, when know-how exists along with patents, both are often included in one licensing agreement. Including know-how can be especially important to a licensee receiving a new product or process.

Know-how grant
If know-how is a defined term in the agreement, then the grant can be a statement such as the following: "Licensee is granted the right to use the licensed know-how to make, use and/or sell the licensed product, licensed process and licensed apparatus in the territory".

Secrecy
It is proper and to the advantage of the parties that the licensed know-how is held in confidence. Suitable wording for this portion of the agreement is available, but attention should be paid to exceptions to the confidentiality provisions. A secrecy obligation that permits the usual exceptions should be acceptable. Obligations of secrecy usually continue beyond the term of the agreement.

Licensee use of the know-how
The agreement should provide conditions giving the licensee the right to disclose any portion of the know-how. Any restrictions the licensor requires on disclosures within the licensee's organization, to suppliers or to customers would be included here.

Technical assistance
Technical assistance can greatly reduce the time required by the licensee to move the licensed technology into production. The obvious benefits are that the licensee generates income more quickly and the licensor earns royalties sooner.

Improvements
If the parties decide to include improvements made after the effective date of the agreement, this section must be drafted carefully. Improvements made by the licensee to be granted back to the licensor require a separate clause to specify how they are to be handled.

Sublicensing rights
Subject to individual country laws, a licence does not have sublicensing rights unless the agreement authorizes them. If the parties agree to allow sublicensing, the main agreement should specify the rights and obligations of the licensor and licensee with respect to the sub licensee(s).

Payments
Payments in technology agreements take the forms already discussed.

Acquisition of machinery
When a licensor sells proprietary machinery to a licensee, the terms for such a transaction can be shown in a separate paragraph of the agreement.

Technical services
In addition to the above payments, the licensee may have to pay separately for specific technical services the licensor may provide in connection with the licence. These may be considered under three main headings: (a) training programmes for licensee's personnel, (b) specific technical services performed in the licensor's works and facilities, such as special drawings, and (c) technical experts supplied by the licensor to the licensee's plant.

Interest on overdue payments
If the licensee fails to make a payment when due, the licence agreement generally provides for interest payments, at a specified rate and in an agreed-on currency.

Licensee records
It is customary for the licensee to furnish a statement, certified by the licensee's appropriate officer or an independent certified public accountant acceptable to both parties (preferred when the parties have no previous experience of working with each other), showing detailed royalty calculations to allow the licensor to ascertain their accuracy. A further provision is usually included requiring the licensee to maintain records that permit a licensor or his representatives to determine that all payments made and due are accurate. These records should be open to inspection by the licensor or to a third-party accounting firm acceptable to both parties, on reasonable notice. If the licensee fails to make correct payments, it will be subject to a fine defined in the licensing agreement.

Term of the licensing agreement
In a patent licence, the term is usually from the effective date of the licence until the expiry of the last of the licensed patents, or until none of the licensed patents remains in effect for any other reason.

‘Boilerplate’ provisions
Termination of the agreement
Termination provisions vary widely. They can be limited to expiry or invalidity of the patents, to a definite time period for know-how and/or to breach of the agreement by either party. Often the agreement will include the following specific conditions as cause for termination: overdue payments; bankruptcy, receivership or insolvency, change of control.

Best efforts
A paragraph stating that the licensee will use its best efforts to exploit the licensed technology is common in both exclusive and non-exclusive licences. It would be desirable for the parties to agree on the meaning of best efforts, and what may constitute best efforts in terms of specific steps to be taken by the licensee.

Most favoured licensee
Non-exclusive licensees should insist on this clause. It provides that should the licensor grant another licence to a third party on more favourable terms, the more favourable terms will then

apply to the first licensee.

Warranty and indemnification
Often a licensor, especially one in a strong position, will make no warranty or representation of any kind, expressed or implied, concerning any matter in the agreement. In effect, no warranty is extended. Courts do not always recognize this practice, however. At the same time, if the agreement does not include a warranty, the licensee should not consider a warranty as implied. The understanding of the parties must be expressed in the agreement. Therefore, the licensee should negotiate the most meaningful warranty.

Export control
If the technology or products made under a licence are considered sensitive or if they might be utilized in countries to which the licensing country restricts exports, the licensor will require a clause to assure that such restrictions are not violated.

Arbitration and applicable law
Arbitration is being used more and more frequently as a means to resolve license agreement disputes because it is usually quicker, cheaper and more amicable than lawsuits. There are many subtleties to writing arbitration and applicable law clauses. Patent laws differ around the world. The licensee and licensor are advised to have legal counsel study the circumstances for each licence before deciding on the most appropriate provisions for such clauses.

Main general provisions include:

- Assignment: It is important for the licence agreement to provide for assignment or to preclude it;
- Severance: A clause will usually provide that if a significant provision of the agreement is declared void or unenforceable by arbitration or court proceeding, the remaining provisions of the agreement will remain in effect;
- Entire agreement: In general, licence agreements contain an entire agreement clause. It is especially important when there are existing or prior agreements between the parties related to the current, or another, subject matter. The clause should state that the license agreement currently being consummated represents the entire agreement between the parties on the subject matter and supersedes all previous agreements or understandings concerning that subject matter;
- Force majeure, contingencies: This clause provides that neither party to the agreement will be responsible for failure or delay in performing its obligations due to circumstances beyond its reasonable control;
- Notices: The parties will designate the principal contacts for the handling of communication, to preclude uncontrolled communication between parties.

Most of these clauses are included in licensing agreements. However, obtaining agreement between the parties always requires creativity and a certain amount of flexibility. The result is likely to be a combination of standard and new wording that will accommodate the current situation.

Success factors
We have seen that acquiring technology from outside is a lengthy process. A number of activities are necessary and require certain skills. Here, we summarise the major steps. How they are performed will have an impact on final outcome.

- Determine your objectives
- Form your technology acquisition team
- Seek professional consultants
- Locate the available technologies
- Evaluate the technologies
- Determine the costs of licensing in

- Examine your financial resources
- Locate additional finances
- Develop a negotiating strategy
- Identify your best negotiator
- Form a negotiating team
- Look for other opportunities through the licence
- Prepare a good checklist
- Adopt a win-win approach

Licensing out

Although technology balance of payments statistics, which record cross-border technology transactions, reveal that developing countries are net importers of technology, cases of technology exports by these countries, to both developed and other developing countries, are becoming more frequent. Companies in developing countries may find it useful to become acquainted with the licensing out process. This includes understanding the strengths and weaknesses of the intellectual property being offered, careful research of qualified candidates and thorough implementation of initiatives actually undertaken. There are four main phases in the licensing out process, namely: analysis of the technology being offered; preparation of a memorandum; selection of a licensee; and negotiating the licence.

Analysis of the technology

Although the advantages of a technology are easily appreciated by its proprietor, the same does not hold true for a potential licensee. Furthermore, lack of objectivity by the proprietor may obscure certain of its disadvantages or limitations to its universal application. It is incumbent upon the technology proprietor seeking to conclude a licence to realistically appraise the comparative advantages and disadvantages of the technology being offered. This type of analysis should address:

- efficiency and effectiveness of the technology
- cost of production of a product
- throughput efficiency of a process
- size of the potential market
- amount of investment required to bring the technology to market
- existing competing technologies
- economic forecasts.

Licensing memorandum

When a technology proprietor makes unsolicited contact with a company, it will be necessary to provide the decisions makers in the target company with concise, accurate and accessible description of the technology being offered. This is called the licensing memorandum and should include:

- a description and brief history of the licensor
- a summary of the technology
- reference to the intellectual property portfolio of the licensor
- the level of economic return that can be expected from the technology
- the terms of the transaction.

Identification of licensees

A list of potential candidates should be compiled to which certain selection criteria are applied, including:

- financial situation, i.e. the capacity of the candidate to incur the investment cost required and pay the licensing fees
- marketing ability, which is more important than possession of suitable manufacturing facilities, as manufacturing can be contracted out
- motivation to give priority to the licensing project
- ambition: probably better to target a firm that wants to challenge the leader in the market.

8. Business Alliances for Competitiveness

8.1 Alliances Concept

The European consortium, Airbus Industry is one of the oldest successful business alliances, illustrating that cooperative relationships can create and sustain competitiveness. Alliances are forms of inter-organizational cooperation. The increased globalization of business is making it necessary to evolve new forms of cooperation to improve competitiveness. Alliances are organizational arrangements designed to create win-win situations for both partners. Networked structures can be robust and flexible. Some of the major driving forces for forming alliances are:

- market uncertainty
- technological uncertainty
- drive for cost competitiveness
- globalization of business
- emergence of outsourcing
- high infrastructure costs
- short product life cycle
- digital convergence.

Alliances are forms of inter-organizational cooperation driven by:

- market uncertainty
- cost competitiveness
- globalization
- high infrastructure cost
- short product life cycle.

These driving forces induce organizations to adopt network architectures rather than systems based on pure market or hierarchical governance. It has been shown that alliance structures enable many of the characteristics of hypercompetitive environments to be overcome. They:

- reduce entry cost into new markets
- meet rapidly changing customer needs
- rapidly fill knowledge gaps
- share R&D costs
- realize scale economies through sharing of facilities
- realize economies of scope
- overcome market barriers
- reduce transaction costs
- speed up new product introduction
- share risk
- eliminate threat of competition
- reduce exit costs
- leverage resources with minimum ownership costs.

Figure 12. Alliance Logic

A strategic alliance rationale contains the following aspects:

- Sharing risk
- Pooling cost
- Reducing uncertainty
- Creating new business
- Linking value chain
- Economies of scope
- Reduced cycle time.

Business alliances can be classified into two groups:

- equity alliances
- non-equity alliances.

Equity alliances take three forms (in the context of emergence of new business models):

- equity joint ventures
- minority holdings
- cross holdings.

Non-equity forms of business alliances include:

- joint R&D agreements
- technology exchange agreements
    - co-production
    - mutual second sourcing
    - market access agreements
- customer/supplier agreements
    - contract research
    - joint trademark agreements
- one directional technology flows.

An example of a business alliance is Ashahi Glass (Japan), Tata Engineering (India), ACC (India) and Tata International (India), which formed a joint venture in India with 16% equity each, the

rest owned by a diversity of investors. Ashahi Glass provides the technology, Tata Engineering sources float glass for its cars, Tata International exports float glass and ACC distributes float glass through its distribution network. The arrangement allows these companies to share the risk, pool resources and evolve new business opportunities .

Alliances allow for highly flexible relationships and enable the firms involved to focus on their core business. Business alliances can be broadly defined as organizations with non-common ownership working towards common strategic objectives. For example, Sanyo of Japan and BPL Limited from India have joined forces to exploit the consumer electronics market in India through an alliance relationship. Theirs is one of the oldest alliances in India and continues to grow. Sanyo has many similar joint ventures around the world. Leveraging technology in many markets through sharing risk with partners is the essence of a business alliance.

8.2 Need for alliances

If the firm has control of technology, capital market, human resources, managerial capability, sufficient knowledge and integration capability then an alliance arrangement will be of no benefit. Therefore, the first step is to determine whether collaboration would improve the competitiveness of the firms by analysing whether the firm has:

- the capability to launch new products on its own
- the required manufacturing technology
- the capability to design products and be successful in the market place.

The competitiveness of collaboration within a strategic alliance can be improved through the following:

- Capability to launch product
- Manufacturing technology
- Product design
- Product durability
- Lower maintenance
- Interchangeability of components
- Compatibility of products
- Access to human resources
- Favourable conditions for acquisition
- Business knowledge
- Access to market
- Managerial capability
- Access to capital
- Price and quality competitiveness
- Global competitiveness
    - the capacity to start up a new business with low risk and minimum investment
    - access to the market and distribution network
    - the human resources and financial assets required to be competitive on its own
    - the managerial capability to meet emerging global competition and exploit emerging global opportunities.

Then the costs of going alone versus forming alliances should be analysed. The costs involved in an alliance include:

- time and efforts to search and negotiate
- forging of the alliance
- reduced operational flexibility
- possibilities of termination
- possible loss of reputation
- loss of opportunities if alliance negotiations fail
- possibility of information disclosures

Figure 13. Example of an alliance

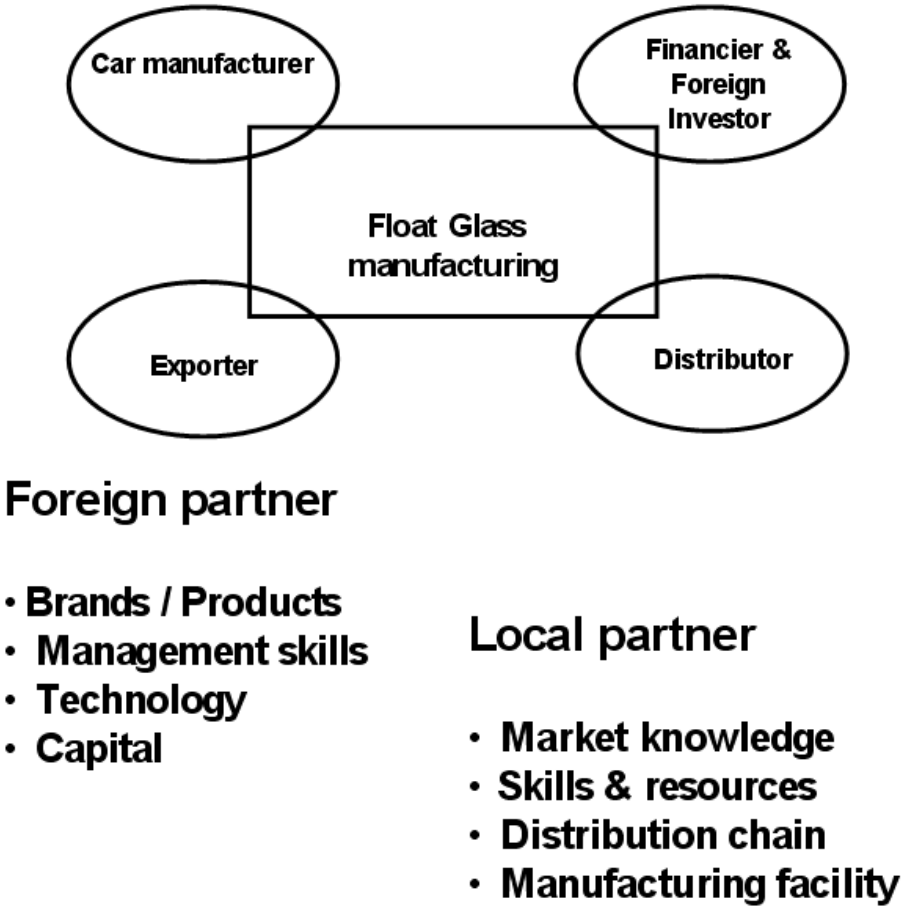


Figure 14. Key stages in building up an alliance

8.3 Types of alliances

There are four main types of alliances:

- pro-competitive - inter industry alliances that improve value added and support long term relationships
- non-competitive - intra industry links, among non-competing firms with complementary capabilities, leading to new business opportunities
- competitive - direct competitors cooperate to reduce the threat of competition
- pre-competitive - firms or organizations that are unrelated cooperate.

Examples of each type are described, based on recent alliance experiences, in order to demonstrate the opportunities.

Types of Business Alliances
Critical aspects in partnering

Table 18. Pro-competitive alliances

- *Value addition*

Activity	Example
• Joint R&D • Original Equipment Manufacturing • Joint Product Development • Cross Manufacturing • Service Centres • Logistics • Franchising	Microsoft and Sony IBM and Canon Intel and HP Sanyo and BPL Tata Steel – Rayerson Xerox – Blue Dart MacDonald's - Partners

Table 19. Non-competitive alliances

- *Learning*

Activity	Example
• Software development • Transaction processing • E-commerce • Venture Capital Financing • E-Banking • Satellite communication	Wipro – GE Medical Systems British Airways – World Network Services i2 – Microsoft – Intel-Price Waterhouse Coopers Yahoo – Softbank Citibank – MCI Loral – Alcatel

Table 20. Competitive alliances

- *Core protection*

Activity	Example
• Comarketing • Research consortia • Collaborative Advertising • Shared Services • Joint Bidding • Service Bundling • Joint patenting • Joint Selling	Roche – Genentech Ford – Daimler – Ballard Intel – Compaq KLM – North West – Alitalia Bechtel – Unocal Yahoo – Amazon General Motors – Ford – Daimler Chrysler Gazprom – Wintershall

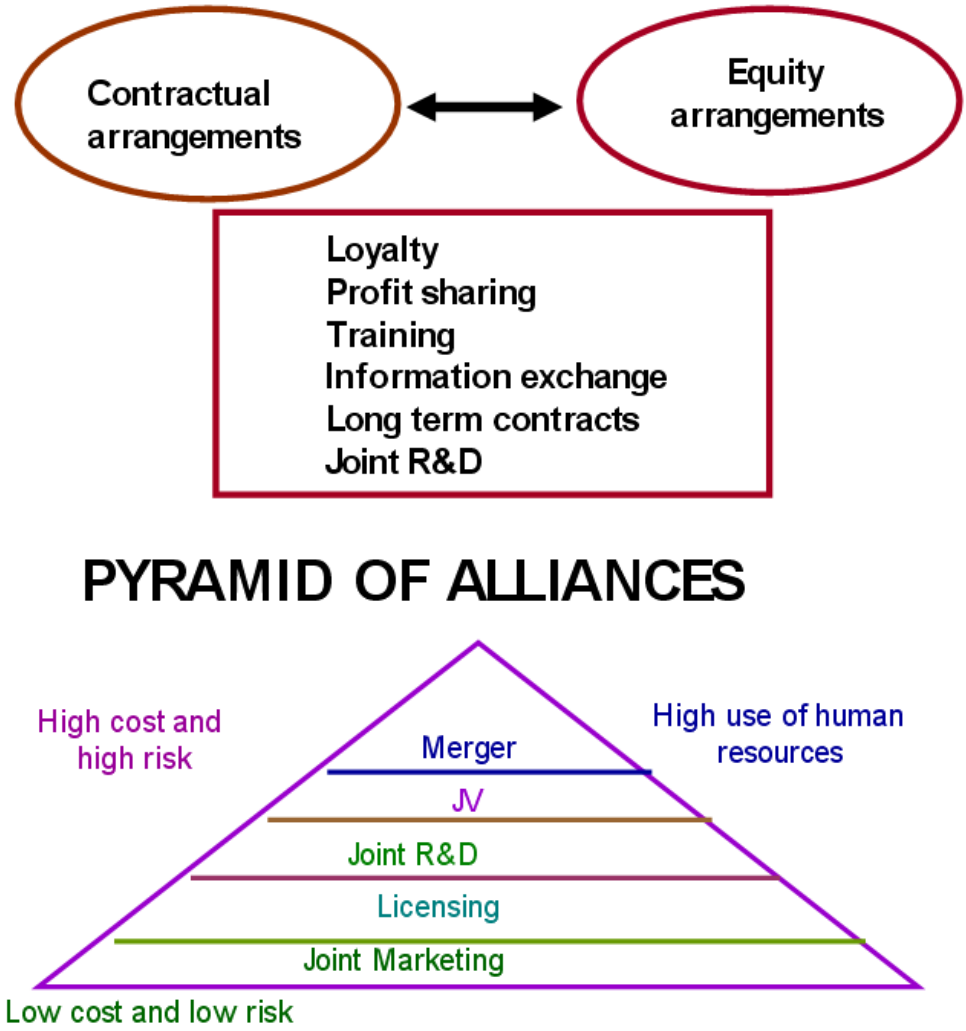
Finally, there can be non-competitive and competitive alliances

Table 21. Pre-competitive alliances

- *Flexibility and action*

Activity	Examples
• Contract Research • Research Spin off • Joint Procurement of Components • Commercialization of technology	Nokia and Indian Institute of Science Lucent/Bell Labs Toyota – Sony – Tokyo Cambridge University - Toshiba

Figure 15. Selecting the Alliance Format



Pyramid of Alliances

Once the decision to form an alliance has been made it is necessary to decide on the format. Pure contractual agreements do not include mutual loyalty, profit sharing, training, information exchange, long-term contracts or joint R&D.

Alliances can be of three types. The first type is a sales and service alliance, used when both parties consider the arrangement to be short term with low level of commitment to extend the arrangement. This type of alliance is usually chosen when manufacturing costs are high or the market is uncertain. No equity agreements are necessary, investment commitments and discontinuation costs are low. The second type is an arrangement that includes sales, service, manufacturing and engineering, which is usually preferred when product life cycles are long and there are adequate patent protections and competitive advantages in manufacturing. The third type of alliance also includes R&D cooperation, which occurs only when there is long-term benefit from cooperation.

Alliances are usually sought when market opportunity is high, but the firm does not have the capability on its own to maintain competitiveness. If market opportunity is poor, the firm can outsource or buy, or enter into a purely contractual arrangement. If the firm has the required capability and market opportunity is high, it can exploit the market on its own.

Thus, when the resources required are minimal and the relationship is short-term, pure non-equity alliances are preferred. When the scope of cooperation is long-term and the strategic

commitment required from both partners is high, a joint venture is more suitable. If resource requirements are high and multiple capabilities are required, a consortium relationship is ideal. In the current highly competitive environments, some form of alliance is becoming essential for survival. The greatest risk is not taking a risk.

8.4 Preparing for the Alliance and Partner Selection

Selecting the Alliance Format based on:

- Distinct scope
- Large market opportunity
- Joint Venture
- Flexibility and short-term focus
- Non-equity alliances
- Large resource needs
- Consortia

Pre-competitive Alliances

In pre-competitive alliances, the strategic objective is flexibility of operations. In pre-competitive alliances, value added is the strategic objective. In competitive alliances, protection of the core business is crucial to reduce the risk of a takeover. In non-competitive alliances, the opportunity for learning is the strategic objective.

Small and new firms will need to enter into alliances for design, new technology and manufacturing, while firms with manufacturing capabilities may need alliances to increase market access or market reach. The type of alliance that is most appropriate will depend on the complementary capabilities required to minimize weaknesses or exploit emerging opportunities.

In preparing for the alliance it is important to consider the following:

- developing qualitative and quantitative partner criteria
- developing a prospect list
- strategic fit analysis
- ranking the strategic fit of candidates
- meeting and evaluating candidates
- getting to know the corporate champion
- looking out for land mines
- obtaining internal approval
- creating an implementation plan
- trying a quick fix if partner development lags
- applying the mind shift method to the partner selected
- final pre-deal evaluation of all relevant information
- managing any pre-deal glitches
- negotiating the deal.

Outlining the alliance and selecting a partner

When the need for an alliance has been identified, it is necessary to:

1. Prepare a strategic vision and analyse the options
2. Develop qualitative and quantitative criteria for potential partner(s)
3. Compile a list of potential partners
4. Examine how well the strategic objectives of the partners match
5. Rank potential partners in terms of strategic fit
6. Meet and evaluate partners
7. Compile justification for an alliance
8. Obtain internal approval to go ahead
9. Enter negotiations

10. Get to know the corporate champion
11. Devise an implementation plan
12. Finalize pre-deal evaluation
13. Negotiate the deal
14. Sign the agreement.

The most crucial step is selecting the alliance partner(s). This involves analysing four aspects:

- competence-opportunity match
- value added flexibility match
- strategic and cultural match
- growth and risk match.

The matrix in Figure 16 provides four possibilities for the matching of competences and opportunities. Only where the match/complementarity is high will an alliance be beneficial.

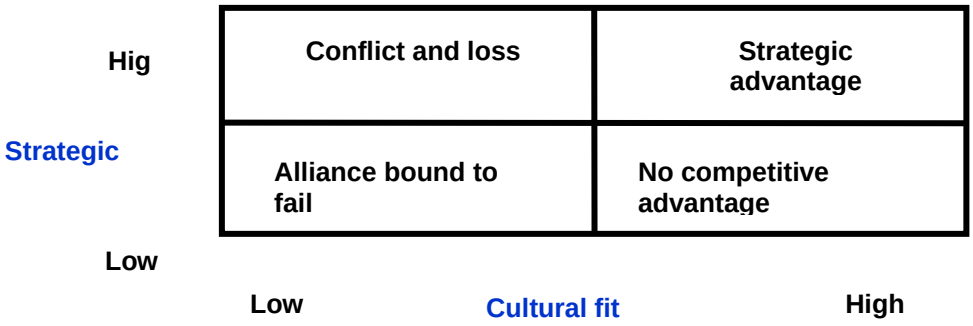
Selecting alliance format

It is also necessary to determine which type of relationship will enable the greatest flexibility. In low value added situations either a contract or a consortium arrangement would be recommended depending on the opportunity and degree of flexibility required. In high value added situations where risk is high, joint ventures would be the choice. When value added is high and opportunity is high, a value chain partnership that support high flexibility would be the best option.

Value Addition - Flexibility Matrix

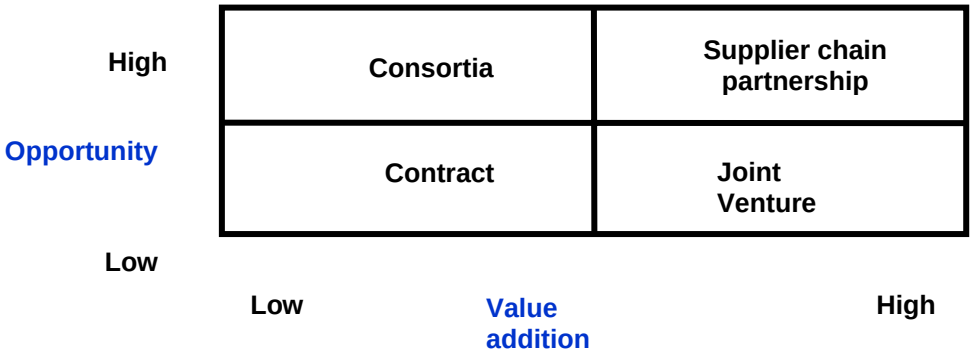
It is also necessary to examine how well the strategic objectives and managerial cultures of the partners are matched as these are crucial for competitive advantage. If the match is poor then the alliance will fail.

Figure 16.Competence - Opportunity Matrix and Strategy - Cultural Fit Matrix



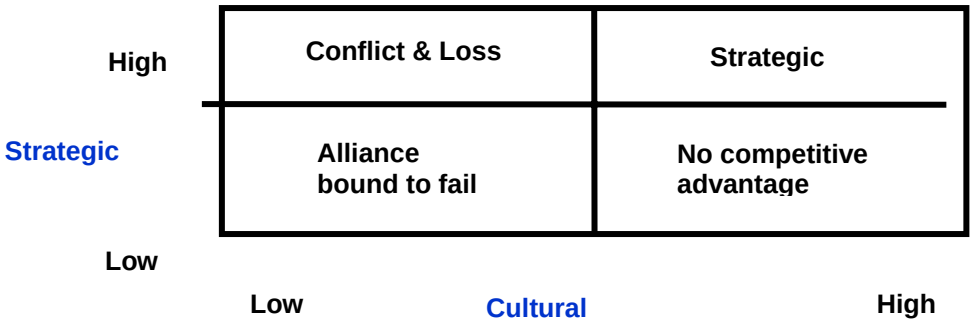
In value addition – flexibility matching, an examination is carried out which kind of relationship will allow high degree of flexibility. In low value addition situations either contract or consortia is used depending on the opportunity and flexibility needed. In high value added situations when risk is high, joint ventures are the choice. When value addition is high and opportunity is high value chain partnership that supports high flexibility can be the ideal option as shown in the matrix below:

Figure 17. Value addition - Flexibility Matrix



The third aspect to be analyzed is the matching of strategic objectives and managerial cultures of the partners. Only when strategic objectives and managerial cultures match, the competitive advantage manifests. If both managerial culture and competitive strategies do not match the alliance is found to fail as shown in the matrix below:

Figure 18. Strategic and Managerial cultures Matrix



Selecting Alliance Partners
It is also necessary to assess the risk involved in establishing an alliance.

The partner selection criteria should be applied following information collection and analysis. The major parameters to be examined are:

1. Technological parameters
    - specific risks associated with the potential partner
    - technology absorption goals
    - compatibility in terms of attitude to patent protection
    - complementary strategies
    - price
    - restrictive conditions.

2. Market parameters
    - knowledge of customer needs
    - reactions of suppliers
    - market approach
    - market trends
    - strength of the distribution network.

3. Financial parameters
    - availability of resources
    - strength of financial base
    - favourable image in capital market
    - access to low cost capital.

4. Organizational factors
    - acceptance of alliance
    - managerial compatibility
    - trust
    - organizational maturity
    - organizational climate
    - employee orientation.

5. Competitive factors
    - risk of take over
    - potential conflicts
    - shareholder perception
    - corporate reputation

A scenario analysis approach should be used to assess these factors as alliances are evolutionary, not purely deterministic relationships. Changes in the market and/or the technology and the competition could make the alliance relationship redundant.

8.5 Managing the Alliance

Once a business alliance is in place it must be managed well to obtain maximum strategic benefit. It is necessary to define:

- Who will do what?
- How will contributions be made?
- What time constraints and milestones should be agreed upon?
- What communication mechanisms must be in place?
- How will information flow?
- Who will be the initial point of contact in each company?
- What incentives are needed for the smooth running of the alliance?
- How will the performance of the alliance be reviewed?
- What mechanisms will be used to resolve conflicts?
- What can be done to improve learning processes?

Managing a business alliance is different from managing an internal organization and involves a different way of thinking. Ultimately, a working alliance is based on trust.

Management of an alliance is a contingent process. In arrangements where there is a high degree of integration, whether the alliance is technology based or market based will influence the management focus. The success of a market-based alliance will depend on access to the market when there is high level of integration. When there is high level of autonomy, trust and flexibility become important. In technology-based alliances, where there is good integration, independent growth of technology is vital. Trust and coordination are crucial in alliances where partners have high levels of autonomy.

- Managing alliances is very different from managing an internal organization.
- Managing an alliance requires a different mindset from traditional economic thinking.
- Alliances can entail many surprises.
- Ultimately, a working alliance is based on trust.

In a vertical cooperation alliance, entrepreneurs are looking to reduce uncertainty and risk, and ensure quality and viability of operations. Developing a long-term relationship is crucial in pre-competitive alliances. The focus is on internal operations. In horizontal alliances, the entrepreneur takes on more initiative and more risk: the relationship is broader and more uncertain. The focus is on continuous creation of new markets and knowledge. Rivalry and autonomy are high.

Alliance management is eased by good communication flow and good management information systems. Openness, frankness, frequent exchanges and social interactions can improve the managerial atmosphere. Common management information systems, standard protocols, common reporting formats etc. can facilitate growth of good relationships. Managing alliances requires certain characteristics such as:

- ability to move across different managerial cultures
- good cross cultural communication skills
- ability to generate trust in transactions
- ability to avoid biases through the use of objective assessments

The key to managing an alliance is development of trust, which is the basis of any long-term relationship. Trust lowers the transaction costs. Trust may take time to develop and will be based on:

- mutual needs of the partners
- good leadership
- interdependence

Managing the alliance is a contingent process that includes: upstream distinctions, strategic intent, human resource management, operating functions, information systems and learning.

Practices that contribute to greater trust include:

- alliance ethics, i.e. carrying out productive rather than speculative business
- keeping promises
- inter firm team work

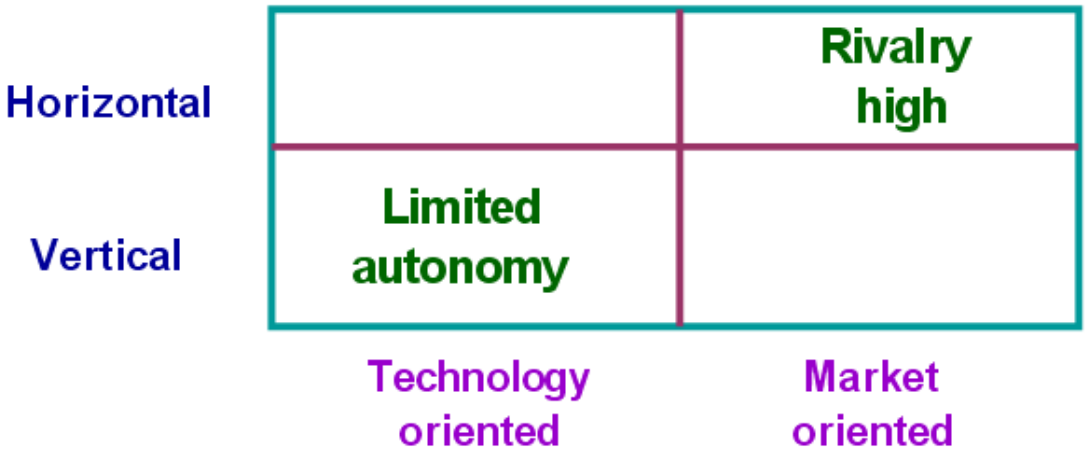
Another aspect of alliances is learning, which is not automatic. Vicious circles can limit the learning process. Learning is cyclical, it is perception based and easily biased. Learning contributes to success; it requires appropriate attitudes, structures, processes and interactions.

Finally, all alliances must be subject to systematic review including:

- goals attained
- competitors' responses
- utilization of resources

The review should be a coordinated effort not aimed at assigning blame. These reviews will help towards the achievement of objectives.

Figure 19. Technology-Market Alliance Matrix



8.6 Learning from Alliances

Negotiation Stage
- Scope
- Exports
- Managerial controls

Agreement
- Product range
- Alliance structure
- Financial issues

Implementation
- Operational issues
- Communication
- Reporting protocols

Evolution
- Expansion
- Increasing equity

Learning from alliance experiences:
Alliances are asymmetric which increases the likelihood of conflicts among partners due to:

- lack of trust
- opportunistic behaviour by one partner
- unfulfilled expectations
- asymmetric learning
- incompatibility
- intellectual property ownership disputes
- take over threats
- unbalanced managerial control
- unexpected situations
- neglect of previous mutually agreed directions.

The more problematic alliances include:

- technical arrangements-ups
- licensing
- original equipment manufacturer (OEM) relationships
- third party agreements
- strategic alliances without equity.

Necessary: trust, openness, communication, information, working together, joint review and cultural compatibility

Alliances with high success rates include:

- contract manufacturing
- outsourcing
- cooperative research
- franchising
- supplier partnering.

Features of successful alliances include:

- common vision among partners

- commitment to working together
- strategic complementarity
- complementarity of interests
- regular communication at all levels
- cultural integration
- conflict resolution mechanisms
- commonality of management systems

Unnecessary: hidden motive, opportunism, taking unfair advantage, clash of interest, narrow focus and different procedures

Figure 20. Dos and Don'ts for creating an strategic alliance

Dos	Don'ts
• Trust • Openness • Regular communication • Working together • Joint review • Cultural compatibility	• Hidden motive • Opportunism • Clash of interest • Narrow focus • Difference in management systems

8.7. SANYO - BPL Alliance: Case Study

Best practices in alliances can be observed in the case of one of the oldest and most harmonious business alliances in India. Sanyo, a major Japanese electronics manufacturer, formed a strategic alliance with an Indian electronics consumer product company, BPL Ltd, in 1982. The main features of this alliance are:

- strategic complementarity: increased strategic reach in the case of Sanyo; increased market share of colour TVs and audio products in the case of BPL
- BPL has built a state-of-the-art colour TV manufacturing facility with Sanyo's support
- BPL and Sanyo cannot change the equity structure without mutual agreement
- BPL and Sanyo uses cross manufacturing to strengthen complementarity
- personal interaction is maintained at three levels: top and middle management and operator level
- BPL has the first rights of acceptance or refusal for any new product introduced in India
- progress and performance are reviewed quarterly
- there are regular staff exchanges
- export to non-competitive markets is permitted
- BPL as an OEM supplies alkaline batteries to Sanyo
- BPL procures components directly from Sanyo
- BPL and Sanyo have set up a joint design unit for colour TV cabinets
- BPL and Sanyo carry out joint business planning and review
- Sanyo helps BPL to procure manufacturing equipment from Japan
- relationships have been built and improved over time
- there is high flexibility and regular exchange of information
- Sanyo helps BPL in problem solving and troubleshooting
- BPL uses the Sanyo chip design centre in Japan for customization of products for local markets

- BPL and Sanyo have compatible quality management systems that result in high quality products and manufacturing practices
- understanding between the companies is broad and non-legalistic
- the parties resolve differences through mutual consultation.

This alliance, its operation and modalities illustrate how a common vision, strategic complementarity, regular exchange of information, good interpersonal relationships, etc. can create a sustainable venture.

Alliances are useful institutional forms of cooperation, but they must be well managed to minimize conflict situations. As competition increases more organizations are using alliance relationships to achieve their strategic objectives. They are extremely useful forms of relationship for SMEs to expand markets or obtain new technologies.

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