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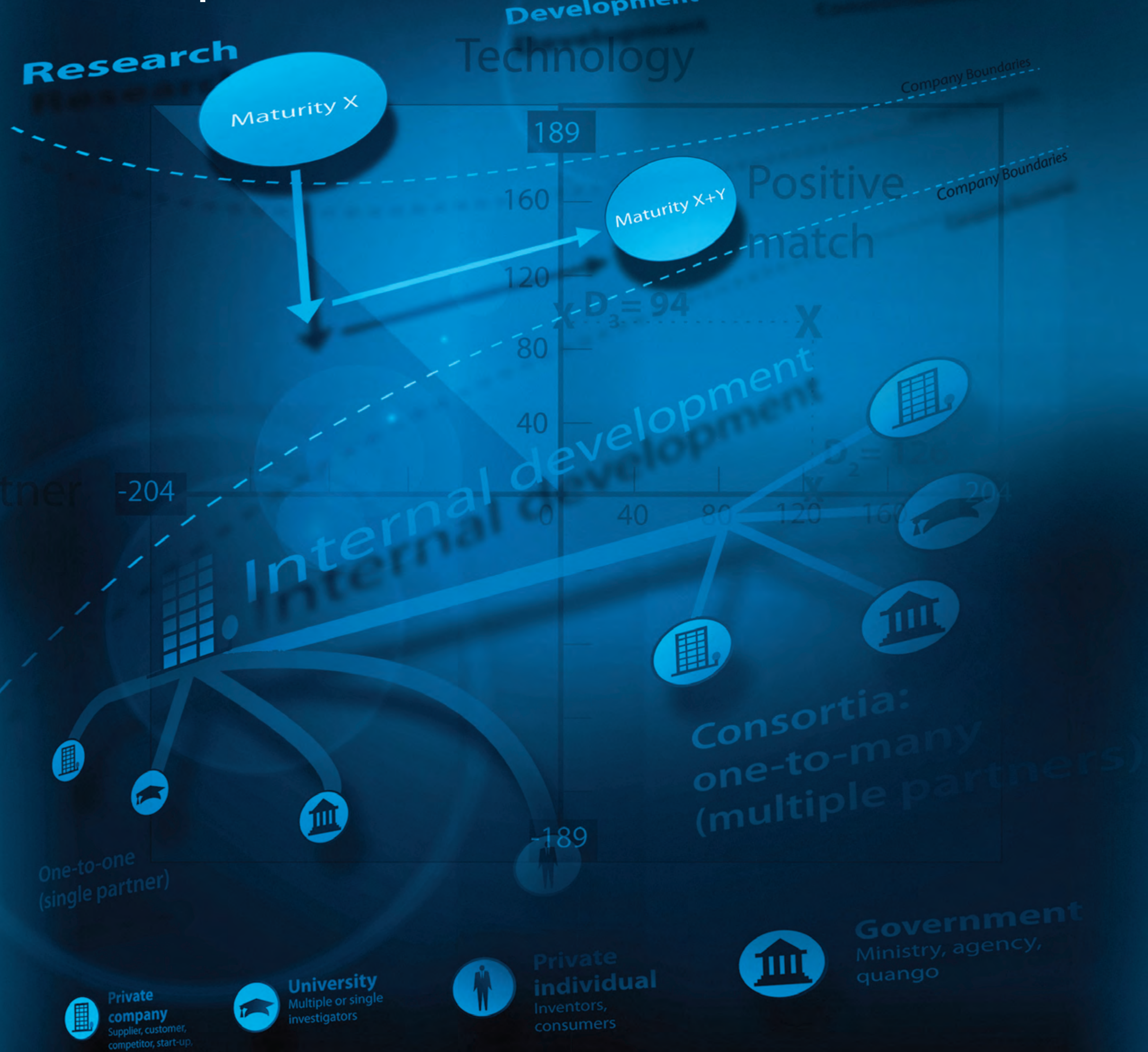
Technology acquisitions

A guided approach to technology acquisition and protection decisions



Why read this report?

The purpose of this report is to provide support for firms during the process of acquiring new technologies – that is buying in new technologies from external sources. A company may decide to acquire a technology because they do not have the necessary resources to develop it themselves. As technologies grow in complexity specialist expertise is often difficult to obtain and a firm may not have the time or wherewithal to undertake the development internally. Bringing in new technologies can also provide the company with the opportunity to enter new markets as well as develop new products.

Many different issues need to be considered when embarking on an acquisition. Understanding the various options available and selecting the most appropriate is a challenge, but one on which the success of the acquisition depends.

This report provides a structured approach to help companies going through this process. The approach should be helpful to both parties, those who are trying to acquire and those who want to sell a technology. It should be read prior to entering negotiations to help anticipate and objectively assess all the issues that may arise.

Acknowledgements

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Technology acquisitions: A guided approach to technology acquisition and protection decisions
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Foreword

Technology is at the core of much of what firms do. It is at the forefront of many governments' minds when it comes to policies for industrial development, growth and employment – witness the UK government's new "Patent Box" tax initiative. Protection given to technology adds significant economic value to firms, enhances their competitive position and adds to their market reputation.

For example, the recent Hargreaves Review of Intellectual Property and Growth (May 2011) reports that investment by UK businesses in intangible assets has outstripped investment in tangible assets – by £137 billion to £104 billion in 2004. Global trade in IP licences accounts for 5% of world trade, and is rising. It is currently worth £600 billion per year.

Against this backdrop this guide is very opportune. Users of it will derive a valuable insight into how to best structure the process of acquiring technology. Appropriately structured transactions increase markedly the success of the acquisition and so the firm's bottom line.

From my experience users who make use of this guide will make better acquisition decisions more efficiently and will establish a clearer set of success criteria. They will then go into negotiations better prepared and ultimately conclude better transactions.

Patrick Farrant

Head of Technology
Taylor Vinters
Cambridge, London and Singapore

Contents

Introduction

The purpose of this document is to provide support for firms during the process of acquiring new technologies.*

Technology acquisitions involve bringing in new technologies from external sources rather than using the firm's own internal research and development activities. Specialist technical expertise and capabilities are often difficult to obtain and a firm may not have the ability – or wish to commit the resources – to develop a technology internally. Bringing in new technologies can provide the company with the opportunity both to develop new products and to enter new markets.

Technology can be acquired in a number of ways. Understanding the various options available and deciding which might be best in particular circumstances can be challenging. This report aims to provide structured guidance to help firms explore the different options and to understand the trade-offs that may be necessary.

By its nature, a technology acquisition is a technology transfer, with transaction costs associated with the various stages of the acquisition process. This is further complicated by the number of possible routes technology acquisitions can take, with these possibilities including mergers and acquisitions of entire companies, licensing, subcontracting, alliances, joint R&D and industry-university collaboration. In all cases there is a need to devote substantial resources to assimilate, adapt and improve upon the original technology and to put suitable strategies in place to protect it. There are particular challenges associated with the transfer of technology for each of these sourcing mechanisms. This report should enable the reader to break down the complexity which is associated with these types of decisions.

Important note: the guidance in this report is not meant to be a substitute for legal support, but an aide to preempt the issues which normally arise during discussions with legal advisors and prospective partners. Identifying in advance the items that need to be agreed upon during negotiations should enable both parties in technology transactions to consider the various aspects of the deal more objectively and to reduce the stress that can arise in future discussions.

We therefore recommend reviewing the issues highlighted in this guide prior to engaging in formal negotiations with an external party and potentially even before seeking advice from a legal team. We often heard of situations in which parties started negotiating without a clear idea of the objectives they wanted to achieve. Those involved felt that in such circumstances they could not 'think freely' and were liable to take impulsive decisions based on emotional rather than objective criteria.

Target readership

This report is particularly relevant for managers involved in technology acquisition decisions such as senior managers in R&D and supply chains, (open) innovation managers, IP officers, product, business and finance managers.

The report is expected to be particularly helpful for those who tackle these difficult decisions for the first time.

It is also expected that this document might be useful to those who are selling their technology to help them anticipate potentially contentious discussions.

Steps involved in technology acquisitions

The process of technology acquisition is illustrated in the figure opposite. In their most simple form, technology acquisitions require:

- Identification of attractive technologies or partners with technological capabilities
- Assessment of these opportunities, selection of the most promising ones and consideration of the terms of the acquisition
- Negotiation of the terms of acquisition between acquirers and sellers;
- Transfer of the technology to the acquirer, if these negotiations have been successful.

The assessment and negotiation stages form a cycle as it is expected that the terms discussed during negotiations will need to be re-assessed before acceptance.

The focus of this report is the second stage of this process, involving the assessment of the technologies and the organisations that own them and the evaluation of all the acquisition opportunities (highlighted in the technology acquisition process opposite). The report sections are structured around the following three stages:

Section 1: Acquisition context

Understanding and defining the issues that need to be to considered. This section leads to the definition of a detailed framework for the acquisition, including the acquisition motives, the different types of partners that could be involved, the desired technology readiness level and an overview of the most likely technology acquisition scenarios.

* See Appendix for a definition of technology

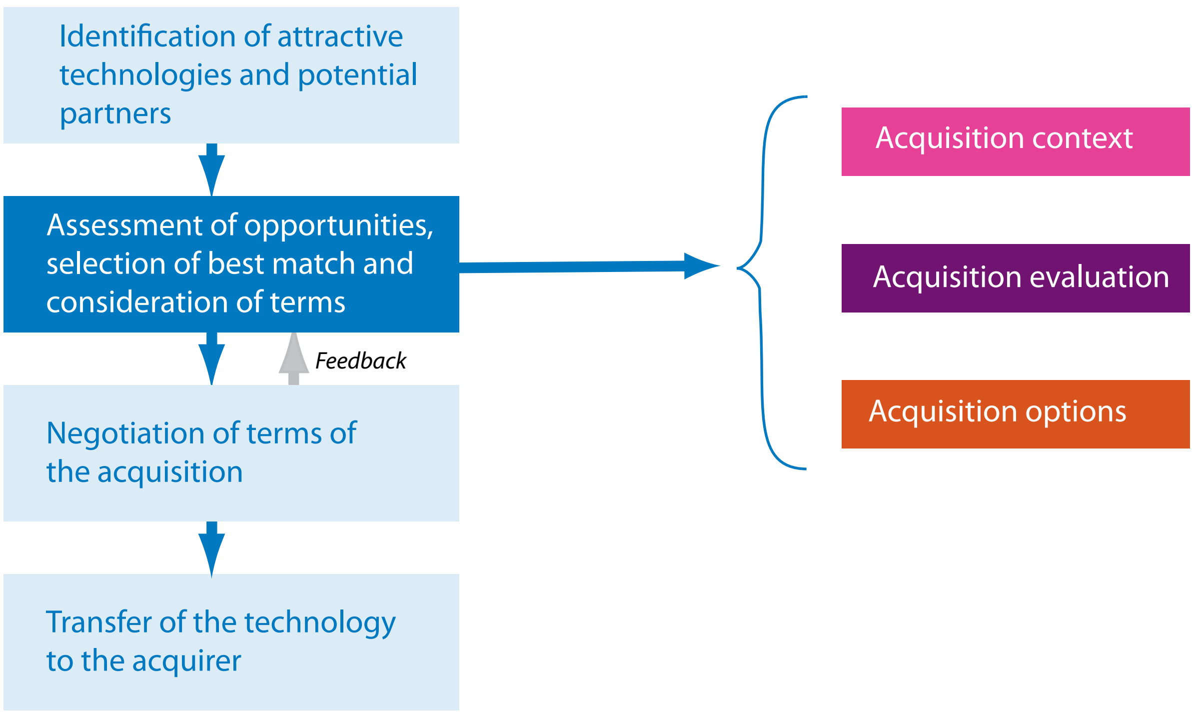


Figure 1: The technology acquisition process

Section 2: Acquisition evaluation

Assessing whether a potential acquisition is a good match. Technology acquisition involves assessing the match between technological capabilities and market opportunities, as well as the capability of the firm to absorb and make good use of the technologies that other firms are developing. This section provides a checklist of questions to evaluate the partner-technology-absorptive capacity combination.

Section 3: Acquisition options

Considering the detailed terms of the acquisition. If the evaluation of a potential acquisition has yielded a positive result, the next step is to consider the detailed terms of the acquisition. This section provides guidance to evaluate the different options associated with such issues as future technological development, exploitation routes, protection strategies, the type of contract governing the relationship and the transaction 'currency'. It provides open ended questions and case study examples to support evaluation of the advantages and disadvantages of each strategic option. It is recommended that the possible options are discussed widely within the company involving as many roles as possible, including, (open) Innovation and R&D managers, IP and legal officers, and Product, Business and Finance managers.

Report approach

In each section of the report key aspects of the acquisition are discussed in detail to provide the reader with an understanding of the issues involved and to identify potential risks and plans to overcome them.

Information about the research undertaken to produce this report is given in the Appendix.

Viewpoint

Throughout the report viewpoint boxes give examples of the views and experiences of some of the companies involved in this research.

Action point

Green boxes identify action points where you can assess your own company's position in relation to what has been discussed. Checklists and other tools are provided to support this. Some assessments are qualitative and some quantitative, but all are designed to prompt discussion and analysis of the complex issues involved.

Section 1: Acquisition context

Before making any decisions in relation to a proposed technology acquisition it is essential to consider the context in which it is taking place and to identify the key issues involved. A structured approach will help to reduce the complexity of all the possible scenarios and ensure that those involved remain objective and focused on the most important questions.

In this section we propose three key questions that firms need to consider in order to define their acquisition context:

1. Why do we want to acquire the technology?
2. Who are we going to acquire the technology from?
3. How mature is the technology and how might this affect our acquisition options?

Finally we look at some approaches that companies have used to help narrow down the sometimes bewildering number of options and identify the most appropriate acquisition strategy for their firm.

1. Why do we want to acquire the technology?

An organisation's motive for wanting to acquire a technology will affect the kind of technology they are looking for, the partners from whom they decide to acquire it and the process they follow to make the acquisition.

Previous research[14] indicates that there are a wide variety of motivations. We find that these motivations can be broadly classed into four categories:

- Developing new technological capabilities
- Increasing strategic options
- Gaining efficiency improvements
- Responding to the competitive environment.

We will discuss each of these in turn below. A checklist is provided to help you discuss the issues and identify your company's motives.

Developing new technological capabilities

One of the fundamental motivations for the acquisition of external technologies is the need to develop new technological capabilities and to fill gaps in the R&D knowledge base. The objective of these acquisitions is sometimes to fill holes in an existing product line, while in other cases it is to create and establish a brand new product. This need may arise because specialist technical expertise and capabilities are often difficult to obtain and firms may not have the ability to develop these valuable knowledge-based resources internally. This may be the case, for instance, when the technological knowledge of a firm is close to exhaustion and most of the possible technological combinations have already been tried.

Increasing strategic options

Acquisitions can enable a firm to improve its strategic flexibility. Increasing its internal technological capabilities, can give the company more strategic options, allowing it to select the best available technology. For example:

- Acquisitions can encourage innovation, countering inertia and rigidity and increasing R&D productivity. Relying on incremental improvements to existing technologies may limit a firm's potential. Experimenting with novel and emerging technologies can provide opportunities for more radical innovation.
- Acquisitions can open new markets, allowing the knowledge of new customers, channels, inputs, processes and markets to be exploited.
- Acquisitions may help to deal with uncertainty and risk. Companies operating in high-tech industries are often dependent on uncertain future outcomes or developments. In such cases, managers are more likely to avoid risky internal investments in R&D with long-term payback periods, investing instead in external technologies as a way of keeping their options open until the risks and uncertainty diminish.

Gaining efficiency improvements

The need to innovate more rapidly is another motivation for technology acquisition as it can reduce the time to market. The internal development of new capabilities may take too long or be too costly. Technology acquisition can create these more quickly so that the firm can be more responsive to market demands.

There are often cost advantages to acquiring technologies externally. Firms substitute fixed investment costs with variable acquisition costs and such costs can be recovered via profits from new businesses that follow a partnership-based strategy.

Responding to the competitive environments

Firms are more likely to consider technology acquisitions as environments become more hostile, when there is rapid technological change and fast-moving competition in their market area. Acquiring technologies helps the firm to feel less vulnerable and more competitive. In such an environment it is likely there will be a greater use of partnerships, collaborations and outsourcing as a substitute for in-house activities.

Checklist 1: identifying your firm's motives for technology acquisition

		Weight (0-10)	Description
Motivations	Develop technological capabilities		Is acquisition sought to: • fill gaps in firm's own R&D base or capabilities? • fill holes in an existing product line? • create and establish a new product for the firm? • overcome technology exhaustion?
	Increase strategic options		Is acquisition seen as: • an opportunity to increase capabilities in light of changes in the firm's environment? • away of overcoming internal technological constraints in order to enhance strategic flexibility? • a means to access the best available technology in the future?
	Gain efficiency improvements		Is the acquisition seen as a means to: • reduce development time? • reduce costs? • increase customer interest (particularly in periods of rapidly changing demand)?
	Respond to the competitive environment		Is acquisition important because: • technology markets are emerging? • environments are more hostile? • there is rapid technological change? • there are fast-moving competitors in the market area?

Action point

Use the checklist above to help you identify your firm's motivations for acquisition. Involve as many people as possible in the discussions. The checklist can be adapted to suit your particular circumstances. The 'weight' column can be used to reach a consensus and prioritise the specific acquisitions objectives. This quantitative approach can be very useful in helping to make the issues more objective and eliminate personal bias. A suggested approach is to use a 0 (not important) to 10 (very important) scale, assigning a value to each of the possible motivation areas. It is important to be really clear about the motivations of an acquisition before making any assessment of specific acquisition opportunities. The results of this exercise will help to inform the evaluations that you make in Section 2, when possible alternatives are considered. Undertaking this exercise should prevent individuals' personal views taking priority over the 'big picture'.

2. Who are we going to acquire the technology from?

Technology can be acquired from a number of different kinds of sources including private companies, universities and government agencies. It may be acquired from a single organisation, or more than one can be involved, sometimes in the form of a consortium. It is very important to understand the characteristics of your potential partner(s) as these will determine their expectations and behaviour during collaborations. Possible partnership options are shown in Figure 2 opposite. Examples of the different perspectives and characteristics of some of the organisations that may be involved are discussed below.

Universities

Universities are increasingly interested in the commercialisation of research[29] but are generally inexperienced in commercialising IP.[18] Regulations regarding ownership of academic research outputs vary from country to country[33]. The Bayh Dole Act[20] has drastically modified the relationship between firms and US academia for instance. Furthermore, an element of tension exists between academics who wish to publish results and industry which prioritizes the filing of patents. An additional issue is that high turnover of people in academia might lead to information leaks.

Start-up companies

Start-ups can be an important source of ideas for larger companies. However, they are typically lacking in resources and business knowledge and are often subject to the influence of their investors (e.g. Venture Capitalists). They may be more flexible but also more 'volatile' than established firms. They may own only one technology and the fear of losing control over it might lead to over protective attitudes.[24, 25]

Partnerships between start-ups and established firms can be mutually beneficial. Research shows that making such partnerships work may be problematic, but there are ways to increase the chances of success.*

Consortia

Consortia are becoming more common. A firm gets together with other types of organisations (any mix of universities, industry and government bodies) typically to tackle complex technological issues which would be difficult to deal with in isolation. Consortia are more common in industries with long technology life cycles such as pharmaceuticals. This industry requires access to a wider set of competences beyond the traditional areas of chemistry and pharmacology - such as molecular biological, nanotechnology and computational science - to guarantee future innovation.[2]

Viewpoint

Universities fall into two categories. The easiest to work with are universities with a track record of spin-outs or technologies that have already been brought to market, and a good technology transfer office. The more profit-driven universities are really hard to work with. Either it is too difficult to negotiate with them or they don't know how to negotiate at all. Early-stage companies are generally easier to work with but their expectations can lead them to overrate the value of their IP, while some don't have a good understanding of what transferring technology really means.

Open innovation manager, electronics company

Universities are difficult. They want to own the IP and behave like SMEs and inventors. They are unaware of, or ignore the costs of scaling up a technology. Large companies understand the rules of the game. Valuing a technology is not about personal judgement. With small companies there is always an enormous emotional stake. Furthermore, small companies often try to do their patents cheaply using a friend as patent attorney without thinking properly of the consequences

Acquisitions manager, large company

* www.ifm.eng.cam.ac.uk/ctm/research/projects/alliances.html

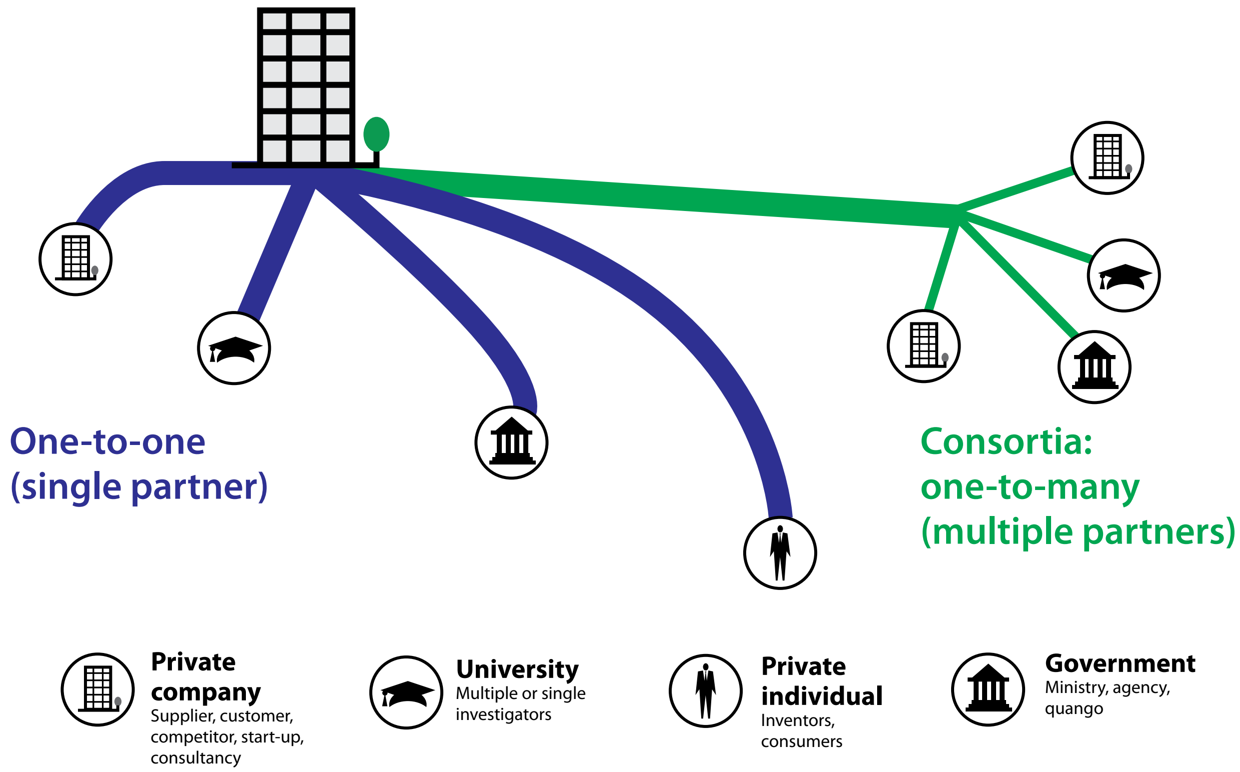


Figure 2: Possible partnership options for technology acquisitions

Viewpoint

There are big differences in how consortia work: 1) Pre-competitive research consortia: these are an important mechanism to share risk and investment with others. 2) Consortia instigated by policy makers: these could be a bad investment as the government dream up a project and fund it. These consortia do not work as there is no real motivation behind it for the participants. 3) Consortia organised along a supply chain or those sponsored by professional associations: these resemble joint R&D projects in which many companies are paying for one firm to do the work. These work well if there is a key champion, who pushes this collaboration forward, although participating in these could mean being driven by other firms' strategic ambitions.

Senior manager, large energy firm

3. How mature is the technology?

The technology you plan to acquire will typically require further development. Its level of 'maturity' may range from something that is simply a new scientific phenomenon right through to a technology that is almost market-ready. The maturity level – and the amount of work needed to bring it up to the level your firm requires – are obviously highly significant factors to consider in the context of any acquisition. There are various ways of measuring the maturity of a technology and we discuss these below. It is important to be aware, however, that how you assess technology maturity levels depends on your particular situation and is affected by your company's motivations for the acquisition.

Measuring technology maturity levels

One approach to measuring technology maturity levels are the reference scales used by NASA.[22] These are frequently used in the context of aerospace innovation.

An alternative metric is provided by the STAM (Science, Technology, Application, Market) model[28] (see box, right). According to this model a technology starts with its *scientific* underpinnings, then develops into a technology, leading to an application and finally to the market. The knowledge transfer mode will vary, depending on the technology's maturity level at the beginning of the collaboration and its desired final development stage.

The STAM model of technology development phases

S = Science Development of understanding of scientific phenomena (and/or underpinning technology platform)

S➔T = Science/Technology transition: Demonstrating the feasibility of a scientific phenomenon (and/or underpinning technology) to support a new market-directed technology platform, showing the feasibility of the supporting science and technology to be integrated into an application-specific functional technology system.

T= Technology Technology emergence. Improving the reliability and performance of the market-directed technology to a point where it can be demonstrated in a market-specific environment.

T➔A = Technology/Application transition: Developing the technology and application to a point where commercial potential can be demonstrated through revenue generation.

A= Application Improving the price and performance of the application to a point where sustainable business potential can be demonstrated.

A➔M = Application/Market transition: Translating price-performance demonstrators into a market with mass growth potential.

M= Market Marketing, commercial and business development leading to sustainable industrial growth.

Action point

Use the framework opposite to discuss your company's options for acquiring a particular technology in relation to its maturity level. An example is provided on page 12 of how one company set about this task.

Framework 1: technology sources and technology maturity levels

Current and expected technology maturity levels	Potential sources for the technology						
	One to one						One to many
	University	Governmt	Individual	Consultant	Large comp	Small comp	Consortium
S Very low							
T Low							
A Medium							
M High							

Action point

This framework is based on the STAM maturity system (see box opposite). Some combinations of technology maturity level and source may not apply to your situation but using this structured approach should help to clarify the implications of the options available.

Involve as many of your colleagues as possible in the discussions. Consider the anticipated strengths and weaknesses of each possible source. Discuss both the initial maturity of the technology and the desired maturity level, post acquisition.

Useful questions to ask

- What types of organisations could be considered as a source for the technology?
- What are their key characteristics?
- What are their motivations in selling/giving the technology to us?
- What alternative partnering options could we consider?
- What degree of maturity characterises the technology currently?
- What degree of maturity will the technology have at the end of the acquisition?

Case example

Current and expected technology maturity levels	Potential sources for the technology						
	One to one						One to many
	University	Governmt	Individual	Consultant	Large comp	Small comp	Consortium
S Very low		↓					
T Low		↓					
A Medium							
M High							

Current and expected technology maturity levels	Potential sources for the technology						
	One to one						One to many
	University	Governmt	Individual	Consultant	Large comp	Small comp	Consortium
S Very low	X	X			X	X	↓
T Low	X	X			X	X	↓
A Medium							
M High							

A firm in the aerospace sector is considering a collaboration with a Government scientific organisation. The key characteristic of this organisation is that it is 'not-for-profit' and hence its objectives for the collaboration are very different to the firm's. For example, it aims to reinvest the payment it receives from the company in further research and in this way meet the expectations of the Government, a key stakeholder. Being clear about the expectations of its prospective partner helped the aerospace company to anticipate future problems. The framework above supported a discussion concerning the possible forms such a partnership could take in relation to the acquisition of very early stage technology. The discussion showed that there was an alternative to a one-to-one relationship between the aerospace firm and the not-for-profit organisation. This involved a consortium of industrial and academic partners. Forming a consortium could require those involved to contribute to its cost. Alternatively, external funding could be found, for example through European grants. A grant might impose constraints on the partnership composition. For example, the consortium might need to include different kinds of members.

The framework enabled the company to explore the pros and cons of the different approaches. The figures above depict both options (one-to-one and a consortium). The arrows indicate the desired increase in the technology's maturity level to be achieved as a result of the partnership. The Xs indicate the potential partnership composition of the consortium.

Narrowing down the options

Experienced managers have devised ways of narrowing down the sometimes bewildering number of options available in relation to technology acquisitions.

They have found it is of fundamental importance to clarify the context of the acquisition, in order to constrain the number of options and reduce the complexity of all the possible acquisition scenarios to a manageable set. Developing an overall acquisition framework will help during the evaluation of the proposed acquisition discussed in Section 2.

Below we show examples of how two companies have set about deciding the most appropriate acquisition strategies for their firms. Both approaches are particularly relevant for firms acquiring technologies to be exploited in their products or services.

Viewpoint

"As the number of potential combinations of the dimensions which regulate and define the acquisition is very high, defining 'a priori' the guidelines to follow in the most likely acquisition circumstances helps by greatly reducing the degrees of freedom. It is like performing a design of experiment."

IP manager, large aerospace company

Example A: Chemical company

Market in which technology will be employed		Technology readiness level		
		Research	Development	Commercialisation
	Current market	Not very common – company's own internal research team more likely to achieve progress.	This is most common situation. May involve in-licensing, joint venture or merger and acquisition. Typical partners are SMEs and other firms.	Not common.
	New market	For example partnership with a university. Technology could be co-developed under an umbrella agreement, or might involve partial equity investment which allows the company to be once removed from the risk.	Unlikely scenario.	Unlikely scenario.

An experienced R&D manager of a chemical firm suggested considering possible technology acquisition scenarios in terms of:

The readiness level of the technology

At what point in the innovation process will the technology be acquired? This might be at the research stage, during the development stage, or close to commercialisation.

The market in which the technology will be employed

Will the technology be applied in an existing market or one which is new to the firm?

This simple framework helps support discussion of the various potential acquisition options.

Example B: Aerospace company

Readiness of the market		Readiness of the technology: Ready	Readiness of the technology: Not ready
	Ready	This is a quite common scenario in which we need to de-risk the acquisition as much as possible, either financially or technologically. We typically stage the acquisition, and 'test' the technology by setting up a collaboration during which we mix our IP with that of the partners. At the end of this first co-development we might have three options. 1) We transfer the technology to our partner, retaining the right to use it. 2) We acquire the technology and agree the other partner's rights to use it. 3) We part company maintaining for a certain time the right to use what we developed together.	This is the 'buy' scenario. We may use different acquisition approaches such as buying up an entire firm, licensing in a technology or setting up a joint venture.
	Not ready	This is the 'speculative' scenario, a very common one in our highly regulated industry. As the market is not yet ready, we are in the pre-competitive realm. We typically go for the consortia or 'clubs' in collaboration with other firms. We create a different institution (e.g. a firm, or to keep the costs down, we use government funds and bodies) setting up clear responsibilities and rights over future IP for all the participants. We look hard to anticipate potential future scenarios and embody them in the terms.	This is the 'game-changer' scenario. We would like to do this more and be able to acquire technologies which could change the way in which we do things. However this requires internal reconfiguration and hence these acquisitions are more difficult. We need to work hard on the absorptive capacity required.

A highly experienced IP manager of an aerospace firm suggested considering technology acquisitions in terms of:

- **The readiness of the market**
- **The readiness of the technology**

The table above shows the kind of issues the company needs to consider in each of the four scenarios that this approach produces.

Section 2: Acquisition evaluation

Once you have identified a technology you want to acquire and a possible source from which to obtain it, you need to thoroughly assess whether the proposed acquisition is likely to meet your needs. This section will help you do this in a structured way in terms of three main factors:[13]

- Your company's ability to absorb and use the technology
- Compatibility of you and your potential partner
- Suitability of the technology for your needs

The issues involved in relation to each of these factors is discussed below, followed by a series of quantitative checklists which can be used to assess a particular acquisition for your own company.

Absorptive capacity: can you assimilate the technology?

Firms that possess a large stock of knowledge are more likely to acquire technologies externally because they themselves are more capable of identifying and absorbing new knowledge. This capability is termed 'absorptive capacity' and represents the ability of the firm to evaluate, appropriate and make good use of external knowledge. Firms with superior absorptive capacity are able to innovate and be profitable by being more effective at either selecting or deploying resources than their rivals. A firm's absorptive capacity will therefore relate to:

- Its level of technical knowledge concerning the technology to be acquired.
- Its level of experience in acquiring technology and its own R&D capabilities. Previous experience of technology acquisition and high technological knowledge may predispose firms to make acquisitions because they perceive themselves to be capable of selecting and absorbing targets.
- Its stock of intellectual property (IP) relating to the technology to be acquired. Depending on the competitive structure of the industry, different types of protection mechanisms can be used to protect and pave the way for future innovation and acquisitions and to block other innovators.
- Its willingness to accept new ideas and technologies from outside the organisation. As successful organisations grow they tend to develop shared expectations about how things are to be done, leading to forms of cultural resistance to change. This cultural inertia is difficult to address directly and is exacerbated by the tendency of organisational departments to develop resistance to new technologies and ideas. The 'not-invented-here' (NIH) syndrome is a risk for acquisitions when external ideas and technologies are rejected by in-house engineers and managers.
- Its flexibility in adopting new routines. Organisations develop highly structured routines in order to reduce the costs associated with certain types of information acquisition and coordination. As a result, organisations tend to exploit existing knowledge and capabilities, avoiding more exploratory activities. It is hence important to understand that the acquired technology can challenge existing routines in a way that the organisation might find difficult.
- Internal support. Achieving internal organisational buy-in is important when bringing new technologies into the firm as the mismanagement of the integration of the technology into the firm can often lead to failure. Support is necessary for the acquisition project in order to ensure the necessary internal resources to assimilate and exploit the technology.
- Sharing knowledge with external partners. Partners need to be ready and willing to share information and understanding with each other. This can be particularly challenging if the companies involved are significantly different in size and experience.
- Applying acquired technology in new products. The company needs to have enough understanding of the new technology to be able to apply it in their products.
- Exploitation of the technology. Technology acquisitions are likely to be most successful if the acquiring firm is able to exploit the new technology in multiple ways.

A firm's absorptive capacity can be increased as a result of the education, training and/or experience of its employees. Firms may attempt to increase their absorptive capacity by sending employees on advanced technical training.

Action point

Use Checklist 2 on page 19 to assess your own company's ability to absorb new technologies. See instructions on page 18 for completing the checklist.

Partners: how compatible are those involved?

The next part of the process involves evaluating the level of compatibility between you and your potential partner and includes what is often referred to as 'due diligence'.

An important first step is to consider the relationship that may already exist between you. How well do you know your partner to be? Have you worked with them before? Trust is central to such transactions (see Developing good relationships page 33) and a good relationship can provide the basis for further, deeper partnerships in the future.

If there is concern about the motives of one of the partners in collaborative acquisitions, measures can be put in place to limit knowledge exchange between the collaborators. For example, in certain types of alliances gatekeepers limit the number of personnel actively involved in alliance management, and control key operational tasks.

The level of strategic alignment between potential partners is another important contributor to their likely compatibility. This includes:

- A shared strategic vision on alliance aims. Do the partners understand each others motives and what they stand to gain from the transaction?
- Compatible alliance and corporate strategies. Will the alliance work in ways compatible with the needs of those involved?
- Shared view of the strategic importance of the alliance. Is the alliance equally important to the partners? Everyone involved should ideally be equally committed if the alliance is to succeed.
- Mutual dependence. Are the partners mutually dependent on each other for the alliance to succeed?
- Potential for the alliance to add value for clients or partners. Will the alliance meet the needs and expectations of other stakeholders?
- Market acceptance of the alliance. Will customers, competitors or government bodies see the partnership in a positive light?
- Technical capability. Does the potential partner have the necessary technical capability to make the partnership a success?

Other factors to consider that may affect partner compatibility include the working style and organisational structures of each organisation. Mismatched organisational structures, excessive physical distance and incompatible communication technologies can all make interpersonal interactions difficult. For example, in partnerships between large firms and start-ups, the firms operate at a different pace. They will have different modes of decision-making and the personal objectives of employees are likely to vary. Furthermore, organisations from different regions may exhibit significant cultural differences.

Finally, any prior experience of entering into alliances or technology transactions is another factor to take into account. If the technology owner or partner has experience in the anticipated form of technology transfer, whether licensing, consortia, spin-outs or joint ventures, then the project is more likely to be successful.

The absence of these components suggests that the proposed technology acquisition is less likely to be successful. Firms should be particularly aware of these issues when entering into alliances or partnerships with competitors.

Action point

Use Checklist 3 on page 22 to assess the compatibility of your company and its potential partners. See instructions on page 18 for completing the checklist.

Technology: is it suitable?

Finally you need to decide whether the technology itself is suitable for your needs. First consider your objectives for acquiring the technology in the first place and make sure your proposed acquisition meets these objectives. See *Why do we want to acquire the technology*, page 6 for a discussion of possible motives for acquiring a new technology.

Other important factors to consider when assessing a technology's suitability include its potential commercial value. Establishing a valuation for an early stage technology can be problematic however. There will be a high degree of uncertainty in relation to both the technology and the market, together with uncertainties surrounding the transaction itself. For example, when undertaking a merger and acquisition (M&A) in order to acquire a new technology or technological capability, there is usually a high level of information asymmetry between the acquirer and the acquired firm. These skills and knowledge are difficult to value. Furthermore, managers may fall in love with some aspect of the technology and be overly optimistic about the value of their prospective partners, failing to recognise that there are really no gains in takeovers. A number of tools can support technology valuations including Portfolio Analysis, Real Options, Net Present Value, and Value Roadmapping among them.[32] *

IP is another issue to consider when acquiring early stage technology via collaborative development modes (e.g. alliances, consortia and joint ventures). Existing IP titles, particularly patents, are considered useful when acquiring the technology as they can be used as 'currency' or 'bargaining chips' to help avoid delays.

The ease with which any technical challenges can be overcome during future development of the technology is another factor to look at when assessing its suitability. Overcoming such challenges will depend on gaining access to various kinds of knowledge:

- **Know-how:** the skills of employees and the ability to make use of these skills.
- **Know-what:** specific technical and market knowledge relating to the technology, including technical details, procedures, manuals.
- **Know-who:** the knowledge and understanding of technically expert contacts and organisations along the supply chain who can make the technology work.

The technology will consist of both the codified knowledge of its operation in documentation and the tacit knowledge that exists in the minds of those who developed it. Acquiring this tacit knowledge without input from these individuals is often expensive and time consuming. Accordingly, the simultaneous acquisition or retention of these key personnel is a significant factor in the further development of the technology. It is important for the acquirer to recognise this tacit knowledge and the need to access the complex network of relationships that often make further technological development possible.

Technology, and the knowledge that underpins it, can be difficult and costly to transfer. Consideration needs to be given to both the implicit and explicit aspects of technology transfer. The cost of acquiring the technology goes beyond the payment made to the technology's owner.

There are also transaction costs associated with the types of issues described earlier. These include an estimate of future costs, costs associated with any uncertainties concerning the acquisition, the need to acquire specific assets and how often it may be necessary to repeat such transactions.

Action point

Use Checklist 4 on page 24 to assess the suitability of a technology for your company's needs. See instructions on page 18 for completing the checklist.

* Dissel M., C. Farrukh, D. Probert and F. Hunt (2006). Multiple perspectives on appraisal techniques for new technologies: Examples from the aerospace industry. International Journal of Innovation and Technology Management 3(4): 421-439

Acquisition checklists

Checklists are provided on the following pages to help you to assess whether a proposed acquisition is likely to be successful. Although the tools are quantitative, their most important function is the identification of areas of concern and the evaluation of potential strategies to overcome any shortcomings. Hence, even if the final value obtained at the end of the exercise is positive, particular attention should be paid to the items which appear on the negative side of the scale and for which contingency plans will be required.

The results will be used to discuss and assess:

- Your company's ability to absorb new technologies and any risks this may present
- The suitability of both the proposed partner and the technology
- Any risks presented by the proposed partnership or technology and contingency plans to overcome these

How to use the checklists

- Checklist 2 is used to assess your ability to absorb the new technology into your organisation
- Checklist 3 is used to assess the compatibility between you and your prospective partner(s)
- Checklist 4 is used to assess the suitability of the technology to be acquired

Each checklist includes some common dimensions:

Column A: Items

Items to consider which could have a positive or negative impact on the proposed acquisition.

Column B: Items weight

In column B enter the importance you attribute to each of the items in column A. This weighting should range from 0 (no importance) to 10 (high importance). The weight given to each item is a subjective decision which depends on the specific skills, past experience and needs of the acquirer. Our research indicated the importance of seeking advice from someone with previous experience in acquisitions prior to carrying out this exercise. Add up the weightings and enter the total at the bottom of Column B.

Column C: Items score

After you have entered a weighting in Column B you can proceed to score all the items in terms of the particular acquisition opportunity you are considering. Rate each item between -3 (low) and 3 (High). The scale is meant to represent indicative estimates and not absolute values. Use the checklist to discuss each item in detail. Make sure that as many people as possible are involved in the discussion, to ensure greater objectivity.

Column D: Final score

Obtain the final score for each item by multiplying the relative weight in Column B with the score in Column C. Write the final score for each item in Column D. Add up the scores and enter the total at the foot of Column D.

Box E: Scale determinant

The checklists will help you analyse your company's position in terms of the key factors influencing the success of the acquisition. You can map the results on the charts on pages 21 and 26. Use the figure in Box E to determine the maximum and minimum figures of each axis of these charts. E is obtained by multiplying the total from Column B by 3 (the maximum value).

For example: in Checklist 2, add all the weights in Column B_1 and then multiply this number by 3. Record the value obtained in the respective Boxes (E_1 and $–E_1$) on the chart on page 21.

Repeat the same procedure for Checklists 3 and 4 and record the final results E_2 (and $-E_2$) and E_3 (and $-E_3$) on the chart on page 26.

Analysing the results

Use the charts on pages 21 and 26 to map your position. Remember, even if the results are positive it is still very important to review all the items in the checklists that appear on the negative side of the scale and make contingency plans to deal with any identified risks.

Checklist 2: Assessing your company's ability to absorb the new technology

A_1:Items	B_1: Weight 1-10	C_1: Items score							D_1: Final score = $B_1 \times C_1$
		Low			Average			High	
Our level of technical knowledge related to this technology		-3	-2	-1	0	1	2	3	
Our level of technological knowledge and expertise in acquiring technology		-3	-2	-1	0	1	2	3	
Our stock of Intellectual property (IP) related to this technology		-3	-2	-1	0	1	2	3	
Our internal acceptance of new technology		-3	-2	-1	0	1	2	3	
Our flexibility to adopt new procedures and routines		-3	-2	-1	0	1	2	3	
Our level of internal support for the acquired technology		-3	-2	-1	0	1	2	3	
Our capability to share knowledge with external partners		-3	-2	-1	0	1	2	3	
Our capability to apply technology in new products		-3	-2	-1	0	1	2	3	
Our capability to exploit and reuse technological knowledge acquired from the external world		-3	-2	-1	0	1	2	3	
Total B_1 =								Total D_1 =	

Any negative scores require review

Box E_1: Total B_1 x 3 =

Worked example of Checklist 2

A_1:Items	B_1: Weight 1-10	C_1: Items score							D_1: Final score = B x C
		Low			Average			High	
Our level of technical knowledge related to this technology	7	-3	-2	-1	0	1	2	3	7
Our level of technological knowledge and expertise in acquiring technology	8	-3	-2	-1	0	1	2	3	24
Our stock of Intellectual property (IP) related to this technology	5	-3	-2	-1	0	1	2	3	15
Our internal acceptance of new technology	5	-3	-2	-1	0	1	2	3	0
Our flexibility to adopt new procedures and routines	6	-3	-2	-1	0	1	2	3	-6
Our level of internal support for the acquired technology	7	-3	-2	-1	0	1	2	3	0
Our capability to share knowledge with external partners	4	-3	-2	-1	0	1	2	3	4
Our capability to apply technology in new products	8	-3	-2	-1	0	1	2	3	16
Our capability to exploit and reuse technological knowledge acquired from the external world	9	-3	-2	-1	0	1	2	3	18
Total B_1 =	59							Total D_1 =	78

Any negative scores require review

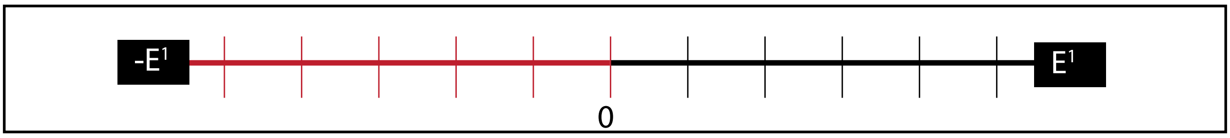
Box E_1: Total B_1 x 3 = 177

Assessing results from Checklist 2

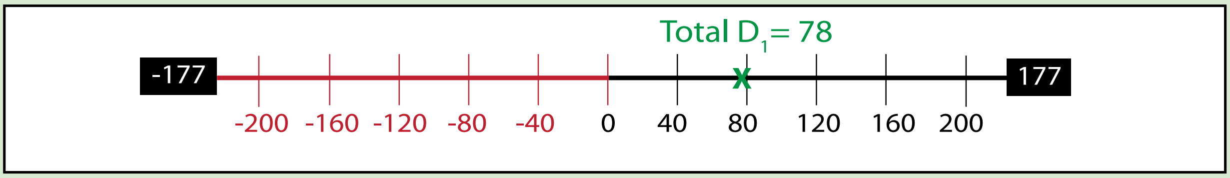
Use the scale below to map your company's capability to absorb and use the technology. Write the figure for E_1 (and $-E_1$) from Checklist 2 at either end of the scale below, to define maximum and minimum values. Map the total from Column B_1 onto this axis.

Risks and contingency plans

Areas of risk will be those items in column A on Checklist 2 with strongly negative values - even if your overall result is positive. If any of your scores are negative, it is important to consider how you could improve your company's capabilities in these areas and/or implement contingency plans to minimise any risks. Discuss each in turn and develop contingency plans to meet the potential risks you have identified.



Worked example based on scores in checklist 2



While the overall score in this example is positive, the negative score for 'flexibility to adopt new procedures and routines' should still be a matter for concern. What contingency plans can be put in place? Possible risks this could introduce need to be considered and measures developed to deal with them.

Checklist 3: Assessing compatibility between you and your potential partner(s)

A_2:Items	B_2: Weight 1-10	C_2: Items score							D_2: Final score = $B_2 \times C_2$
		Low			Average			High	
Previous knowledge of partner		-3	-2	-1	0	1	2	3	
A shared strategic vision on developments in the alliance environment		-3	-2	-1	0	1	2	3	
Compatible alliance and corporate strategies		-3	-2	-1	0	1	2	3	
Common strategic importance of the alliance to both partners		-3	-2	-1	0	1	2	3	
Mutual dependence between partners for achieving their objectives		-3	-2	-1	0	1	2	3	
Added value of the alliance to clients and partners		-3	-2	-1	0	1	2	3	
Market acceptance of the alliance (e.g. customers, competitors and government)		-3	-2	-1	0	1	2	3	
Partner technical capability		-3	-2	-1	0	1	2	3	
Partner working style compatibility (e.g. flexibility, trustworthiness, project delivery)		-3	-2	-1	0	1	2	3	
Partner previous alliance experiences		-3	-2	-1	0	1	2	3	
Total B_2 =								Total D_2 =	

Any negative scores require review

Box E_2: Total B_2 x 3 =

Worked example of Checklist 3 (see page 27 for results of this example)

A_2:Items	B_2: Weight 1-10	C_2: Items score							D_2: Final score = $B_2 \times C_2$
		Low			Average			High	
Previous knowledge of partner	9	-3	-2	-1	0	1	2	3	27
A shared strategic vision on developments in the alliance environment	8	-3	-2	-1	0	1	2	3	16
Compatible alliance and corporate strategies	6	-3	-2	-1	0	1	2	3	6
Common strategic importance of the alliance to both partners	7	-3	-2	-1	0	1	2	3	21
Mutual dependence between partners for achieving their objectives	5	-3	-2	-1	0	1	2	3	5
Added value of the alliance to clients and partners	2	-3	-2	-1	0	1	2	3	-2
Market acceptance of the alliance (e.g. customers, competitors and government)	8	-3	-2	-1	0	1	2	3	-16
Partner technical capability	9	-3	-2	-1	0	1	2	3	27
Partner working style compatibility (e.g. flexibility, trustworthiness, project delivery)	8	-3	-2	-1	0	1	2	3	24
Partner previous alliance experiences	6	-3	-2	-1	0	1	2	3	18
Total B_2 =	68							Total D_2 =	126

Any negative scores require review

Box E_2: Total $B_2 \times 3$ = 204

Checklist 4: Assessing the suitability of the technology for your needs

A_3:Items	B_3: Weight 1-10	C_3: Items score							D_3: Final score = B_3 x C_3
		Low			Average			High	
Degree to which the technology fits with our objectives		-3	-2	-1	0	1	2	3	
Degree to which the technology has potential commercial value		-3	-2	-1	0	1	2	3	
Degree of technology protection (All part of IP is covered by legal protection, the partner has legal rights over the background IP)		-3	-2	-1	0	1	2	3	
Ease of overcoming technical challenges		-3	-2	-1	0	1	2	3	
Degree of access to know-how (skills and their application to technology)		-3	-2	-1	0	1	2	3	
Degree of access to know-what (facts and principles underpinning the functioning of the technology)		-3	-2	-1	0	1	2	3	
Degree of access to know-who (social skills and personal relationships that support the technology)		-3	-2	-1	0	1	2	3	
Financial attractiveness of technology transfer fees (i.e. transaction fees)		-3	-2	-1	0	1	2	3	
Attractiveness of other transaction costs (evaluating and searching knowledge, screening options, processing and contracting, uncertainty, specificity of assets and recurring technology transfer)		-3	-2	-1	0	1	2	3	
Total B_3 =								Total D_3 =	

Any negative scores require review

Box E_3: Total B_3 x 3 =

Worked example of Checklist 4 (see page 27 for results of this example)

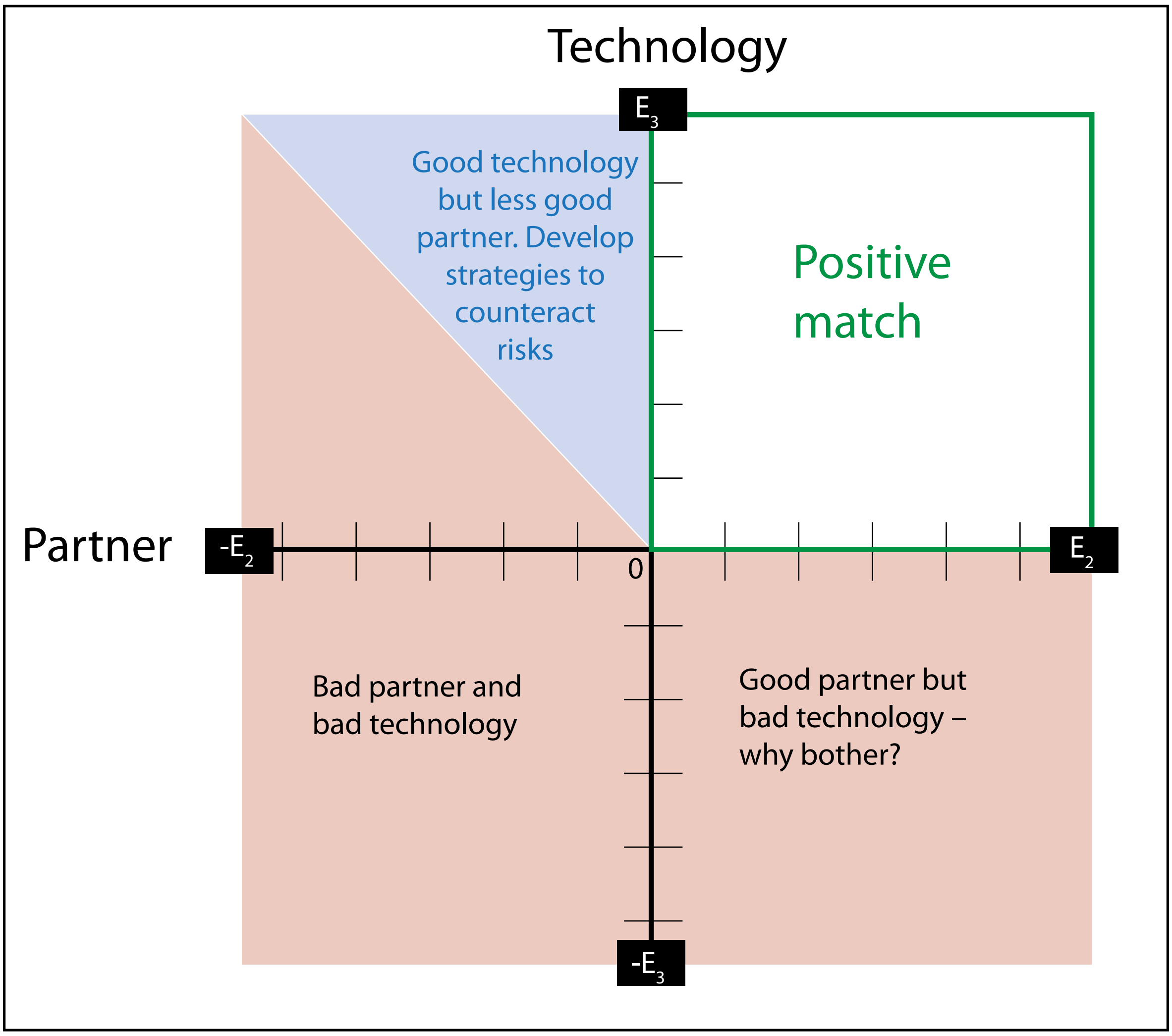
A_3:Items	B_3: Weight 1-10	C_3: Items score							D_3: Final score = B_3 x C_3
		Low			Average			High	
Degree to which the technology fits with our objectives	10	-3	-2	-1	0	1	2	3	20
Degree to which the technology has potential commercial value	6	-3	-2	-1	0	1	2	3	-6
Degree of technology protection (All part of IP is covered by legal protection, the partner has legal rights over the background IP)	4	-3	-2	-1	0	1	2	3	12
Ease of overcoming technical challenges	4	-3	-2	-1	0	1	2	3	0
Degree of access to know-how (skills and their application to technology)	8	-3	-2	-1	0	1	2	3	16
Degree of access to know-what (facts and principles underpinning the functioning of the technology)	8	-3	-2	-1	0	1	2	3	16
Degree of access to know-who (social skills and personal relationships that support the technology)	8	-3	-2	-1	0	1	2	3	24
Financial attractiveness of technology transfer fees (i.e. transaction fees)	6	-3	-2	-1	0	1	2	3	-6
Attractiveness of other transaction costs (evaluating and searching knowledge, screening options, processing and contracting, uncertainty, specificity of assets and recurring technology transfer)	9	-3	-2	-1	0	1	2	3	18
Total B_3 =	63							Total D_3 =	94

Any negative scores require review

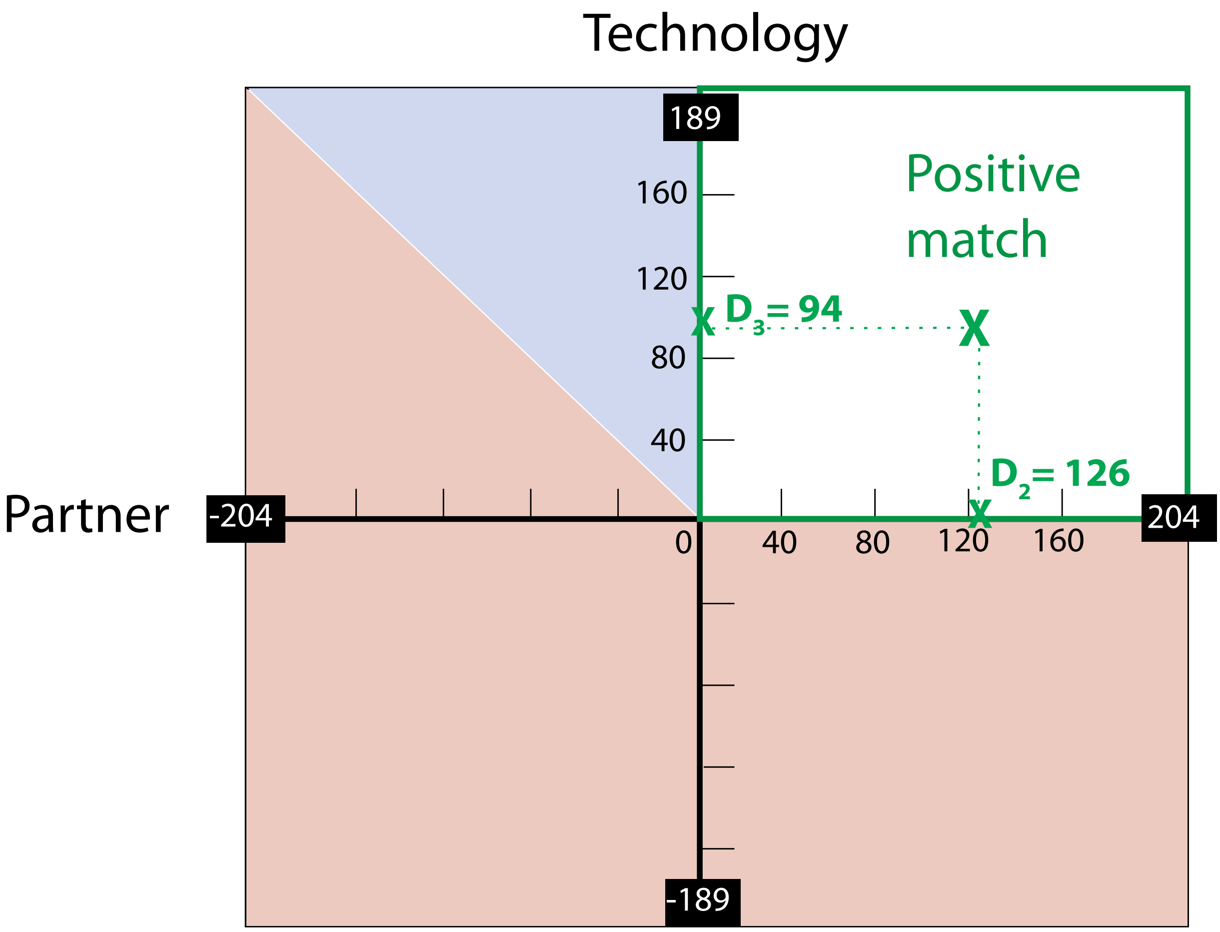
Box E_3: Total B_3 x 3 = 189

How to map results from Checklists 3 and 4

Write E_2 (and $-E_2$) in the black boxes on the horizontal axis of the chart below and write E_3 (and $-E_3$) on the vertical axis. Map the total scores from D_2 on the horizontal axis and D_3 onto the vertical axis and identify your final position on the chart (point where coordinates $D_2 : D_3$ intersect). If the final position ends in the red area, the pursuit of this acquisition will be challenging. If the final position ends up in the white space, there is a positive match and it may be a good acquisition to pursue. If the final position ends up in the blue area, the technology is very promising, but the partner might be not appropriate or ready. See worked example opposite.



Worked example mapping results from Checklists 3 and 4



Risks and contingency plans

While the overall score in the example above is again positive, any negative scores on either of the Checklists should still be a matter for concern.

Those on Checklist 3 indicate possible risks associated with your proposed acquisition partner. In our worked example, the negative ratings for market acceptance of the proposed alliance and its questionable value for clients and partners raise potential issues that need to be looked at carefully.

Negative scores on Checklist 4 indicate a problem with the technology. In the worked example there are questions raised about the potential commercial value of the technology as well as concerns in relation to the technology transfer fees.

What risks do these negative scores present and what contingency plans can be developed to deal with them?

Section 3: Acquisition options

This section will help you identify and evaluate the different options for regulating and managing the acquisition. We have divided these into seven areas:

- Future technology development
- Contracts and relationships
- Ownership of intellectual property (IP)
- Technology exploitation
- Rights to use a technology
- Exchange 'currency'
- IP protection

Evaluating these issues is intrinsically more speculative than the types of assessment made in the previous section. Frameworks and checklists are provided to help you consider all the issues involved, together with case study examples. We also identify the potential risks relating to the various options, so that these can be properly considered ahead of negotiations and protection strategies adopted if necessary.

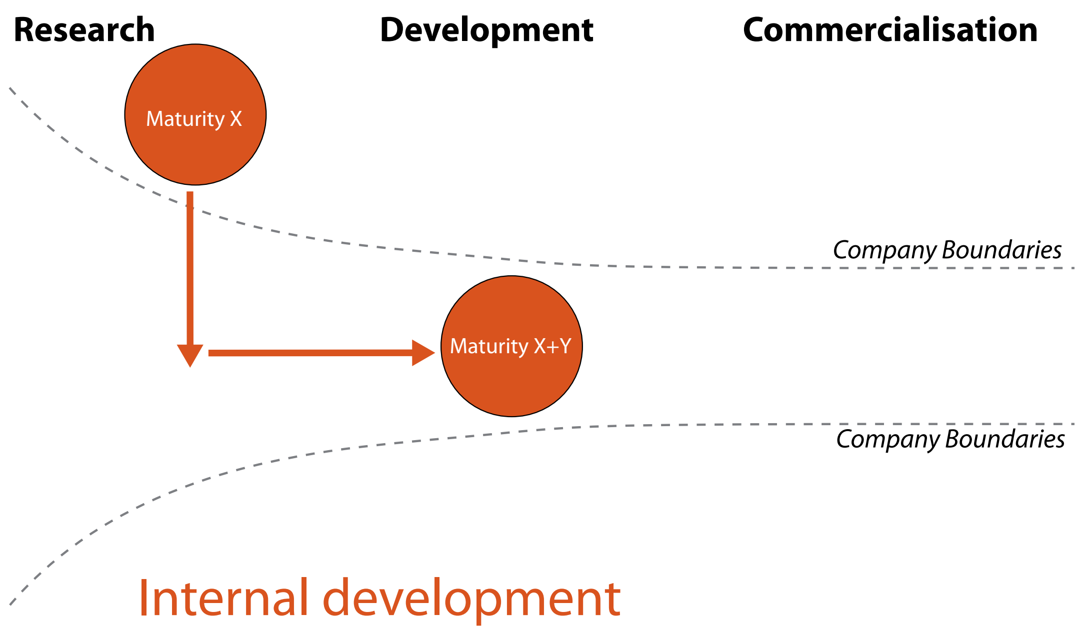
Future technology development

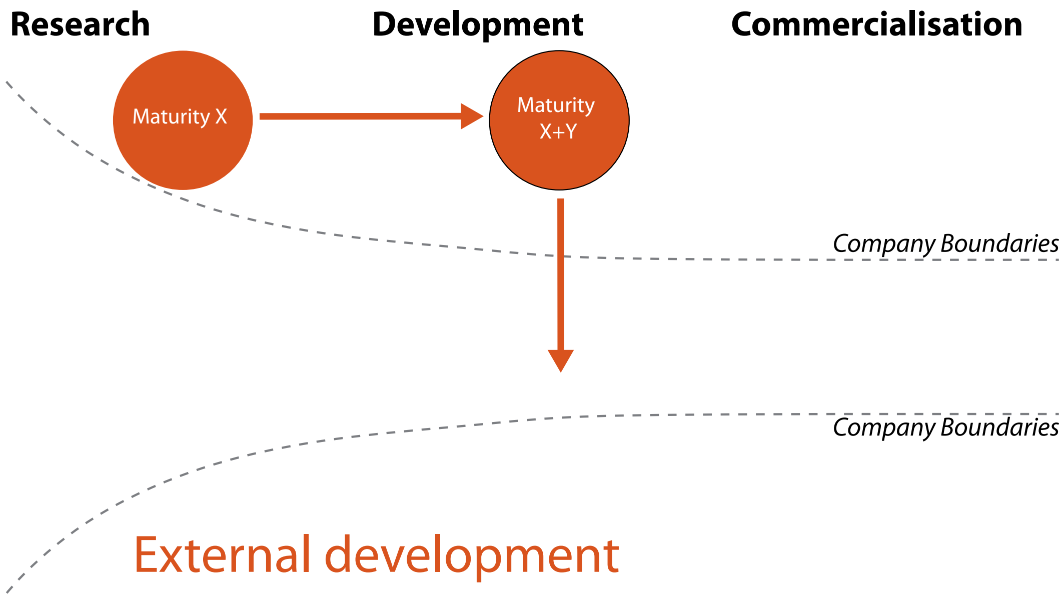
In most technology transactions, the technology is still immature and needs to be enhanced and developed to fit the needs of the firm. Knowledge has to pass between one party and the other at some point during this development. There are three main approaches to this: the technology can be developed internally by the acquiring company; it can be done externally by the technology provider; or it can be carried out collaboratively between the two. The choice of development path will depend on a number of things including the type of technology involved, the resources available, the degree of control the acquiring firm needs to maintain over the technology and the strategy driving the acquisition.

Internal development

When the technology to be acquired needs to fit very precisely with the company's products, a high degree of control over the development may be required and hence internal development may be preferred. This approach is particularly desirable where there are concerns over confidentiality.

> **Viewpoint**
>
> "The costs of integrating the technology into our products is very high. Because of our defence applications we are also concerned with information leaks. We prefer to acquire the license over a technology and deal with the development internally."
>
> *Technology manager, aerospace firm involved with security*

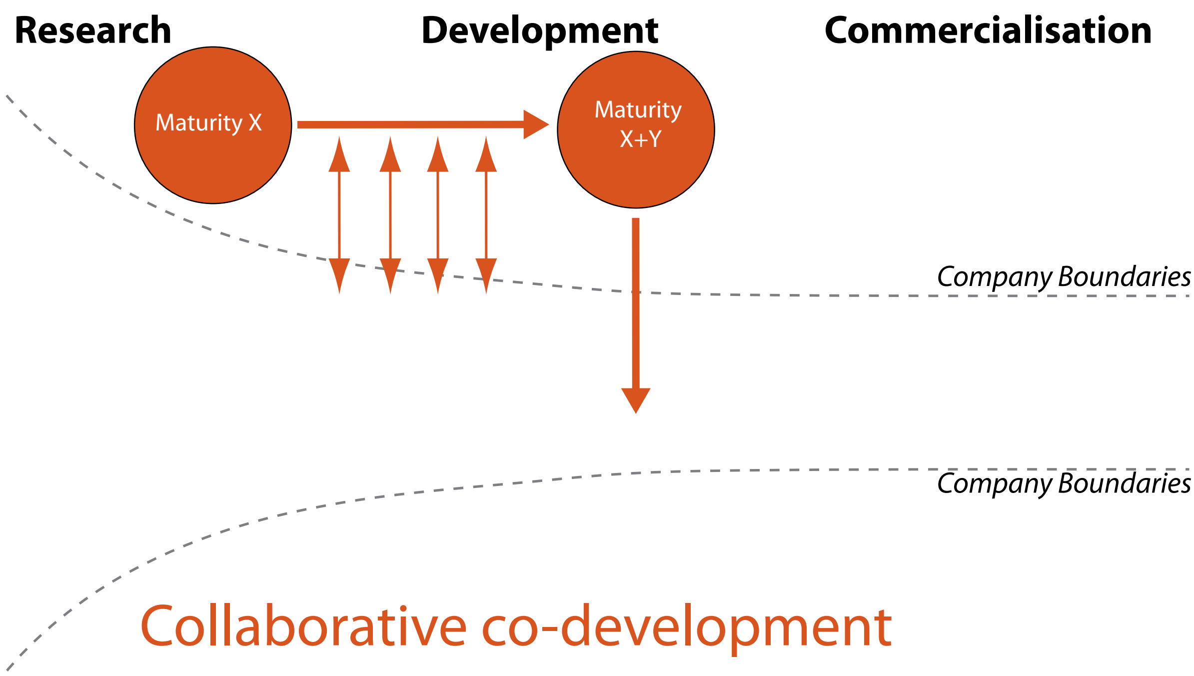




External development

External development

An alternative development path could be to give very detailed specifications to the external party so they can carry out the required enhancements to the technology. This is the preferred approach by firms who consider the cost of internal development is too high and prefer to obtain as mature a technology as possible .



Collaborative co-development

Viewpoint

For a chemical firm, the most important reason for acquiring technologies is to developing future opportunities.

"We want to create the conditions necessary to improve our access to future technological developments in a number of fields. It is about business renewal. We run a portfolio of projects with a particular university partner with whom we have set up a formal relationship to access their skills and competence on a continuous basis. We also share our own IP and take an active part in co-developing technologies. There is a continuous flow of information both ways and we have created a unique collection of competences."

Co-development

Other firms may prefer to co-develop a technology with an external partner or partners. This approach is likely to be preferred if they consider the partner suitable for strategic long term collaborations. In such cases, the knowledge will pass from one partner to another gradually, over a period of time. It could then be more formally transferred at the end of the relationship. This type of development requires the investment of a great deal of time and resources to manage the relationship effectively.

Contracts and relationships

Another dimension of acquisition to consider concerns the relationship between the parties involved. The form the relationship takes will vary according to the nature of the technology transfer. This may range from a simple contract for R&D services at one end of the scale, to a joint venture or even take-over by one company of another.

The formal relationship between the parties will be governed by some kind of contract designed to protect the parties during the transactions and act as a guarantee that the relationship will be profitable for both sides. Perhaps equally important is their informal relationship, which is based on the social norms and level of trust that exist between them.

Both these aspects of a relationship appear to be necessary to ensure the success of acquisitions.[31] We discuss each of these in turn below.

Contractual relationships

The contract is a written legal agreement between the parties which specifies the expected contribution of each partner, their benefits, duties and rights. It should also specify how risks are to be allocated and should pave the way for exit routes in the worst possible scenarios.

The contractual issues are most likely to be discussed during the negotiation phase. The problems and potential reasons for tension should be analysed in advance in order to design a suitable agreement which will prevent problems arising during the relationship. As one lawyer put it: "The negotiation process is a very difficult step. It is the process of divorcing whilst getting married".

Viewpoint

A legal firm with much experience in supporting small companies during technology transactions emphasised the emotional difficulty associated with setting up deals.

"There are situations in which the negotiation has been protracted for so long that one of the parties is really impatient and often desperate enough to get things going that they will lose objectivity in the evaluation of the terms of the contract. It is the legal team's responsibility to make up for this bias and prevent more costly errors. It is our role to be cynical."

Hence it is of paramount importance that legal support is accessed by both parties as soon as possible in order to minimise the risk of litigation at a later stage. One of the greatest risks in a relationship between 'asymmetrical' parties (e.g. large companies and small inexperienced ones) is the absence of appropriate legal support for the weaker party.[24, 25]

The main aim of the contract is to protect both parties, but, according to the professionals we interviewed it also has an important role in making the two parties feel at ease: "It helps both parties feel they are not being treated unfairly," said one OI Manager of a large firm.

What are the contractual options?

There is a range of contractual options for acquisitions based on the degree of commitment and involvement desired between the parties.[27] At one extreme technology acquisitions can take the form of short-term contracts for R&D services, at the other they might involve a joint venture or merger/acquisition between the two organisations. These two extremes represent a sliding scale of commitment between the parties, in which both the level of control, and of the resources required, increases.

There is no one ideal contractual arrangement to govern an acquisition. The choice is dependent on a range of issues both inside and outside the firm, including the degree of market uncertainty, the novelty of the technology and whether the parties involved have prior experience of working together.

Firms tend to tackle different types of uncertainty with different contractual arrangements.[36, 37] When there is a great deal of uncertainty and turbulence in the external environment, flexibility and reversibility are more important than control. In such circumstances firms prefer to carry out small and reversible investments. Corporate Venture Capital (CVC) is often used to manage the acquisition of high-potential, new technologies held by start-ups or other small firms. Through this mechanism, a firm acquires an equity stake in the venture. If the technology delivers on its promise, the investor is in a position to have first access to its application. Such an investment allows the firm to maintain a high degree of flexibility and also allows the option of withdrawing from the investment if the technology does not satisfy expectations or meet requirements.

While such an approach may be appropriate when there is high uncertainty, greater control may be considered necessary when the value of the acquisition opportunity becomes more certain.

Protection clauses

The contractual terms of the relationship could be made explicit in the contract or implied by statute*. The implied ones might sound obvious (for example, we generally know what type of duties, rights and responsibilities exist between us and the retailer when we purchase some petrol), but as many of them vary and depend on the national legal framework of different countries, it can be hard to know them all.

It is common for firms to customise the contract to suit their specific circumstances and explicitly address individual issues.

> **Viewpoint**
>
> We do not have a boilerplate contract although we have standard contracts which we customise for each collaboration.
>
> *Legal manager, multinational company*

Some standard agreements are published and constitute a good basis for customisation (e.g. Lambert's modular agreements†). Extra clauses may be included in the contract to protect the parties from specific risks. These may be needed, in particular, when a technology is being co-developed, and the final outcome of the transaction is less clear.

Examples of issues covered by a contract include:

Parties changing their minds

A 'right to exit on notice at will' can be negotiated to deal with one party's change of mind. In cases where one party leaves, this can involve a termination payment to compensate the 'innocent' party. A right to terminate if one party breaches the contract (and is behaving in a manner inconsistent with the contract) is normal. These clauses serve as a protection mechanism for the 'weaker' party and discourage leaving the partnership. In an investment context, Corporate Venture Capital (or other investors) will insist that small firms which enter a relationship with a stronger and established firm include what is known as a 'good leaver/bad leaver' clause – a mechanism to allow them to recover shares from a founder who leaves the partnership before the objectives are met.

The warranties and liabilities clauses are essential. They are contractual promises and are designed to provide a clear statement on which each party can rely regarding key aspects of the contract, typically IP. Breach of warranty gives the innocent party a contractual remedy, generally damages. It is normal, as part of risk allocation, to put a cap on the liability of the parties. Thinking about 'worst case scenarios' should help in constructing exit plans for difficult circumstances, for example if one partner is taken over by a competitor.

Contracts can include the possibility of using arbitration, naming a neutral arbiter who can be called in to resolve disputes. These mechanisms are designed to avoid having to go to court and provide a cost-effective process that helps to balance the relationship between small and large organisations.

Knowledge leakage

Confidentiality clauses can be included, for example, non disclosure agreements and limitations to publishing rights.

Non solicitation clauses provide a legal barrier to prevent 'stealing' staff from the other party.

Lack of good faith

A 'negotiation in good faith' clause can be included for contracts made in countries where there is no such legal requirement. This clause has the effect of increasing the commitment of the parties to act in a transparent fashion.

Underperformance

A 'use it or lose it' clause can be an effective way to guarantee that parties who agreed to do something within a certain time will comply. It is a particularly useful tool in cases where the transaction fee is linked to the achievement of the final results of the collaboration. For example, if one of the parties will gain royalties from product sales in which their IP has been used.

Procrastination and delays in reaching agreements

In contracts which define an ongoing relationship mechanism, an 'endeavour to agree' clause must be included to encourage parties to agree key issues that arise in the future.

Third parties' rights

A clause could be placed in the contract to protect others with whom one of the parties has existing obligations.

For example, in the sample of case studies we observed one party in a transaction (the seller) was part of an association of firms. In the transaction agreement the seller made it a condition that the acquirer could not

* Information in this section is based on a discussion with a lawyer specialising in technology transfer agreements.

† http://www.ipo.gov.uk/lambert

refuse to supply the products or technology to the other members of the association.

Future costs

Contract clauses can be included concerning possible future costs, for example the responsibility of the parties in relation to filing and maintaining patents.

Developing good relationships

A formal contract is not the only means of achieving a successful partnership or alliance. The less formal aspects of a relationship are also very important and these emerge from the social norms and level of trust that exist between the parties. A good relationship between the acquirer and the seller of a technology will create the flexibility needed to overcome any problems that may arise during transactions and to deal with unforeseen events.

Trust is very important to any form of successful partnership. The development of trust between the parties is likely to require time (and hence implicit costs). Firms between whom trust has been well established are more likely to repeat collaborations in the future.

The establishment of trust requires information to be shared regarding existing problems and future plans. Acquirer and seller both need to be clear about each others' expectations and to understand each others' needs. Trust is particularly important in situations where the acquisition process has to occur over a long period of time such as in the case of co-development or outsourced development. A practical way to establish good relationships is to use 'softer' terms in an agreement which will leave room for negotiation, flexibility and adaptability in an evolving situation.

Viewpoint

Using softer terms in an agreement is a potential way to foster trust. Whilst hard terms and an emphasis on the legalistic aspect of contracts will emphasise the contrasting perspectives of the two parties, using softer terms in an agreement will show good will and commitment and will help to establish a framework of cooperation. The softer wording will refer to 'standards' and 'terms' to be defined once the conditions (e.g. the value) around a technology becomes clearer.

Lawyer involved in partnership agreements

Viewpoint

Trust can be difficult to establish. Tension between partners may develop because they have quite different perspectives on a situation. For instance, small companies and universities have often been accused of having unrealistic expectations of large companies.

"The value of an idea is often the subject of lengthy discussions. Disagreements over this are frequently the reason why we decide not to work with a university. They do not understand how much more investment will be needed before a scientific concept or an idea can be successfully implemented in products."

Large company Alliance Manager

Action point

Use the framework on the next page to consider the pros and cons of different options for technology development in relation to your preferred mode of technology transfer, bearing in mind all the issues we have discussed so far in this section.

Framework 2: Technology development and contractual/relationship options

Development increasingly devolved →

Increased level of control & resources ↓

	Internal development	Co-development	External development
Contract R&D services			
In-licensing			
Joint research			
Partial equity			
Joint venture			
Merger & Acquisition			

Most likely scenarios

Greater levels of trust required

Use the framework above to discuss the pros and cons of different relationship options in terms of different development paths. The most likely relationship/development path combinations are highlighted in green.

Good relations between the parties will be especially important for the co-development and external development options. If you select these approaches consider ways to ensure that sufficient levels of trust exist between the organisations.

Questions to consider

- What type of agreement is more convenient?
- What type of technological development path would we prefer?
- What are the pros and cons of each contract type and development path?
- If we choose to co-develop or externally develop, can we ensure enough effort will be made to support the relationship?
- What types of arrangements can we put in place to guarantee that trust is established and maintained?

Useful information concerning partnership management can be found at: www.managingpartnerships.net

Ownership of intellectual property

An important point of debate for any technology acquisition is the ownership and control of the intellectual property (IP) relating to the knowledge generated or transferred. Ownership can take one of three different forms:

- The IP can belong to one party only
- The IP can be shared between the parties who collaborated to develop it. This might mean they co-own it equally or ownership could be divided up on a 'field of use' basis. Some parties might acquire rights to use, rather than actual ownership of the IP (see page 40)
- The IP can be owned by everyone and is donated to the public. In this case nobody has the legal right to exclude others from using the IP. This is the case with the Human Genome Consortium[2] for example.

The ownership of IP can be difficult in relation to technology acquisitions, particularly where both parties contribute to the development. Debate over ownership has been accentuated by an increased interest in IP and commercialisation by institutions that historically have been less concerned with owning IP rights. This is particularly true of universities in the US where the Bayh-Dole Act is now in force.[20]

The growing interest in owning IP is putting legislators under pressure to expand patenting as a means of claiming ownership of more basic science principles. This is leading to the redefinition of the legal IP framework as disputes bring about refinements of the rules concerning what type of intellectual assets can be legally protected.[33]

However, the often unduly emotive ownership problem can be solved by setting up an agreement in relation to distribution of the rights to use the IP (see section on dividing up rights to use a technology on page 40).

Joint IP ownership

Many large firms are firmly opposed to the idea of co-owning IP and have refrained from filing joint patent applications with their innovation co-developers. They regard co-ownership as risky, as the future progression of a technology could be hampered if the owners cannot agree over the details of IP development. The agreement can be particularly difficult when partners operate in different geographic locations where IP regulations are dissimilar.

The large companies we interviewed generally prefer to fully own the IP, or failing this, to own the perpetual rights to use a particular IP for certain applications. The lack of ownership of IP does not therefore preclude the use of the IP. Getting the 'rights to use' for certain applications can compensate for the lack of formal ownership.

Open IP

In certain technological fields it could be advantageous to leave the IP open. This is the case, for example, where the IP relates to basic science, rather than technology, and where the advancement of the technology is dependent on the collaboration of parties with expertise in different disciplines. Open access to IP is likely to improve the chances of progression of downstream innovations, allowing easier access to knowledge by a number of innovators. For this reason, even commercial organisations sometimes do not want to have sole ownership of the results of a discovery. This happens particularly when they consider that the benefits of allowing the knowledge to be used by every potential innovator would increase the probability of delivering future innovations. An example of this is when Novartis, in collaboration with the Broad Institute of MIT, created a genetic codification of the causes of diabetes.[30]

A recent study[1] suggests four different ways to approach IP ownership, depending on the distribution of the knowledge (whether it is localised or distributed widely) and on the technology environment (whether it is calm or turbulent). The strategies are summarised in a table on the next page.

		Technology environment	
		Calm	Turbulent
Knowledge distribution	Spread across the world: very distributed	Large pool of potential solution providers. Distribute problem to a wide audience and use crowdsourcing for solutions. Need to obtain full IP ownership.	Grant free access to IP base in order to attract third parties who may support further development. Give away core technology. Retain proprietary core but make extensions freely available (e.g. open platforms for developers).
	Localised: very few people have the knowledge	Search the market for technologies to license or acquire for specific needs.	Co-development of IP in partnership to spread the risk. Clear rules for how IP will be treated. Collaborative agreements or consortia.

Figure 3: Four different approaches to IP ownership, depending on how widely the knowledge is distributed and the nature of the technology environment.[1]

Technology exploitation

Decisions concerning the ownership of IP are intrinsically linked with decisions over how to exploit it.

Two possibilities, not mutually exclusive, exist:

- A firm may want to exploit a technological IP by embedding it in products and services,
- A firm may want to exploit the technology with a number of business models and 'sell' it in its disembodied form (i.e. licensing it).

This decision over the IP's exploitation route is of paramount importance and is linked to the decision on how to protect it. This is illustrated by the case study examples on pages 37 and 38.

Technology exploitation

Case Study A

Firm A, in collaboration with a consultancy firm, developed a new production process technology which allowed the making of products with a unique shape feature.

The company decided to opt for an embedded exploitation strategy for this new IP, using the technology for its products which, as a result, could be highly customised and uniquely shaped. This was considered a potential unique selling proposition for the firm which would be the only world supplier offering such a range of products. Furthermore, the new processing technology left an unmistakable fingerprint on the products which could be used to uncover potential emulators and patent infringers. The company obtained three process patents covering this production process and proceeded to commercialise its new range of products with its customers.

It was a struggle to create the market for this particular product, with customers still sceptical of the advantages of adopting the new product lines. Several years after the patents were granted, the legal department realised that a competitor was launching similarly shaped products and that there was almost certainly an infringement of their IP.

To investigate the issue, neutral assessors were sent to the competitor's production plant to evaluate the patent infringement. They estimated that only one of the three patents had been infringed and that there was only a 50 per cent chance of winning a case in court. Furthermore, due to the small scale of the market, the potential damages which could be recovered if Firm A was successful were smaller than the expected costs of the trial itself. Firm A decided not to pursue the case.

In their retrospective analysis of this situation, Firm A realised that they had been focusing too much on the 'embedded' exploitation route and that the protection in place was not adequate for this approach. The patent was a good means of protecting the technology and of identifying potential infringements, but this protection route would only have worked if they could claim damages for infringed rights.

Firm A realised that an alternative approach would have been to adopt the technology in their products and to also license it to competitors. This would have had the advantage of growing the market as the customers could use multiple suppliers. It would also have meant that some of their competitors would have depended on their technology.

Technology exploitation

Case Study B

Firm B made a very different strategic choice to Firm A. It chose to exploit its technology by selling it in a disembodied form.

Firm B was born as a spinout, founded on an exciting new technology in a yet underdeveloped market. The options for the exploitation of the technology in a number of sectors and businesses were great, but the applications were still to be demonstrated. According to the former CTO: "We were told publicly: yours is the technology with the largest number of patents and the lowest number of products."

Firm B decided to develop their business by means of a licensing model.

"We limited the number of licenses of our technology and never gave exclusivity. We could have targeted those who would need our technology, but identifying them was difficult. We ended up licensing to a number of firms we came across more or less serendipitously. It is difficult for a small company identifying the potential licensor as it turned out that the motives behind the acquisition of the technology were very difficult to imagine from the outside. In one case a large firm wanted to spinout part of its business and the acquiring of our technology was going to facilitate this process. However, we found this lead only through a serendipitous contact – we contacted a university professor by mistaking him for someone else! On a second occasion, we licensed to another large company because it turned out that there were two R&D groups in that firm which were supporting competing technologies. It was an internal fight. Our technology seemed to promote one of the two options and this firm licensed our technology."

Eventually Firm B expanded and developed a large patent portfolio. Maintaining this portfolio costs more than £1 million per annum.

"In total we can say we had about two or three very definite success stories but making a business out of licensing is very hard and we originally thought that the successes would have been more. It is very hard to rely on the successes of others (for your revenue and growth) and you have very little control over it. Furthermore there is the problem of managing all the licensors. They also invent and develop innovation on your patents. You risk being cut out by your licensors who eventually become your competitors. With difficulty we managed to negotiate sharing deals which helped us to remain in control and not to be cut out of the supply chain we helped to build."

Action point

Use the framework opposite to consider your own company's options in terms of IP ownership and exploitation routes, discussing the pros and cons of the various alternatives.

Framework 3: Options for ownership of IP and exploitation routes

Who is going to own the technology?				
Exploitation routes / How will the technology be sold?		Only one party	All partners	Everyone
	Embodied: in products and services (see Case Study A)			
	Disembodied: e.g. licensing (see Case Study B)			

Use the framework above to discuss the pros and cons of the options for IP ownership and exploitation routes.

Questions to consider

- Who will be the final owner of the technology?
  Should it be for your company alone? You and your partners? Donated for everyone to use?
- How do you intend to exploit the technology?
  Will you 'embody' it in your products and services or 'disembody' it by, for example, licensing it for others to use. A mixed exploitation strategy could also be considered.

Rights to use a technology[35]

Dividing up the rights to use the IP in different ways can compensate for a lack of formal ownership. The IP can be exploited along multiple dimensions, ensuring that each party gains the rights they need to make use of the IP in their particular area. The parties can have exclusive or non exclusive rights to use the IP for each dimension.

The major dimensions are geography, time frame and field of use, but the IP can also be divided along the technology axis (e.g. the chemistry of an innovation or the mechanical parts, the aesthetics or the design). Defining these dimensions will help companies override the restrictions on filing patents in the countries where non-inventors cannot be listed as patent owners such as the US. At the same time it ensures they will benefit from the future use of the IP. When making these decisions consideration must be given to the anti-trust and competition laws.

Viewpoint

Technology development collaborations fail for two kinds of reason – either they are difficult to scale-up or they are too expensive to incorporate in a mass consumer product. The cost margin is so narrow!

For example, once when we tried to scale up a technology, we realised that the costs were too high. We needed to split the IP and we decided to keep the IP of the technology we already owned.

For the scaled-up technology, which had co-developed with the other company, we decided to keep the right to use the technology for other applications using an NERF (Non Exclusive Royalty Free) agreement. In these kind of situations you need to define the non-competing fields clearly to prevent the other party from using the technology with your competitors.

Manager, FMCG company

Options for dividing up rights

Geography: Each partner may have interests in developing markets in different locations. Contracts can therefore specify in what geographic location each party will be able to use the IP.

Time frame: The time limit to the exploitation rights of an IP can be anything from a few months to perpetual.

Field of use: Each party may define the boundaries concerning the IP's field of application.

Viewpoint

We have a joint development agreement with a technology consultancy for the development of one of our products.

This deal is hard but straightforward with three levels of IP:

1. Background patent. Basic technology IP belongs to the technology consultancy that will use their know-how for our products. They have got a patent.

2. Aesthetics. The direct consumer interface belongs to the brand owners.

3. The clever design of how to adapt the technology to a market application such as ours belongs to us.

Technology director, manufacturing company

Action point

Use the framework opposite to discuss the division of your technology's IP rights.

Framework 4: Division of technology rights

Different dimensions in which rights can be applied	How will the IP rights be divided?			
	Partner 1	Partner 2	Partner 3	Partner 4
Field of use				
Time frame				
Geography (market)				
Technical aspects (chemical, mechanical etc)				
Other (aesthetics, design etc)				

Use the framework above to discuss the division of your technology's IP rights. Consider all the possible dimensions across which the rights might be split including geography, time frame and field of use, as well as technological aspects, the aesthetics or design.

Discuss how these rights might be divided between you and your partners and whether they will be exclusive or non exclusive.

Acquisition 'currency'

The acquirer can offer the seller a number of different kinds of benefits in exchange for the technology – not necessarily financial.

The terms of an exchange are specified in the contract under the legal terms of consideration. It is helpful to be clear about what is exchanged in return for a technology as the implicit benefits of collaboration can often be overlooked.

We observed three main kinds of transaction currencies during our study:

Financial

Financial payment can take a number of different forms. For example, in some cases a lump sum is agreed between the parties whilst in others the financial return is offered in the form of royalties from the sale of products using the IP. The contract can specify when financial payments will be made (e.g. linked to particular milestones of technological or regulatory development), and whether the amounts will be the same or vary over time.

Payment could also be made in the form of shares or further contracts – for example the opportunity to supply the acquirer with other technologies or manufacturing rights.

Rights over something else

Having the right to use the technology in specific areas or ways can form part of the benefits of the transaction. As discussed under technology rights on page 40, this could involve dividing up specific rights to the IP – or it could include rights to another piece of IP which is of interest (a practice known as cross-licensing). These rights could, for example, relate to geographical markets or parts of the technology. In the latter case, this may include the chemical principles, the mechanical parts, the production process, or the design of a product or machine.

A special type of right involves having priority of use for the technology over other users.

Other forms of help

Parties involved in a technology acquisition often help each other in a variety of other ways. For example, a large company might support a smaller one by helping it to identify more customers in its market area.

A key advantage gained from technology development partnerships is the opportunity to share the risks of innovation. In collaborations involving early-stage technology development, this should be recognised as an intrinsic form of currency exchange.

The technology seller often benefits from the buyer's knowledge, for example concerning markets, competitors, or other technologies. The value of these less explicit benefits needs to be recognised.

Action point

Discuss all the possible currencies or benefits involved in your company's technology transaction. Make sure you consider all the implicit benefits as well as the more explicit ones.

Acquisition 'currency'		
Financial	**Rights over something**	**Other forms of help**
• Lump sum, cash linked to milestones or royalties • Stable or variable flow (increasing or decreasing) • Shares • Contracts (e.g. to supply something)	• Markets, other technologies, applications, product parts, design etc. • Priority over others (e.g. in using a certain technology)	• To find customers, to develop other technology etc. • Risk sharing • Knowledge (e.g. of markets, technologies) • Time (e.g. to do or to use something)

Figure 4: The three main kinds of 'currency' that are used in exchange for technology

IP protection

Transferring technology knowledge from one organisation to another (whether in the form of know-how, know-what or know-who) is well known to be problematic as far as IP is concerned. It differs from the transfer of products and goods in various ways:

- Exchanges of knowledge cannot be reversed. Once knowledge is transferred it cannot be taken back.
- In certain cases it is difficult to verify if a specific piece of knowledge has been (ab)used. For example, it is difficult to ascertain if specific know-how on production technologies has been employed in another company's production plants.
- It is extremely difficult to pinpoint the ownership of an idea and where it originates.
- Every country has different laws regarding knowledge protection.
- It is very difficult to assemble the necessary parts of knowledge required to develop future IP.

Two perspectives on technology IP

There are two ways of looking at technology IP which need to be considered:

- Background IP
- Future IP

Background IP

It is often difficult to find one's way through the varied IP landscape and several problems may arise. In particular, to innovate in a certain field you need to ensure that existing IP is not infringed and the rights to use it are acquired.

Firms use a number of strategies to defend their IP and have for example created 'patent thickets' – dense portfolios of overlapping patents – which are used to prevent others using their invention.

Another problem is that IP may be so fragmented that it is difficult for anyone to use it. This phenomenon is often referred to as 'the tragedy of anticommons'. Patent or knowledge pools – agreements between the owners of independent pieces of IP – can be a solution, packaging together complementary areas of the technology's IP and reducing transaction costs.[4] This is sometimes done to develop industry standards.

It is of paramount importance for the acquirer to understand as much as possible about the technology's background IP and who owns it, to guarantee that any future innovation will not be hampered by patent lawsuits. To this end firms routinely perform 'due diligence' research on the publicly available information concerning the background IP, prior to starting any discussion with a prospective partner.

Future IP

It is also important to think in advance about the rights over future IP in order to understand how the two parties might benefit from it and how best to exploit it (see discussion of technology rights on page 40).

Knowledge protection mechanisms

A number of mechanisms can be used to protect knowledge[3]:

- Patents and registration of design patterns
- Copyright
- Secrecy
- Design complexity
- Gaining lead-time advantage
- Trademarks
- Confidentiality agreements and knowledge management

The choice of protection mechanism depends on whether the knowledge is codified or tacit and whether the output (i.e. the final innovation) is tangible or intangible.[19] The table below summarises which mechanisms apply in each case.

The degree of protection required also depends on how fast a technology is evolving. If the technology is new (fast evolving and closer to science), increased knowledge diffusion will increase future gains. Hence, there is an advantage in sharing it and a low degree of IP protection is appropriate.[26]

For slow moving, more mature and well-understood technologies, higher profits are possible. Hence firms will be more inclined to own the IP and impose a higher degree of protection.

Some economic studies provide a way to determine the ideal length of the protection method. These suggest that the optimal span is two years for a copyright term and ten years for patents.[10]

Patents and registration of design patterns

The most discussed protection mechanism is that of patents. IP and patents are often referred to interchangeably because patents are often regarded as the strongest means of legally protecting intellectual assets. Patenting practices differ across disciplines and countries, but the overall tendency is towards an increase in patent applications and an increased length of such documents. For instance, newer disciplines seem to generate longer, unfocused applications which are later subdivided into several more focused applications. Furthermore, there seems to be a difference between those countries governed by common law and those where civil law applies: the former file much larger patent applications. However, as a result of an increased globalisation of markets for technology and innovation, the Patent Cooperation Treaty was introduced to harmonise the styles of patent filing, using the US model as a basis.[38]

Due to their explicit nature, the knowledge covered by patents can be assessed and traded in a relatively easy way.

Viewpoint

We adopted a proactive strategy to protect our interests in a new product we were about to launch.

We had a technical problem and we found that one of our competitors held a patent which would have been useful in tackling the problem.

We did two things. We attacked the patent and opposed it. At the same time we proposed a cross licensing agreement with another patent. In this way we created uncertainty around the patent we were interested in and we gained a better bargaining position.

Patent attorney working for a large firm

Type of knowledge	Preferred protection mechanism
Tangible/Codified	Patents as primary protection mechanism, plus copyrights, trademarks and confidentiality agreements
Intangible/Codified	Copyrights as primary protection mechanism complemented by trademarks and confidentiality agreements
Tangible/Tacit	Secrecy, complexity of design, lead-time advantage over competitors, confidentiality agreements and trademarks
Intangible/Tacit	Trademarks complemented by secrecy, lead-time advantage over competitors.

Figure 5: The preferred protection mechanisms for different types of knowledge.[19]

Viewpoint

Our strategy in relation to patenting can vary depending on the situation and the financial constraints. We used to file patents everywhere in the world. Nowadays we don't file in many countries, concentrating instead on the most strategically important ones. We now file in countries such as China and India as they have taken on a dominant role, whilst they were not of strategic importance a few years back.

Legal team, large multinational firm

However, as illustrated in the example on page 37, patents alone are insufficient to guarantee protection. It is also necessary to be able to enforce them. The infringement of intellectual property rights, as opposed to any other material property breach, is not covered by the state's policing system. It is down to the individual private organisation to fight its own battles. Hence, patents are not often a workable protection option for small and under-resourced organisations.

The nature of patents is also subject to debate. On the one hand they are considered an incentive to innovation, as the inventors can claim rights over the commercialisation of an innovation. On the other hand, they are often regarded as an obstacle to innovation, for example in cases where ownership of the necessary IP to innovate is inaccessible or too distributed to generate future innovation. This is referred to as the 'tragedy of the anti-commons'.

There is a continuous debate over how patents are and should be granted and the legislation has been evolving over time. What can or cannot be patented, and for how long, is decided on a national basis, with patenting policies being adapted at different rates across these different countries. While in some cases the granting of patents has been restricted,[7] the general trend seems to be towards expanding patents applicability to new objects and subjects, shifting the locus of enforcement and granting longer terms of protection. For instance, in the US (whose patent law is one of the most influential), it is now possible to legally protect IP rights more upstream than in the past, including living organisms, basic research tools and procedural methods, together with algorithms, databases and journal articles.[33] This trend is potentially risky for the development of future knowledge as the 'tragedy of anti-commons' might stifle future innovation.

There are several motives for patenting.[8, 9] These include:

Viewpoint

The problem with SMEs is convincing them that their patent doesn't protect them completely especially if there are other ways to do the same thing. Other technologies can achieve the same things without going through the same route. This impacts the value of a patent. We reject a large majority of acquisitions at this stage. We would try in such a case to develop something together and to give them recognition but not a full license. There was a case which happened sometime ago. An SME came to us with a patent application pending which was weak. We had worked on an alternative approach for some time and hence we knew that they were at risk. We resolved that we would pay them a bit of money up front to retain them as consultants, giving them the chance to come to us with other ideas as a first port of call. That would have given us three months to accept or refuse their ideas. If their patent was eventually granted we would have given them full royalty. If it wasn't granted we would have resolved to give 50% of the value requested. If a competitor launched a product that did the same job, we would have progressively reduced the royalties down to nothing over three years.

Manager of a large company involved in collaborative developments

- **Protection**. A firm can use patents to protect their inventions from imitation. Patents can also be used to safeguard national interests.
- **Blockade**. Using patents to create a blockade can be done in two strategic ways.

  Defensive patent strategies aim to stop others from patenting your inventions and allow suing for infringement, regardless of whether the IP is needed or not. This strategy can also be pursued in order to generate revenue by trading IP with other firms.

  Offensive patent blockades aim to block others from getting into a certain innovation space and patenting inventions that are similar, but not identical, to the invention that is planned. In this case, the tactic is to build a broad patent wall or a 'thicket' around the innovation.[9] This strategy is also used even if the firm does not intend to make use of the IP.

- **Reputation**. Improving the image of a company as an innovator and to increase the capital value of the firm (important for instance in M&As, or for attracting capital investments).
- **Exchange**. Patenting has great potential for encouraging cooperation. Having stronger patent protection over a technology improves a firm's bargaining position and hence is particularly important for small and young companies who want to establish partnerships and alliances with well established firms.
- **Incentives**. Within large companies, patents are often used as a measurement of performance and as a basis for rewarding innovative members of staff.

There is evidence that firms who mostly use patents as a protection mechanism receive overall more citations of their patents in future patents applications. On the other hand, if patenting is used with the aim of blocking competitors or for exchange reasons, the number of citations received on the entire portfolio of patents is smaller. In addition, using patents as an offensive blocking strategy is likely to result in a great number of oppositions to the patent portfolio, as competitors are likely to react against this strategy. Oppositions to patents are also likely to be less for companies who take a cooperative approach to protection.[9]

Weakness of patents: By itself, filing a patent is not a strong protection mechanism because the art of drafting patents is quite difficult. If the patent claims are too specific and narrow there is always the risk that competitors will easily get around them. A potential strategy is to file relatively unfocused patents which could be later divided into more specific patents.

Patents' values are also dependent on how unique the item in question is and how easy it is to work around it. An example is the now very common Schneider wheelie-bin, which was originally patented in 1976. The bin hooks on to a rack at the back of a lorry via a flange at the front of the bin, and it is this flange which the company decided to protect. Because the bin is polymer and hence has quite a low stiffness, the design needs to include substantial stiffening ribs and flanges. This is a very precise and narrowly-worded claim. It would probably not be possible to produce a plastic bin which was compatible with the same lorry attachment and did not infringe the patent. For steel it is a different story. In the 1980s a UK firm, EH Taylor Ltd, produced a steel bin which did not infringe the Schneider patent and rapidly captured half the market for the large 1100 litre bins.[12]

The other downside of patents is that once the knowledge becomes public it may reveal the firm's strategic intentions. Patent analysis is one of the most common ways of gaining intelligence about a competitor and its technologies. As a result, firms may prefer not to broadcast this information to the world, using trade secrets and/or using complex designs to protect their technology instead.

Copyrights

Copyrights are a means of protecting authorship of intellectual ideas including literary, artistic and musical forms which have been captured on, or through, a tangible medium.

In contrast to patents, copyright protection starts immediately, without the need for an application and an evaluation of originality, as soon as the authors of the work codify the knowledge (e.g. on paper, on the web etc.)

Copyrights allocate exclusive rights to the author(s) to reproduce the work, as well as to modify, disseminate, and publicly perform or display the work. However, even during the period of protection (usually the lifetime of the authors), the original ideas can be reproduced by others, if minimally changed. This means that copyrights are weaker forms of protection than patents.

Software is a typical example of invention protected by copyrights, but more recently examples exist of patent protection granted to software. Another area typically covered by copyrights is databases. The rationale is that the assembling of data is considered the intellectual product of the authors.

Secrecy

As information contained in patents is analysed in great depth by competitors, maintaining an invention's secrecy can be a very effective strategic alternative. For small companies, who lack the resources to cover their IP globally and to pursue infringers, maintaining secrecy can be a very important protection mechanism. Secrecy is also an effective approach when a patent cannot be enforced, for example, when it is difficult to assess whether a certain production process has been used. Some studies show that firms of all sizes rate secrecy as more valuable than patents.[5] Another reason for preferring secrecy over other forms of protection is that the latter take time to obtain (patents require approximately 18 months). In areas where innovation evolves at great speed, patents can have a very limited effect.

Design complexity

Reverse engineering is often used to uncover and copy the working principles of a competitor's technologies. A protective approach which could work in this case is that of making use of complex designs.

Gaining lead time advantage

Technology protection can also be achieved by gaining lead time over competitors.[21] A firm may stay ahead of the game by protecting the market to which its technology will be applied. Imitators can be preempted by the occupation of existing and potential strategic niches in order to reduce the range of investment opportunities that are open to potential competitors.

Companies employing technologies that demand skill from the user can gain an advantage by being first to the market. Customers who have invested time and effort in mastering a product are less likely to switch to another supplier. This is often the case with computer software for example. Being the first to market means that the firm can establish a user base, creating switching costs that lock-in consumers.[11]

Pre-emption can take a number of forms:

Proliferation of product varieties by a market leader. This limits the number of opportunities for new entrants and smaller rivals to establish a market niche. For example, in the US between 1950 and 1972, the six leading suppliers of breakfast cereals introduced 80 new brands into the market, combined with large investments in production capacity. When done ahead of the growth of market demand, this also preempts market opportunities for rivals. For example, Monsanto's heavy investment in plants for producing NutraSweet ahead of its patent expiration was a clear threat to would-be producers of generic aspartame.[17]

Patent proliferation. Protecting technology-based advantages by limiting the technical opportunities available to competitors. For example, in 1974, Xerox's dominant market position was protected by a wall of over 2,000 patents, most of which were not used. When IBM introduced its first copier in 1970, Xerox went on to sue it for infringing 22 of these patents.[17]

These issues are critical in standards battles. The ownership of seven critical assets are essential in standards battles: 1. Control of an installed base 2. Intellectual property rights 3. Ability to innovate 4. First-mover advantages 5. Manufacturing abilities 6. Presence in complementary products 7. Brand name and reputation.[34]

The effectiveness of first to market is also dependent on the maturity of the technology or industry. For example, in immature fields such as nanotechnology, along with the opportunity to file patents, first mover advantage can allow firms to participate in standard setting with industry groups and government agencies. This can provide the firm with the additional leverage necessary to ensure that the selection environment favours its technology and that compatibility is protected.[15]

Trademarks

Trademarks are indicators of the source of a product or a service. They are symbols which identify the origin of the innovation. This is an asset in particular for those organisations whose reputation is positive. Hence the trademark becomes synonymous with quality or other positive attributes for the consumer who prefer sourcing a product or a service from a respected organisation. Trademarks become less effective when the name becomes the epithet of a product or service[16] (e.g. Post-it® has become the general name for sticky notes).

Confidentiality agreements and knowledge management

Firms who want to collaborate with others in order to access knowledge, face the challenge of preventing knowledge leaks.

Non disclosure agreements (NDAs), also called confidentiality agreements, are often exchanged between parties to impose a protective umbrella on what can be disseminated outside the partnership, or even within other departments of the collaborating companies.

The most delicate stage is that just prior to signing the collaboration agreement. If the two parties eventually decide not to enter into collaboration, they may regret exchanging any information. This is why, in the majority of cases, firms say they refuse to sign confidentiality agreements until they are certain they have a real interest in the potential partnership.

Most open innovation internet portals set up by large firms, which are designed to attract ideas from external innovators, have an up front condition that ideas submitted must be non-confidential. While these websites are designed to identify new knowledge, they must also protect the prospective acquirer from the risk of being exposed to unsolicited and proprietary knowledge which could infringe others' rights. One solution to such

Viewpoint

Intermediaries protect us from IP contaminations. They pre-filter opportunities on our behalf so that we don't need to know certain details. They can sign the NDA.

Technology and Open Innovation director, large manufacturing firm

Viewpoint

Knowledge management went out of favour for a long time. Knowledge management used to only mean 'the library', but now it provides the protective cushion for brand, technology and business.

When we write a presentation, every single claim in the presentation has a reference to a lab book. Anything which is disclosed is referenced to its source in our archive. This is what differentiates a small firm from a large firm which has the resources to make explicit, archive and retrieve knowledge.

Open innovation manager, large multinational company

unintentional knowledge contamination is to involve independent third parties, or intermediaries in the process. Legal support will be required to set up NDAs. Even when NDAs are signed, the prospective collaborators need to be careful about what they exchange and how.

If the NDAs specify that both parties have to put what has been disclosed (and hence has to be kept secret) in writing, it is important that a good record of conversations is kept. This can be very difficult for firms who do not follow strong knowledge management practices.[23] Maintaining such records is a critical practice to protect the firm from possible claims.

The confidentiality agreements are a key protection tool as the risk of knowledge leakage could be severe. Precautions are sometimes needed to prevent knowledge from crossing internal boundaries as well. For example a firm realised that a competitor had implemented a similar production technology to the one that they had developed a few years before in collaboration with a technology consultancy. After much investigation it was revealed that the competitor achieved a similar production capability by partnering with a second consultancy founded by a former employee of the first technology consultancy.

Another protection strategy is to fragment knowledge across the firm. An extreme example is provided by a firm working in the defence sector, for which security is paramount. The firm has different levels of security, imposing restrictions about what can be exchanged, even between parts of the same company. This proves particularly challenging as the firm is a multinational and the interests of different nations sometimes have to prevail over the company's business interests and innovation needs. The internal infrastructure is carefully designed along multidimensional controls and labels to partition the firm's knowledge management system and to allow the identification of safe areas of discussion and collaboration between employees with different disclosure rights. As security takes priority, staff are trained to file the documentation appropriately and to become highly dynamic in managing complexity.

Action point

Discuss which knowledge protection mechanisms are most appropriate for your company by considering the pros and cons of each of the following:

- Patents and registration of design patterns
- Copyrights
- Secrecy
- Design complexity
- Gaining lead-time advantage
- Trademarks
- Confidentiality agreements and knowledge management

In conclusion

This report has explored the key aspects and dimensions involved in technology acquisition decisions. A number of checklists and frameworks have been provided to help the reader to review and select the best approaches for their particular situation.

The report can be used to support these complex decisions, but it does not, in itself, provide clear-cut answers on what options to use and when, as each situation that the reader encounters will be different.

We strongly advise that colleagues from across multiple functions are involved in the discussions and that appropriate expertise (technical, strategic and legal) is made use of. For those who are new to these types of transactions, it is also recommended that more experienced managers are consulted.

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Appendix

What do we mean by 'technology'?

It is useful to clarify the concept of 'technology'. Technology is conventionally defined as the "application of fundamental science to industrial and commercial purposes". However, the process described in this workbook would also apply to scientific principles, which are very early stage technologies.

In the process of transferring technologies between organisations, two aspects of technology need to be exchanged:

The 'hard' part: the products, materials, equipment, and coded information such as databases

The 'soft' part: the knowledge (practical and theoretical), experience, skills, procedures and relationships with others

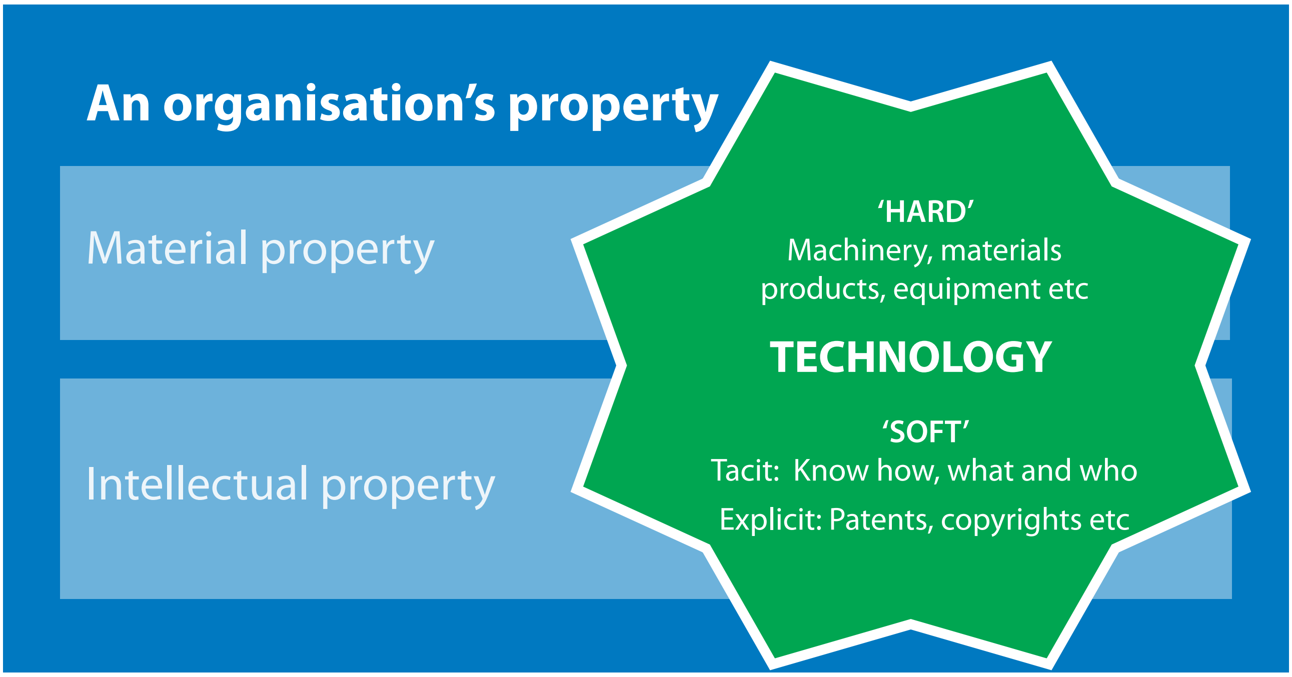
The 'soft' part of the technology encompasses both tacit and explicit items.[6] Tacit items include:

- **Know-how**: skills (e.g. mathematical modelling) and their applications to the technology
- **Know-what and why**: facts and principles underpinning the functioning of the technology
- **Know-who**: social skills and personal relationships which can support the technology (e.g. value chain contacts, external experts, knowledge of who operates in this field)

Explicit items include patents, copyrights and trademarks.

We can also say that the organisation owns intellectual property (IP) as opposed to the material property (MP), the latter including land, building, equipment, money etc.

The organisation can exercise rights over its property, both material and intellectual (IPR). For instance it has the right to decide over its future, to improve it or change it, to make money out of it by embedding it in products and services or by trading it.



Research background

This report has been produced as part of research project undertaken by the Centre for Technology Management at the Cambridge University Institute for Manufacturing.

A variety of different research methods were used to identify the key dimensions relating to the issues of early stage technology acquisition. These included literature reviews, case studies and group discussions. The research benefited from the support of a wide community of practitioners, senior technology managers from large and small firms with experience of acquiring technologies, as well as lawyers who support firms during technology transactions.

The project also organised two workshops, each of which included three focus group discussions. Attendees were mainly from the UK and covered a range of different sectors including aerospace, fast moving consumers goods, chemicals, mechanical engineering, defence, printing and technical consultancies.

The contributors to these events were given access to the interim findings and were encouraged to discuss their own experiences. Drafts of this report were sent to our community of practitioners for comments and improvements, prior to publication.

Related topics and resources

Open innovation

Open innovation (OI) is a strategy by which companies allow a flow of knowledge across their boundaries as they look for ways to enhance their innovation capability. Company boundaries become 'permeable', enabling the matching and integration of resources between the company and external collaborators. In a closed approach to innovation, a company relies on internal resources only.

The IfM has undertaken extensive research into open innovation and has produced two reports:

How to implement open innovation: lessons from studying large multinational companies. This provides an overview of existing approaches to OI and outlines how a company can start to implement a strategy to match the organisation's needs.

Getting help with open innovation. This describes the capabilities companies need in order to implement open innovation successfully and the range of assistance offered by different types of innovation intermediaries. It suggests a structured approach to selecting the most appropriate intermediary for a particular company's needs and illustrates this with case studies and examples.

Both reports can be downloaded for free at:
http://www.ifm.eng.cam.ac.uk/free/
Printed copies are also available for purchase.

Cambridge Open Innovation Network

A project funded as part of the EPSRC Cambridge Integrated Knowledge Centre to investigate the skills required to implement open innovation, with particular emphasis on the role of universities as partners. Please contact Tim Minshall for more information: thwm100@eng.cam.ac.uk

http://www.ifm.eng.cam.ac.uk/ctm/teg/openinnovation.html

Managing partnerships between start-ups and established firms

Start-ups can be an important source of ideas for larger companies seeking innovation outside their own organisation. Technology-based start-ups typically lack the strategic and operational rigidities that sometimes stifle innovation in established firms. On the other hand, start-ups have limited resources and often struggle to access the complementary assets they need to bring their ideas to market.

Bringing together start-ups and established firms in mutually beneficial partnerships seems an obvious solution. Research shows that making such partnerships work can be problematic. However, there are ways to increase the chances of success. The web site below provides access to resources that support the development of successful partnerships.

http://www.ifm.eng.cam.ac.uk/ctm/research/projects/alliances.html

Technology intelligence

Keeping abreast of new developments in technology is essential to support innovation. For those taking an 'open' approach, technology intelligence can also help to identify potential partners and collaborators.

Intelligence helps to shape the technology strategy of firms, influencing areas such as development and technology acquisition. Technological information has become an increasingly important advantage for technology-based companies facing shorter technology life cycles and a more globally competitive business environment. Companies have dedicated progressively more resources to the development of bespoke technology intelligence systems, realising that intelligence activities are important assets for business success.

Intelligence comes from external sources but it may also be contained within the organisation – explicitly or tacitly – if it has already been acquired by an internal party. Firms need to be able to find and use this information quickly and easily, as well as acquiring the information they need from external sources.

Researchers at the IfM have created a three-level model comprising the framework, system and process of acquiring technology intelligence (TI). The model was tested through case studies of technology intelligence systems in technology-based companies. Further work (Mortara et al., 2009a and 2009b) has been directed to understanding how to implement and to expand the coverage of TI activities.

http://www.ifm.eng.cam.ac.uk/ctm/intelligence.html

Breathrough innovation

Established firms can find it challenging when faced with rapid technology change. They need to remain competitive in the short-term through the exploitation of existing lines of business and incremental innovation, while simultaneously developing radical innovations for longer-term competitiveness. The IfM has undertaken research into the challenges faced by established companies trying to generate radical innovations. A report based on the research, *Organising for breakthrough innovation,* provides companies with guidelines on how to improve their approach in this area. Copies of the report can be downloaded for free at:
http://www.ifm.eng.cam.ac.uk/free/
Printed copies are also available for purchase.

Open Innovation FMCG Consortium

A structured programme of workshops where members share best practice, explore 'hot topics' along the FMCG Value Stream and participate in optional, accelerated open innovation collaborations.

http://www.ifm.eng.cam.ac.uk/ctm/teg/oi_forum.html

IfM Education and Consultancy Services

Consultancy and education services concerning technology management issues can be provided through IfM Education and Consultancy Services Ltd, a university-owned company which disseminates IfM research outputs to industry and governments.

http://www.ifm.eng.cam.ac.uk/working/

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The Centre for Technology Management

The Centre for Technology Management (CTM) is one of several research centres within the Institute for Manufacturing (IfM). CTM focuses on helping managers to make the most appropriate use of current and future technological resources. It aims to provide comprehensive support to managers, based on an integrated understanding of science, engineering and business management. CTM disseminates its research through its annual Technology Management Symposium, through courses and workshops and through its extensive network of industrial partners and commissioned projects.

The Institute for Manufacturing

The Institute for Manufacturing (IfM) provides a unique environment for the creation of new ideas and approaches for modern industrial practice. Part of the University of Cambridge's Department of Engineering, it brings together expertise in management, economics and technology to address the full spectrum of industrial issues.

The IfM has over 240 people working across a range of specialist areas, integrating research and education with practical application in industry. A team of industrial practitioners helps companies of all sizes to apply research-based improvement techniques via a programme of consultancy and education services. This work brings benefits to both parties. Industry receives practical solutions based on the latest applied research; the IfM gains live feedback to help set the agenda for new research and an income stream to assist in funding future research activities.

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