

# Factors That Affect Mode Of IP Transfer

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Insightful survey reveals factors firms consider in transferring or acquiring technology

Many companies are finding that their overall competitive success is dependent upon their technological competence. Technology-driven companies of the 1990s are faced with a changing competitive landscape: The rising costs of development, rapid technological diffusion, the compression of product life cycles, and the increasing complexity of research innovations are forcing organizations to look beyond purely internal development as a source of innovation. Indeed, firms are becoming increasingly sophisticated in their technology procurement strategies. More and more, organizations are expanding their technology portfolio through a variety of procurement techniques, including inward licensing agreements, joint development arrangements, and the acquisition of other firms.

For instance, such firms as Genentec, Novartis, the Veeva, and Lucent Technologies have all made recent acquisitions in an attempt to expand their technology base. Likewise, Merck, Motorola, and Cray Research have pursued the inward licensing of technology to supplement existing know-how. Moreover, joint-development arrangements have been formed between the likes of IBM and Apple, AT&T and Eastman Kodak, and Condulec and Varian Associates. Because technology is fast becoming the basis of competition, and firms are increasing their use of external alternatives, a rigorous study of how firms make these decisions, and the implications of these decisions in terms of the success of the procured technology, is particularly timely.

My research investigates two related questions. First, under what conditions is a firm more likely to choose a particular method of external technology procurement (licensing, joint development, acquisition)? Indeed, these three procurement techniques represent a continuum of commitment and interaction between two or more organizations. Licensing can be viewed as an arm-length market arrangement between two organizations. The transfer of technology is one direction — from the source firm to the procuring firm. Joint development allows for the merging of the skills and know-how of two or more firms, yet maintains a separation in ownership. Acquisitions, meanwhile, potentially provide the highest level of interaction and commitment as one formerly autonomous organization is subsumed within the boundaries of another.

IBM's recent acquisition of Lotus Developers provides a classic example of this procurement method decision. In its quest for Notes technology, IBM could have pursued a licensing arrangement instead of an outright acquisition. Alternatively, IBM could have potentially involved itself in a joint effort with a partner in order to develop the desired technology. Are there systematic differences between when a firm might pursue an inward licensing arrangement, versus the outright acquisition of the firm that possesses the relevant know-how? When might a firm be most likely to become involved in joint development projects?

Naturally, a greater awareness of the "buyer" perspective may be of value to those firms trying to market their know-how. At present, very little is known in regard to the consumer behavior of firms, as they try to fill their technological

needs. A better understanding of how executives decide on the means by which their firms attain technology may improve the search process for potential licensees, collaborative partners, or acquiring firms.

The second question that was addressed has more direct implications for the procuring firm. Are certain procurement methods more effective in generating payoffs to the firm, depending on the characteristics of the technology? In other words, is there a "fit" between the nature of the technology and the appropriate procurement method? Should a firm pursue licensing arrangements under certain conditions and acquisitions in other situations? When is it perhaps more appropriate to pursue joint development?

Potential technology payoffs to the procuring firm include gaining entry into a new market, securing a window into "state-of-the-art" technology, obtaining a competitive advantage, upgrading technical skills, or simply keeping pace with competition. Regardless of the specific objectives of the procuring firm, certain technology attributes may more or less determine the success of the technology for the procuring firm. A better comprehension of the relationship between the attributes of the technology, the means of procurement, and its ultimate success will provide guidance to decision makers in determining not only whether to pursue certain know-how, but also by what means the technology should be procured.

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## METHOD OF INVESTIGATION

Gaining insight into these questions required multiple and systematic steps of analysis. First, recent (1993/94) technology procurement arrangements were identified to the public press by using the Dow Jones News Retrieval Service. This service allows the user to electronically search press releases based on key words (e.g. license agreements, joint development) within a designated time frame. From this process, details regarding each procurement arrangement was recorded. This information included the type of agreement (licensing, joint development, acquisition), firms involved, specific technology procured, and executives from the procuring firm whom were cited in the press release.

A survey was developed that could be targeted toward those executives from the procuring firm who were ultimately responsible for the procurement arrangement. The survey had numerous questions regarding characteristics of both the procuring firm and the specific technology that was gained. These characteristics included: (1) the ease by which the technology could be imitated or "reverse engineered," (2) the extent to which competition had similar technology (rivalry), (3) the relationship of the technology to the firm's existing asset base, (4) the uncertainty of the technology in terms of its design and market acceptance (technological uncertainty), (5) the expected longevity of technology (i.e. life cycle), and (6) previous experience that the procuring firm had with the various types of procurement arrangements.

In addition, the overall benefit of the technology to the procuring firm was determined by responses to survey questions. These questions pertained to the importance and fulfillment of various goals including new market entry, operational efficiency, enhancing existing product lines, gaining a window into "state-of-the-art" technology, gaining competitive advantage, and upgrading technical skills. An overall measure of technological payoff could be computed by taking into

account the importance and fulfillment of these goals.

Some 140 procurement arrangements were randomly selected from each category of procurement method. Preliminary phone calls were made to the procuring firm requesting their participation in the study. Surveys were sent to two executives from each firm. Completed surveys from either one or both of the executives were received from 208 firms for a 69% response rate. Some 80% of the respondents had the rank of vice-president or above (chairman, president, senior vice-president). The responding firms represented 12 distinct industries. However, the majority of the responses were from firms in the chemicals, computer equipment, electrical equipment, instrumentation, and software industries. The data from these responses were analyzed using several statistical techniques including logic and correlation analysis.

### WHEN ARE FIRMS MORE LIKELY TO CHOOSE A PARTICULAR PROCUREMENT METHOD?

The results of the statistical analysis pertaining to this question are shown in Table 1. The table

indicates that the firms pursued the given method versus the alternative. A "+" suggests that an increase in the given attribute decreases the likelihood of one method occurring versus the alternative. For example, the results suggest that as a firm's previous acquisition experience increases, the firm is more likely to pursue an acquisition as opposed to a licensing agreement when procuring technology from external sources.

Three technology-specific attributes, as well as additional firm characteristics, were found to partially determine whether firms would pursue licensing arrangements, joint development, or acquisition. The technology attributes include (1) difficulty in technical imitation, (2) technological uncertainty in terms of design and potential market acceptance, and (3) the expected longevity of the life cycle of the technology. In addition, a firm's procurement history also influenced the likelihood of its choosing one type of procurement arrangement over another.

#### Difficulty of Technical Imitation

One technology attribute that was found to significantly influence procurement method choice was

### IMPACTS ON PROCUREMENT METHOD CHOICE\*

Variable	Acquisition versus licensing	Joint dev. versus licensing	Acquisition versus joint dev.
Low attribute			
Previous acquisition experience	+		-
Previous joint development experience			-
Previous licensing experience		-	
Technology attribute			
Difficulty of technical imitation		+	
Limited prevalence of technology (rivalry)			
Relationship to firm's existing assets <sup>†</sup>			
Technological uncertainty	-	-	
Expected longevity			-

\* Multinomial logit analysis was used. All variables indicate one full intensity was awarded. Coefficients that are significant at the 0.1 level are indicated by a + or -.

Table 1

shows what characteristics significantly differentiated between the various procurement methods. A "+" sign indicates that an increase in this particular attribute occurred

the ease with which the technology could be imitated or copied. The more difficult the imitation of the technology, the more likely a firm was to pursue an acquisition or

joint development arrangement as opposed to a licensing arrangement.

There are three plausible explanations. First, the ability to form an acceptable licensing arrangement becomes problematic when the licensee is ambiguous in nature and difficult to codify into written documents. Technology sellers may not wish to design specific technical innovation, knowing that if too much is offered, the buyer will no longer need the seller or will be able to bargain on the price to be paid. The buying firm, however, may not be willing to accept a contract which only a limited amount of information regarding the technology is available.

Further, establishing complete contractual specifications regarding the allowable usage of the technology can be difficult when the technology in question is not clearly defined. An alternative to this market failure is a joint development arrangement, whereby the provider of the technology may be in a better position to take advantage of the commercial benefits of its proprietary know-how and thus be more willing to share its expertise.

A second rationale for the preference for joint development arrangements and acquisitions is that they provide for higher levels of interaction between the firms and promotes the know-how, and the firm that wishes to acquire these skills. Joint development facilitates learning and the transfer of particularly difficult and ambiguous technology, as the two firms are able to work side by side.<sup>1</sup> Likewise, an acquisition further reduces the commitment between the two organizations and facilitates the transfer of know-how from the acquired firm to the acquiring firm. This level of interaction required to effectively transfer ambiguous know-how that is difficult to imitate is often not available through one-way licensing arrangements.

Finally, a technological resource that is difficult to reproduce or copy has greater potential for providing

above normal economic gains to those firms that control the resource.<sup>2</sup> Thus, decision makers who perceive a given technology to be particularly ambiguous and difficult to imitate will be more willing to pursue higher commitment procurement methods such as joint development and acquisition. In doing so, these firms will be in a better position to direct the future development and commercialization of the technology. Indeed, the control of such technology will distinguish the firm from its competitors and provide it with a competitive advantage.

#### Technological Uncertainty and Expectant Learning

An additional consideration that partially determined the method of procurement within the sample was the perceived uncertainty associated with the technology, in terms of its design or potential market. Depending on its maturity and state of development, technology takes on varying levels of uncertainty. The greater the technological uncertainty, as reported by the firms' executives, the greater the odds that an inward licensing agreement was formed, as opposed to an acquisition or joint development.

Similar to design and market uncertainty, another risk faced by technology-dependent firms is being heavily committed to an isolated design, or, as it often the case, having no claim to a state-of-the-art technology. Technology is typically advanced in a lumpy fashion, based on an overriding design. At some point, however, this cumulative process is interrupted by an innovation so significant as to render the older design technologically competitive, *i.e.*, secureable *vis. transferri*. Thus, the expected longevity, or life cycle, of the technology also influenced choice of procurement method within the study. Indeed, as seen in Table 1, the greater the expected longevity of the technology, the greater the likelihood that an acquisition was

to occur over joint development.

There exists theoretical rationale for the observed results. It has been recently argued in academic circles that firms should be viewed as a composite of strategic options that can be exercised or abandoned in the future, as the firm sees fit.<sup>3</sup> The results of this study strongly support this view. In accordance with this perspective, firms appear to be attempting to hedge against uncertainty by forming arrangements of varying flexibility and commitment, consistent with the level of perceived uncertainty (design, market, longevity).

For example, licensing arrangements provide a firm with a window of time to different technology, while maintaining a comparatively low level of commitment. Such action would be consistent with technology that is highly uncertain. As the outcome of the technology becomes apparent, the firm can, perhaps, increase its commitment through joint development, or even the acquisition of the licensee. Contrarily, if one firm it is learned that the technology will be a loser, the firm will be able to cease its licensing agreement with relative ease. Extensive commitments will not have been made in terms of physical or human capital. Ultimately, however, it is the initial licensing arrangement that provides the firm with a door in the glass, or option, for increased commitment.

Likewise, joint development can be viewed as providing a level of flexibility that an acquisition does not. Indeed, these types of arrangements may be particularly attractive when the success of the proposed technology is somewhat uncertain; the partners are able to share the risk and leverage their R&D resources. Ultimately, the joint relationship can be dissolved if initial results are disappointing, or, in the case of positive results, further investment can be made.

#### Firm History

One firm-level attribute that pre-

<sup>1</sup> See also Hagan, O., Ho, Y.L., & Wiedersheim-Paul, F. "Organizational Structure of Internationalization," *Journal of International Business Studies* (January/February, 1980), p. 65-78.

<sup>2</sup> For further discussion, see Barney, J. "Firm Resources and Sustained Competitive Advantage," *Journal of Management* (July, 1986), p. 656-665.

<sup>3</sup> See Miller, Christopher, and Gary, H. "Evaluating the Hidden Value in High-Potential Investments," *Strategic Management Journal* (Summer, 1993), p. 63-74.

fully determined the procurement method used in one sample of procurement arrangements was a firm's history of technology procurement. Firms that had extensive prior technology via acquisitions, licensing, or joint development in the past were more likely to do so in the present. Organizations appear to develop norms and success programs that build on their past experience. For instance, firms that regularly utilize licensing to acquire know-how develop techniques and systems that allow them to successfully integrate the new technology into current operations. They may have overcome the not-invented-here syndrome, where technology from the outside is viewed as less trustworthy.

The same may be true for those firms that consistently acquire new technological know-how through the acquisition of other firms, or joint development. One significant challenge to these acquiring firms is the integration of the newly acquired firm into current operations in order to fully reap the benefits of the associated technology. Further, the formidable task of managing joint development projects has also been well documented. These types of integration and management skills are likely to be learned only through experience, which can then be subsequently leveraged in the future.

It is also interesting to note one factor that did not significantly differentiate between the procurement methods. The relationship of the technology to the firm's existing asset base did not appear to influence the choice of procurement method. In other words, whether the firm had an existing skill base or capital assets that would allow the firm to develop internally, or established joint development arrangements, did not come into play. It has been argued that overall corporate success is dependent on the leveraging of existing corporate resources.<sup>1</sup> The likelihood performance of some American firms has been partially attributed to the

neglect of these internal capabilities. In the name of efficiency, these firms have increasingly relied on outsourcing and collaboration without considering the competitive consequences.

#### THE BEST METHOD OF EXTERNAL PROCUREMENT? IT DEPENDS

A primary concern of technology-intensive firms searching for external know-how is not simply gaining access to the technology, but also developing a level of proficiency or depth of know-how that can be expanded upon in the future. The degree to which firms internalize technical know-how may vary, from having to be dependent on outside assistance in order to maintain the technology, to being able to independently reproduce the technology, to ultimately being capable of adapting and customizing the technology for other applications.

Not surprisingly, it was found that the depth of technology procurement was significantly dependent upon the procurement method that was used. Acquisitions provided for the deepest level of know-how gained, followed by joint development and licensing arrangements, respectively. This is consistent with the level of interaction that each method provides. On average, the higher the level of interaction, the greater the technological know-how gained.

Across the entire sample of technology procurement that was studied, the reported success of the procured technology, in terms of fulfilling firm objectives, was also

related to the various technology attributes, specifically: (1) the degree of technological uncertainty, (2) the difficulty of technical imitation, (3) limited prior use of technology in industry (novelty), (4) the expected longevity of the technology, and (5) the relatedness of the technology to the firm's existing asset base.

However, as expected, the complete story is not as straightforward. Indeed, it was found that the relationship between technology attributes and payoffs varied depending upon the method of external procurement. Table 2 shows the relationship between the reported payoffs of the technology and the attributes of the technology as determined by correlation coefficients. These coefficients can range from -1 to 1 in magnitude. A negative coefficient suggests that the specific technology attribute has a detrimental influence on technology payoffs to the firm while a positive coefficient suggests that the attribute is conducive to technology payoffs.

For example, the difficulty in imitating the technology was particularly important to payoffs derived from that technology when firms procured procurement via joint development and acquisitions. This finding can be explained with simple economics. Firms are able to derive higher payoffs from their monopolization of the technology. If it's not easily diffused or copied by the competition, the technology is more likely to provide a long-standing competitive advantage.

However, difficulty in technical imitation had adverse effects on payoffs when firms procured technology via licensing arrangements.

RELATIONSHIP BETWEEN TECHNOLOGY ATTRIBUTES AND TECHNOLOGY PAYOFFS<sup>1</sup>

Technology Attributes	Licensing Agreements	Joint Development	Acquisitions
Difficulty of technical imitation	-0.17	0.41	0.36
Limited prevalence of technology (novelty)	0.24	0.37	0.42
Technological uncertainty	-0.05	-0.08	-0.27
Expected longevity	-0.23	0.33	0.38
Relatedness to firm's existing assets	-0.38	-0.01	-0.08

<sup>1</sup> Results from a partial correlation analysis. Firm size, procurement history, industry, and R&D intensity was controlled. All correlations greater than 0.15 in magnitude are significant at the 0.05 level.

<sup>1</sup> D. Foray, M. L. L. and M. L. C., "The Competitive Advantage of the Corporation," *The MIT Review*, Boston, MA, June, 1986, p. 7-18.

Table 2

Again, ambiguous technology may be particularly problematic for firms to internalize and build on with an inter-plant arrangement (licensing), where the level of interaction is typically low. In addition, the potential for monopolistic gains and competitive advantage, derived from the limited ability of competitors to imitate, may be lost under licensing arrangements. With licensing, the procuring firm lacks the necessary control over the technology in order to ensure its limited access to competitors under a licensing arrangement.

In a similar fashion, the variety of the technology had a positive influence on technology profits for all three of the procurement types. However, it appears to be most important where acquisitions are pursued, and at least critical for licensing arrangements.

Technological uncertainty adversely affected the profits derived from acquisitions, but was not particularly detrimental when the technology was pursued via a licensing arrangement or joint development. Licensing and joint development may provide an effective hedge against such uncertainty and dissipate its damaging influence.

Likewise, expected longevity was a critical determinant of the reported profits for those firms pursuing joint development and acquisitions, yet was not an important factor in determining the technology profits derived from licensing agreements. Again, the low commitment method of licensing may hedge against the risk of technology being considered in a short period of time.

Interestingly, the more related the incoming technology was to the firm's existing asset and skill base, the lower the level of profits derived from licensing and joint development arrangements. While it is difficult to fully explain this outcome, it may suggest that these external methods can be increased if utilized as a substitute for internal development.

#### MANAGERIAL IMPLICATIONS

What do these findings imply for firms that are either trying to market their existing technology, or trying to procure new innovations through external sources?

For those firms that wish to market their technology in the form of licensing arrangements, the procurement history of potential buyers should be carefully examined. Those firms that have extensively procured technology via inward licensing in the past, are more likely to do so in the future.

In addition, technology that maintains certain characteristics may enhance its "licensability." Technology that is risky may be particularly appropriate for licensing. Licensors may be willing to take on relatively higher levels of uncertainty, in terms of design, market acceptance, and limited longevity, through a low commitment method, such as a license arrangement. Finally, the ease with which the technology can be imitated should be factored in. Ambiguous technology may be a tough sell with the limited resources typically provided by licensing arrangements.

Several issues are relevant to those organizations considering procuring technology from external sources. Perhaps, most important, firms must recognize the difference in the depth of know-how that is gained through the various procurement means, in conjunction with the level of interaction. Objectives must be established regarding the desired level of technological know-how.

Moreover, the effectiveness of the various procurement methods may depend upon certain attributes of the technology (Table 2). For example, when considering potential acquisitions, special attention should be given to the degree of difficulty involved in imitating the technology, its overall uncertainty, and its proximity among competitors. Acquisitions may be most appropriate when the technology is ambiguous in nature, yet fairly low risk in terms of design, market acceptance, and expected longevity.

Similarly, joint development may be more suitable when there is increasing uncertainty with regard to the technology, and when the firm possesses limited assets related to the know-how. Licensing may be particularly appropriate when the technology is highly uncertain, when the firm has limited related assets, and the know-how is easy to imitate.

Finally, decision-makers may want to view their technology investments as options for the future, and pursue the various procurement methods in accordance with their varying levels of commitment and ability to hedge against uncertainty.