6-1999

The Effect of Technological Environment and Competitive Strategy on Licensing Decisions

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Recommended Citation
Roy, Matthew H. and Sanjiv S. Dugal. "The Effect of Technological Environment and Competitive Strategy on Licensing Decisions." American Business Review 17.2 (1999): 112-118.

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Abstract

The expectation that firms that have a high differentiation strategy will also have low levels of licensing is not supported. For business units (BU) with products in the growth stages, the competitive strategy of the BU did not significantly affect licensing decisions. The results are not too surprising when one considers new technological advancements and global competition. A company may perceive its technological advantage as transitory and expect rapid imitation by competitors. In such a case, the company might want to license the innovation as quickly as possible to gain global acceptance. It is shown that when products mature, the competitive strategy dimensions do have a significant impact on licensing decisions. Under such conditions, the expectation that high differentiation will lead to protective actions was not confirmed. It is also shown that licensing activity is only related to the competitive strategy of the firm when the product-demand life cycle is in the mature stages.

Introduction

Decisions concerning the sharing of company patents and proprietary know-how have been a major consideration for business managers for a great many years (Forrest & Martin, 1992; Lovell, 1968; Shahrokhi, 1987). Recently, the geometric growth in technological advancements coupled with continuous increases in global competition have served to increase the importance of these decisions (Dugal and Roy, 1996). Some business units refuse to license the production of their inventions because of the potential for reduced profits and/or the decrease in barriers to imitation (Hill,1997). However in today's competitive environment, the great majority of firms find that a flexible attitude is the only way to preserve their current position or gain a competitive advantage (Dugal and Roy,1996; Gemunden et al,1992; Grindley and Teece,1997). Companies of all sizes and nearly all industries license the production of products and services, but there is evidence to believe that the incidence is higher in technically complex and research-active industries such as aircraft, communication, industrial machinery, computers, and chemicals. (Arora, 1997; Grindley and Teece, 1997; Lovell, 1968).

Conventional business strategy prescribes that companies have three choices upon successful development of an innovation. They can "go it alone," form a strategic alliance, or license the production of their innovation to other businesses (Hill and Jones, 1998). Licensing makes most sense when (a) the licensor lacks complementary assets to produce and market the product, (b) barriers to imitation are low, and (c) there are many capable competitors. If any of the aforementioned criteria

apply, the rapid diffusion of the innovators technology through imitation is inevitable (Caves, Cookell, and Killing, 1983; Gallini, 1984; Shapiro, 1985). Given these factors, by licensing out its technology the innovator can at least share in some of the benefits of diffusion.

Licensing decisions are made within the larger context of the technological environment. The technological environment influences the decision to license innovations, particularly through its influence on input and output activities and the types of technology adopted by the business (Bourgeois, 1985; Rousseau, 1979). For instance, an environment of technological turbulence reflects rapid changes in technology creating shorter product life-cycles. The threat of product obsolescence is real even before the product enters the market, making the decision to develop technological know-how a critical factor in firm survival. Theoretically we would expect firms in turbulent technological environments to be more active in licensing products/processes as the time span for recouping development costs is shorter. In this paper, the link between a business unit's (BU) technological response, viz., licensing, to its competitive position (Brockhoff & Pearson, 1992) is analyzed in the context of managers' perceived technological environment.

Technological Environment and Competitive Strategies

Strategic managers and theoreticians have long since recognized the importance of technology as a strategic dimension. Since the early 1980's there has been an understanding that technology is a strategic asset and needs to be managed accordingly (Arora, 1997; Hill, 1997; Frohman, 1980). The technological strategy-environment link is becoming more critical as boundaries between industries become blurred as a result of technological change (Kirschenbaum, 1990). Consequently, in the formulation of industry and business trends, managers must characterize technical trends. A good example of this is the rapid changes in the photography industry as computer technology crosses once formidable industry boundaries.

Technology is commonly defined as the process of converting input into output, through the use of knowledge, tools, techniques, and actions (Rousseau, 1979). This definition goes beyond the "production function" concept by introducing the technologyenvironment interaction in an open systems perspective. The open systems perspective treats technology as an input-conversion-output mechanism and thereby recognizes the qualitatively different types of activities that make up different competitive strategies (Jennings & Lumpkin, 1992). The technological decision to license products or processes, is contingent upon the competitive strategy and managerial perceptions of the technological environment.

No single technological decision is optimum in every situation, therefore a contingency approach is appropriate. A contingency approach to strategy has been most clearly depicted in the environment

strategy-structure paradigm (Chandler,1962). Murray (1988) shows the bilateral nature of a firm's relationship with its environment and the strategic implications of these external factors. He suggests that Porter's generic strategy concept can be clarified by linking each strategy to a set of environmental preconditions. Other research (Dvir et al, 1993; Brockhoff & Pearson, 1992; Hambrick,

1983) has shown the intricate possibilities that can exist between Porter's generic strategies and Murray's environmental link.

While taking a similar approach, we are not concerned with deriving a typology of generic strategies between successful and unsuccessful firms. We are concerned with exploring the technological response viz., product/process licensing, of BUs in different strategic positions under different sets of technological preconditions. We assume that a BU operates in a technological environment based on managers' perceptions of technological conditions which are described as "stable" or "turbulent". Our research seeks to ascertain any commonalties in managers' response to licensing activity, when positioned competitively in their technological environments.

Research Design

The Demand-Technology-Product Life-Cycles (Ansoff, 1984) form the theoretical basis for distinguishing technological environments. The Demand-Technology-Product Life-Cycles depict BUs producing their distinct products, and operating at different stages of their product life-cycle curves, as determined by the demand for their product. These curves form the basis for distinguishing BUs into technological environments. The underlying assumption is that technologies move through life cycles, just as industries and products do (Chrisman & Bolton, 1992).

A "stable" technological environment describes businesses with a long-lived technology which remains basically unchanged for the duration of the product's demand life-cycle. On the other hand, a "turbulent" technological environment is distinguished by one or more basic technology substitutions taking place within the life span of the product. In this environment, the threat of product obsolescence is real even before the product is produced because of relatively frequent and short-lived product life-cycles.

Describing technological environments from such a perspective becomes a useful method for analyzing competitive strategies of BUs, because the technology environment interaction in an open systems perspective includes the role of managers making technological choices among strategic alternatives (Dugal and Roy, 1996). The research design is based upon a two way cross-classification of a sample of BUs by their technological environment (stable and turbulent) and the stage of their product's life-cycle (growth and maturity). This classification is a cross-sectional view of the Demand-Technology Life-Cycle which is viewed as a static picture at a particular time period. Evidence supports this approach as a longitudinal view may make classification of BUs impossible (Reger & Huff, 1993).

Within each of the four cells, a BU makes choices which link dimensions of its competitive strategy and its response with regard to licensing decisions.

The dimensions of competitive strategy are based on Porter's generic strategies (i.e. differentiation and focus). Since the competitive strategy positions represent strategy dimensions, not "generic" strategies (Porter, 1980; Chrisman & Boulton, 1992), both the dimensions operate simultaneously to form a BU's competitive strategy. Assuming each dimension is a continuum, we partitioned the BUs in our sample into high and low levels on each of the two dimensions (i.e., high/low differentiation, and broad/narrow focus). The result is four possible competitive strategies (which form our independent variables) viz., high differentiation-broad focus, high differentiation-narrow focus, low differentiation-broad focus, and low differentiation-narrow focus.

Research Question

To what extent is the decision to license innovations related to the technological environment? Also, what effect does business level strategy have on licensing decisions? Finally, what is the relationship between the product life-cycle and licensing decisions?

Hypotheses

We would expect that BUs with a competitive strategy of high differentiation would not license products/processes readily as this decreases the barriers to imitation. Additionally, we would expect BU's in turbulent technological environments to be more involved in licensing of their products/ processes in an attempt to recoup development costs prior to product obsolescence. Formally stated, the hypothesis are as follows:

H1: BU's pursuing a differentiation strategy will license innovations less frequently, whether the technology is perceived to be stable or turbulent and whether the product life cycle is in the growth or mature stages.

H2: BU's in a turbulent technological environment will license innovations more frequently, whether the product life cycle is in the growth or mature stages and whether the strategy is differentiation or focused.

There are many other relationships which will be explored. However, their exploratory nature prohibits the formulation of hypotheses.

Methodology

In order to test our hypotheses, data must be available on managers' perceived technological environment, product demand life-cycle, competitive strategy variables and the licensing activity, for a large number of BUs. The data base designated the Profit Impact of Market Strategy (PIMS) Competitive Strategy Research Data Base, is a line-of-business data base describing business units and their served

markets. It is considered particularly appropriate for the following three reasons: (a) The unit of observation is a BU in our study. The open systems perspective assumes "technology" is embodied in the product, and hence our unit of observation must be "distinguished by the distinct set of products or services that it provides to an identifiable group of customers, and for which a meaningful study of revenues, operating costs, investments and strategic plans can be made" (PIMS definition of the BU). (b) The definition of the served market of a BU narrows down to include only product categories and customer groups identified by the embodied technology. The PIMS Data Base is distinguished precisely by such a definition of the served market, making it particularly suitable for this research. In essence, PIMS served market is equivalent to a market segment rather than a total market. If a number of segments are sold to, they are combined into one served market. Segments not sold to are excluded from the definition. (c) The market definition avoids the usual problem of diversification noise when industry definitions are used. Market competitors are observed at the level of the BU serving the market, not at the level of the entire company.

The Sample

The PIMS Data Base does not draw a sample from any explicitly defined universe. The data base consists of over 3,336 business units serving many national and international markets. For the purposes of this study information was gathered from the 2,498 BUs which serve markets in the United States. A business is defined as "a division, product line, or other profit center within its parent company, selling a distinct set of products or services to an identifiable group or groups of customers, in competition with a well-defined set of competitors" (Buzzell et al, 1975). This sample covered the time period 1992-1995. The average value for each variable over the four year time period was used in this study. A large sample is necessary because the data are subjected to cross tabulations.

Technological Environment Variables

These variables are managers' perceptions of the technological conditions of their markets. BUs which are perceived to have experienced "recent major technological change" (PIMS Data Base), are described as operating in a turbulent technological environment. The stable technological environment includes a perception of BUs which have "not experienced any major technological change in the recent past, nor have experienced any product change except sporadically, with no regular nor periodic pattern of change" (PIMS Data Base).

Product Life-Cycle Variables

The PIMS Data Base distinguishes BUs by their product life-cycle into introductory, growth, maturity and decline stages. In a two stage process, respondents are asked if their product/process is in the introductory stage. If respondents answer "no" they are then queried as to the level of growth. Hence

none of the firms included in this study are in the embryonic stages of development. Business units in their growth stage have demand for their product growing at 10% or more annually in real terms. In the mature stage, a BUs' real growth ranges between 0% and 10%.

Competitive Strategy Variables

Consistent with the work of previous researchers who have used the PIMS Data Base (Dess and Davis, 1984; Frohman,1985; Heany,1983; Thietart and Vivas, 1984; Thorelli and Burnett, 1981; Varadarajan, 1985; Yip, 1982) we identified the competitive strategy variables to represent our strategic dimensions. Details are available upon request.

Licensing

The level of external versus internal development of technological capability has been studied previously (Berkowitz, 1993; Galbraith & Kazanjian, 1983; Mulder & Vergragt, 1991). The variable is measured categorically, BUs either license the production of their innovations or do not.

Data Analysis

The data was tested using analysis of variance. The goal is to assess whether differences in the dependent variable (licensing) can be attributed to differential levels of the independent variables rather than to chance. Only those results were considered with a minimum sample size of 15 BUs, and mean results of the dependent variable significantly different at an alpha level of .05.

The second stage of the analysis is a follow-up test of the ANOVA. Here we consider the question, if the competitive strategy dimensions differ significantly in mean response to licensing, which specific dimensions are contributing to the general significance? For example, if we find that firms in a mature technological environment are more apt to license innovations, is it the differentiation, focus, low cost, or interactive effect which is contributing to this decision? Note, the interactive effect represents the relationship the independent variables have on each other. An interaction is present when one of the independent variables does not have a constant effect at all levels of the other independent variable. If the interaction effect is significant, conclusions based on the main effects alone may be misleading (Keppel, 1991).

Results

The overall level of licensing activity for BUs in a turbulent technological environment is higher than that of BUs in a stable technological environment. It appears that when technology is changing rapidly, business units are more apt to contract with outside vendors to develop necessary technology.

Another possible explanation is that firms which have the technology are more apt to try to capitalize and make a profit on their technological know-how before it is replaced by new advancements. Business units in stable technological environments were much less involved in these types of activities.

The stage of the product life-cycle has a definite impact on the decision to produce technology inhouse or to license production. BUs in the growth stages of their product life-cycle, were found to have no significant differences in licensing activity regardless of the competitive strategy of the business unit. In Table 1 the results of the ANOVA for BUs in the growth stages of their product life-cycle are displayed. Note, that none of the comparisons are significantly different.

Meanwhile, BUs in the mature stages of their product life-cycle have significant differences in licensing depending on the competitive strategy of the firm. Table 2 provides a summary of the ANOVA results for BUs in the mature stages.

More specifically, in a stable technological environment when the product is in the mature stage, BU's following a highly differentiated and focused strategy were significantly more likely to be involved in licensing activity than both the low differentiation/ low focus strategy and the high differentiation/low focus strategy. Alternatively, in a turbulent technological environment when the product is in the mature stage, differentiation strategy appears to be accounting for differences in licensing regardless of the product/market breadth position. In other words, BUs which operate in a rapidly changing technological environment but produce a product which is aging, appear to license products more often when attempting to differentiate their product than BUs operating under the same conditions but not trying to differentiate their product.

The second stage of our analysis is designed to determine which competitive strategy dimensions are responsible for the significant mean differences in licensing. Please note, in an attempt to make this paper more readable, Porters' low cost strategy was not included. However, it was used in the analysis and as such may provide additional information here. Under stable technological conditions, with product demand in the mature stage, the interactive effect is the most important factor explaining the variation in the dependent variable. The differentiation dimension also explains a significant amount of the mean differences in the dependent variable. Meanwhile, under turbulent technological conditions, with demand in a mature stage, cost and differentiation dimensions explain the major variation in level of proprietorship.

Conclusions

The expectation that firms that have a high differentiation strategy will also have low levels of licensing is not supported. For BUs with products in the growth stages, the competitive strategy of the BU did not significantly affect licensing decisions. The results are not too surprising when we consider

new technological advancements and global competition. A company may perceive its technological advantage as transitory and expect rapid imitation by competitors. In such a case, the company might want to license the innovation as quickly as possible to gain global acceptance. Matsushita successfully utilized this strategy in overcoming the technologically superior Sony beta format with the VHS format VCR. Matsushita's product was most certainly different than Sony's, but they successful chose to license production to insure their format (VHS) would survive. Other differentiators have failed to recognize the importance of speed in entering a market and lost millions in revenues. The Body Shops entrance into the U.S. market is one notable example. Their decision not to franchise their U.S. operation limited the influx of capital and the speed of growth. The result was rapid imitation by Bath and Body (Wexner owned) and Estee Lauder. Like Matsushita, the Body Shops strategy was differentiation. However, their failure to license global expansion resulted in the loss of their competitive advantage.

Interestingly our results show that when products mature, the competitive strategy dimensions do have a significant impact on licensing decisions. Under such conditions, the expectation that high differentiation will lead to protective actions was not confirmed. In fact, it appears that the opposite is true. When products enter the mature stage, firms that are concerned with differentiating take part in more licensing of their products/processes than their counterparts. The explanation for these actions may lie in a deeper look at the characteristics of mature industries. Generally, mature industries are post the shake-out stage and therefore large companies determine the nature of competition (Hill and Jones, 1998). Recognizing their interdependence firms adopt a competitive strategy that simultaneously allows each company to protect its competitive advantage while maintaining industry profitability. One way to deter the entrance of new competitors is through product proliferation via the introduction of new products. However, the licensing of these innovations to existing competitors may allow for sharing of the risks and maintenance of the competitive balance.

Our results show that licensing activity is only related to the competitive strategy of the firm when the product-demand life cycle is in the mature stages. Another possible explanation for this behavior is that firms utilizing a differentiation strategy use the profits from the licensing of mature products to develop new (and more easily differentiable) products. The risk of this strategy is that the latest innovation will not be successful and the firm has already licensed its technological know-how. For instance, RCA once licensed its color television technology to a number of Japanese companies. These companies quickly assimilated RCA's technology and used it to enter the U.S. market. Today the Japanese dominance of the U.S. television market is widely accepted.

A BU makes choices which ipso facto link dimensions of its competitive strategy and its response to licensing decisions. Our research was a cross-sectional study of the pattern of these responses under different perceptions of the technological environment and different stages of the product lifecycle.

The results indicate that the decision to license products depends not only upon the competitive strategy and technological context, but the stage of the product life-cycle. When in the mature stage of the product life cycle U.S. firms which have embarked upon differentiation strategies more often than not license their products to others. These findings show the multiple dimensions that must be considered by managers when making decisions to fund new technologies in-house or to subcontract them out to vendors. Our research makes a contribution to the notion of gestalts by showing that there are indeed significant associations between competitive behavior and managers' perceived technological environment.

Limitations and Suggestions for Future Research

In its present form this study is restrictive in scope. By distinguishing the BU's technological environment on the basis of the nature of technology as embodied in its product, we present a rather broad view of technology. In reality all the technologies embodied in a BU's value chain have competitive impacts.

Much research has been done on the environment-strategy-structure paradigm. Our research has a major limitation in that we have not considered the influence of technology on structural elements like concentration in the industry. Further, business characteristics like type of technology, the culture of the organization, or its internal structure, have not been taken into account. A final limitation of the study is the underlying assumption of equality of effort for all competing firms. A business with a good strategy but poor implementation is likely to fail. Although the database does include some performance measures (i.e. ROI), there is no way to measure a BU's quality of effort. Therefore, to link the results of this study to performance measures cannot be justified.

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