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Innovation, Competitive Advantage and Rent: A Model and Test

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Four antecedents, it is argued, are necessary precursors for a firm to capture rents from innovation. The antecedents are causal understanding; innovation team proficiency; emergence and mobilization of new competences; and creation of competitive advantages, each of which are conceptually distinct and precisely defined in the paper. These constructs are linked together in a stage model and subsequently operationalized and tested using LISREL. Substantial support is found for the central thesis, that achieving each of the four antecedent processes increases the predicted rents from an innovation project.

(Innovation; Competitive Advantage; LISREL Analysis; Competences; Capabilities)

1. Introduction

As traditional mechanisms for growth erode (Capon and Glazer 1987), scholars are placing an increased emphasis upon innovation as a crucial mechanism through which firms secure a place in the competitive world of the future (Van de Ven 1986). Notwithstanding this emphasis, theories of innovation permit only limited ability to predict whether and when a given innovation will significantly benefit the firm (Abrahamson 1991).

Our purpose is to make progress toward such a predictive theory. We take the position that the strategic benefits of innovative activity occur when, as a result, a firm captures above-normal returns, or rents (Bowman 1974).¹ Drawing on resource-based theories of competition, we articulate a model which specifies the ante-

cedents required for an innovation to yield rent for the firm, and test this model on a sample of 58 innovation projects underway in 40 companies using LISREL.

The essence of our argument is this: Before a firm may expect rents from an innovation, it must establish a distinctive competitive advantage, else rents will be appropriated by rival firms. In order for an innovation project to create competitive advantages, it must be able to demonstrate successful and reliable achievement of its business objectives, which suggests that it has created new "competences." Such achievements will be difficult if the innovation team cannot work together proficiently. Proficiency, similarly, will be hampered unless the team comprehends the nature of the challenges facing it.

Advantage, in short, can be seen to emerge as the result of a series of definable and describable antecedent processes.

2. The Utility of the Innovation Process

When does a firm benefit from undertaking innovation, as opposed to simply re-investing in existing products, markets and technologies? Received theory suggests

¹ When a firm has earnings above normal but does not attract or motivate competition which could potentially dissipate these excess earnings, it is said to be enjoying rents. When the lack of competition is due to unnatural restrictions in entry (such as legal restrictions or controlling the supplies of critical raw materials thus preventing access to it) the rents are said to be monopoly rents. When they are based on firm specific, non-imitable advantages they are said to be Ricardian (see Alchian (1991) for an exposition on these terms).

two primary arguments. First, a research stream following the work of Schumpeter (1950) holds that only through innovation can a firm renew the value of its asset endowments. Otherwise, economic forces exert relentless pressures toward perfect competition, in which there are no rents. This thinking is reflected in the second argument, that of resource-based views of strategy. Competitive effectiveness in this view is a function of firms' ability to create idiosyncratic, relatively inimitable resource endowments, which then become "strategic assets" (Amit and Schoemaker 1993).

It is important to note that strategic assets derive not only from a firm's factor endowments, but also from the way in which these are combined and utilized (Penrose 1959). These "ways of combining" become routinized over time (Nelson and Winter 1982), where routines are defined as repetitive patterns within an organization. A key aspect of routines is that they often possess a tacit dimension, making them difficult to identify or replicate. Further, resource and routine accumulation is path-dependent, meaning that their state at any point in time is profoundly affected by the past.

The consequence of all this is that it is virtually impossible for different firms to develop identical resource endowments. Resources, in other words, may be combined in routinized, but relatively idiosyncratic ways, implying that firms will develop enduring differences in strategic potentialities over time. It is this heterogeneity which is posited to delay (although not to indefinitely defer) appropriation of rents in competitive markets.

The significance of innovation in this context is that innovation always represents change. Change can have considerable benefit for the firm when superior resource combinations are discovered, often disrupting combinations which had been dominant (Schumpeter 1950). This is considered its chief benefit (Burgelman 1983). Moreover, to the extent that the new combination incorporates difficult-to-imitate routines, it will take some time before the combination can be matched by competitors.

In other words, innovation is one mechanism through which a firm gains superior insight about, and access to, firm-specific resources with positive future value. This helps create and sustain advantage in two ways. First, superior insight and superior access allow the firm to make competitively superior resource investments and allocations, because other players are less informed about the

future value of such investments (Alchian and Demsetz 1972). Second, through implementing innovations, firms can establish "flows" of resources which can lead to "stocks" of specific assets others will find impossible to replicate quickly (Dierickx and Cool 1989). Therefore, a substantive desired outcome of innovation is the generation of valuable new resource combinations, specific to the firm, which it alone may exploit.

This also raises the following problem: If valuable resource combinations are idiosyncratic and to some extent tacit, how are we to predict whether any specific innovation attempt is likely to contribute to the capture of rents in the future? This can be done, we suggest, through identifying the extent to which four distinct and necessary antecedents to rents are present, which tend to appear in a characteristic temporal progression as an innovation project unfolds.

3. A Model of Antecedents to Rent from Innovations

3.1. Causal Understanding

Following Knight (1921), Rumelt (1987) argued that absent uncertainty, competitors will "bid" for the price of valuable factors, until the price of these factors equals the return to be expected from them, thus driving rents to zero. So for a firm to realize rents from an innovation it must be able to reduce uncertainty in ways that are specific to it, while the uncertainty of its competitors remains (Amit and Schoemaker 1993, p. 40). In other words, by initiating an innovation, a firm can develop unique insight into the future which is opaque to competitors.

The strategic significance of such insight regarding the heterogeneous use of factors recalls Alchian and Demsetz's (1972, p. 793) point that "Efficient production with heterogeneous resources is a result not of having better resources but in *knowing more accurately* the relative productive performances of those resources" [emphasis in the original]. Unique insight is thus an important determinant of the ability of a firm to garner rents. An indicator of insight is the degree of what we shall refer to as "causal understanding" possessed by a project team. Causal understanding reflects the team's grasp of the relationships among antecedents and consequences, most critically their understanding of

relations among inputs, combinations and results to be expected from the deployment of production factors.

By definition, causal understanding in the early stages of an innovation will be limited. Decisions must be made under simultaneous conditions of uncertainty (absence of information) and ambiguity (lack of clarity about the meaning of data). Such a situation is “. . . characterized by rapid change, unanalyzable technology, unpredictable shocks and trial and error learning” (Daft and Lengel 1986, p. 558). The response is to “often and extensively simplify” (Amit and Schoemaker 1993, p. 41). The cognitive mechanisms through which simplification occurs have two important implications. First, no two individuals are likely to develop the same set of belief structures, so they will tend to simplify reality in an idiosyncratic way. This preserves heterogeneity. Secondly, since the true state of nature cannot ever be correctly and impartially ascertained (see March, 1991 and his concept of the “organizational code”), the experimental learning taking place during an innovation allows a firm to create firm-specific and idiosyncratic insight.

As causal understanding develops, a project team’s ways of combining resources should reflect increased insight. Similarly, the behavior initiated in light of unusual insight will be routinized, reinforcing and preserving the differences between firms operating with different views of causality. So in general, if an innovation is to yield new rent streams, there is a need for the development of new causal understanding, the outcome of which is the creation of superior insight into the future value of resources. To the extent to which causality is unclear and insight is absent, an innovation team can only rely upon luck for its results, (though we would never advocate a summary dismissal of luck—see Barney 1986).

As a general rule, the greater the distance between the existing asset- and knowledge base of the firm and the attempt at innovation, the more difficult it will be to develop superior insight. This point is in agreement with Meyer and Utterback (1993). They argue that to the extent that any product innovation differs substantively from extant “product platforms,” causal understanding will be less clear, making the innovation more difficult to accomplish. Similarly, attempts to adapt existing product platforms to create product families in

new markets (Meyer and Utterback 1993), are inhibited to the degree that the firm lacks causal understanding of the dynamics of those markets.

3.2. Team Proficiency

Insight aside, any innovative idea must be translated into action if it is ever to capture rent. This is usually done in the realm of teamwork, since teams are a vehicle used by firms to overcome individual limitations, whether they be limits of cognition, of skill or of labor time (see Gladstein 1984, p. 500). To echo the classic definition provided by Alchian and Demsetz (1972, p. 779) “team production . . . is production in which 1) several types of resources are used and 2) the product is not a sum of separable outputs of each cooperating resource.”

The project team plays a major role in creating and preserving heterogeneity between firms, because as Wernerfelt (1989) argues, a proficient team develops interactions which lead to inimitable, deeply imbedded, routines. When these are unusually efficient, the team itself becomes an intangible asset with considerable long-run potential. Teams form the context in which idiosyncratic routines become established—team interactions become routinized and this routinization contributes to the many subtle behaviors and beliefs associated with organizational culture, further contributing to inimitability (Fiol 1991, Hofstede 1991).

Our object here is not to revisit the burgeoning team-building literature (see Miller 1992 for a review); but rather to propose that the development of team proficiency is generally antecedent to new streams of rent from an innovation. To the extent that a team lacks proficiency, the firm will incur serious opportunity, agency and transaction costs. Opportunity costs arise because the optimal use of the team and its resources is not known. Agency costs are incurred because expenditures must be made to align goals and ensure coordinated production. Transaction costs stem from expenditures to cope with or overcome delays and inefficiencies related to poor internal coordination. A proficient team economizes on these costs and eliminates related obstacles to achieving desirable results.²

² The focus here is on “task processes,” or “. . . those behaviors aimed at organizing members to get work done as opposed to those that influence affect or the team’s ability to maintain itself as a group . . .”

Thus project team proficiency represents a second antecedent for the attainment of rents from an innovation. Team proficiency moreover is somewhat dependent upon progress in developing causal understanding. Coordinated production and mutual accountability are difficult to attain when the team is unclear, or in disagreement about basic causal sequences. As causal understanding and team proficiency co-evolve, their effects can be traced in the ability of the firm to deploy new competences.

3.3. New Competences

Following Teece et al. (1991), we define competences as particular combinations of firm-specific resources which allow an organization to meet its objectives. Increased competence, therefore, should accompany increased ability to achieve objectives. This has important implications for emerging advantage (McGrath 1993).

In the early stages of any innovation, performance against targets is typically volatile. Cognitive theory and theories of organizational learning (Lant 1992, Levitt and March 1988, Cyert and March 1963) suggest that the resulting gap between the desired state and current results acts as a trigger to seek performance improvement. The team might, for example, try new resources or employ different routines. If improvement occurs, the team is likely to not only conclude that they have found a successful combination, but to build subsequent efforts on the basis of the successes which preceded it. The project team thus learns (or thinks it has learned) what patterns of resource deployment will create desired results. Of course, an alternative path to reducing the gap between goals and aspirations is to change the nature of the aspirations themselves. This, too, can reflect idiosyncratic learning as the innovation is redirected in a more promising direction (Block and MacMillan 1985).

In either case, evidence which suggests that a team is closing the gap between aspirations and performance can also be taken as evidence that the team has developed new competences. This does not require that the

objectives are those the team began with, nor does it imply that the same team is engaged in their pursuit. Rather, the point is that a firm which becomes capable of reliably and predictably meeting **any new** objectives has evidence that potentially valuable new competences are being developed.

We make an important distinction here, one which is often blurred. The fact that a firm has created competence does not mean that it has created competitive advantage. One need not search too far to find many examples of firms which succeeded in creating breakthrough competences without necessarily achieving desired commercial results. Examples include Penicillin, automobile safety glass and (initially) Post-It notes.³ The good news for firms is that if resource-based arguments are correct, emerging competences will be imperfectly mobile, meaning that other organizations will not be able to rapidly duplicate them in the event that a commercial success does occur (Penrose 1959, Nelson and Winter 1982).⁴

The ability to mobilize new competences is a function of the extent to which causal understanding and team proficiency have progressed. Absent causal understanding and team proficiency it is highly unlikely that the firm will be able to reliably and consistently achieve new objectives, be they the original objectives of the innovation or some new set of emergent objectives.

New competences, then, may be conceived as *potential* competitive advantages. They represent the ability of the firm to do something it couldn't do before the innovation attempt. In some cases, this will simply be necessary to compete, as technology races in industry after industry drive up the minimum performance required to participate at all. In others, deployment of

³ We stress that being new is not the same as being desirable. The competences created in an innovation project may not actually improve on existing uses for the firm's resources. Recall Kimberly's (1981) comment that the study of innovation suffers from a pervasive positive bias. New competences may well end up as "mistakes" (Van de Ven 1986, p. 592) rather than the more desirable "innovations."

⁴ Further, aspirations and goals of the project team themselves are likely to be idiosyncratic. To the extent that a firm is able to create new competences which meet these idiosyncratic goals, it is likely to be increasing or at least preserving heterogeneity.

(Ancona and Caldwell 1992, p. 323). The linkage between task processes and performance has precedent in work by Eisenhardt and Bourgeois (1988), Pettigrew (1973), Guth and MacMillan (1986) and Tushman (1977).

competence does show the possibility of creating advantage, and from advantages, rents.

To move from competence to competitive advantage, a firm must embed its competences in products and services and create customer transactions, which brings us to the final element of our model.

3.4. From Competence to Competitive Advantage

The final antecedent condition for an innovation to yield rent for the firm is the establishment of new competitive advantage. To recall the relationship between advantage and rents, we noted earlier that rents over the long term are achieved only when a firm can earn abnormal profits for its offerings, and when other firms cannot duplicate the product characteristics that yield these abnormal profits. This occurs in one or both of two ways as von Hippel (1988, chapters 4 and 5) has suggested: 1) when a firm is able to operate with superior efficiency relative to competitors, thus creating a pricing advantage, or 2) when a product offers so much customer value that it commands prices which far exceed costs. In either case, differentiation or distinctiveness is a crucial aspect.

3.4.1. Efficiency Advantage. Efficiency as a source of competitive advantage is much emphasized in resource-based treatments (Peteraf 1993). When a firm is able to overcome the limitations of existing or standard practices to do things faster, cheaper or better than the competition (von Hippel 1988), and when the factors which yield this level of efficiency are firm-specific competences, the firm has an advantage (von Hippel 1988). It is able to produce at a lower average cost, and may be able to attract customers by selling at a price fractionally below industry equilibrium price. It is thus able to reap abnormal profits. If others cannot follow, these are rents.

3.4.2. Value Advantage. When the benefit a firm is able to offer a customer exceeds the customers' cost of obtaining that benefit, the firm has created value for that customer. If opponents can't match value, the firm may be able to command premium prices. To the extent this premium price exceeds the costs to the firm required to create the benefit, the firm can earn abnormally high profits, which again translate to rents to the extent that others cannot immediately follow (Day and Wensley 1988; Teece et al. 1991).

It is worth reiterating that the competences creating either efficiency or value advantages must be distinctive (in other words, different from those of competitors) if they are to contribute to generating rents. Distinctiveness lies at the heart of the resource-based argument. Distinctive (firm specific) competences stem directly from the degree to which the innovation process has generated idiosyncratic insights, idiosyncratic resource combinations or idiosyncratic routines that competitors cannot easily match or imitate.

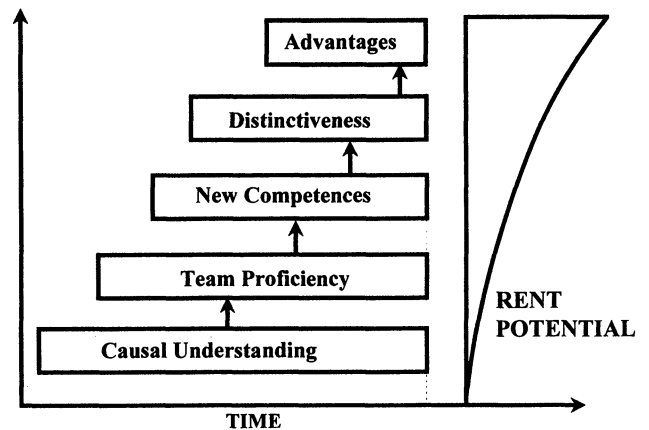
Achieving distinctive efficiency advantage or distinctive value advantage or both is thus a final necessary antecedent for securing rent from an innovation effort.

3.5. Toward a Stage Model of Antecedents of Rent

We have argued that there are four antecedents to rent from innovation, which unfold in sequence. However, once an earlier antecedent starts to develop it continues to accumulate, so that at any specific point in time several antecedents may be evolving simultaneously, as depicted in Figure 1.

This figure depicts the full sequential and cumulative nature of the antecedents—initial antecedents need to develop prior to subsequent ones, but all are essential and are evolving. It is not possible for the project team to be creating new competitive advantages unless it is mobilizing new competences. New competences are unlikely to be emerging absent emerging team proficiency. Innovation team proficiency cannot progress without concurrent development of causal understanding. So, at

Figure 1 Sequential and Cumulative Antecedents to Rents



any one point in time all these antecedents may be co-evolving, but the pace at which those downstream progress will be impeded by lack of progress on upstream antecedents.

Let us turn now to the method used to empirically examine this model.

4. Methodology

4.1. Description of Sample

The data for the study were collected from 58 innovation projects underway in 40 different firms in eight different countries. To increase diversity, a wide variety of innovations were included in the sample, including product, process, market and major systems innovations. The level of analysis was the innovation project itself, so the primary sources of data were therefore within-firm, within-group.⁵ Specific innovations were identified by senior executives in each firm to whom the research team had access. While the sample was a convenience sample, we show below that there is high variety along a number of contingency variables important in the study of innovations.

An innovation was defined as the development of a new offering, entry into a new market, or a significant attempt to restructure or improve a process (such as the adoption of a new technology in a manufacturing firm or implementation of a major new operating system in a service firm).

The degree to which the innovation underway was novel to the firm undertaking it was widely distributed in the sample.⁶ The sample also included equally wide

variation in project size, project age, firm and project performance, and industry as important contingency variables. Most of the projects were in US-based firms, although 24% were from firms based in eight other countries. Regressions run with and without these controls showed no significant changes in Beta coefficients, which to some extent increases confidence in the generalizability of the results.

The senior executive in charge (usually in conjunction with key innovation team members) determined the composition of the project team. All the individuals who were classified as part of the project team for the innovation were included in the respondent set. Questionnaires were developed which operationalize and provide measures for each independent and dependent variable. These were administered to each of the individuals in the respondent set. The response rate for each project was 100%. Individual responses were averaged for each item for each project, to provide project level data for each variable.

4.2. Construct Operationalization

As the first step in testing the model, we elected to undertake a cross-sectional study. The objective was to capture the relations among the various constructs at a point in time for each of the wide variety of projects in the sample. Six constructs needed to be operationalized for the study. They were causal understanding, team proficiency, degree of development of new competences, distinctive value advantage, distinctive efficiency advantage, and rent.

Items which tap each construct were derived, item by item, from relevant literature. Items were scored by respondents, either on 1 to 5 Likert-type scales or by the assignment of probabilities. Higher values for the score are always associated with higher levels of the construct.

how of the project team; the skills of the project team; the technology used in the project, the distribution channels for the product; the people who are working in the division. The minimum possible score for this measure of innovation novelty is 12 and the maximum 60. The sample had a range of 20 to 50 with a mean of 31.1 and a close to normal distribution. The sample thus includes substantial variety in innovation novelty.

⁵ This echoes the conclusion of Clark, Chew and Fujimoto (1987, p. 738) who find that "Any study of the development process faces several problems in acquiring data. Publicly available information on R&D either is not project-specific or does not provide evidence on the outcomes of the development process or the operating characteristics of the firm. A study of this kind thus requires collection of data in the field."

⁶ This was measured by having respondents respond to the following question: "To what extent are the following project characteristics or factors new to your firm at the moment?" Respondents answered on 1 to 5 scale (not new at all to completely new) for the following items: The product or service offered; the market or clients served; the customer/client need to be met; those paying for the offering; the users of the offering; the competition faced; the systems used; the know-

Table 1 Descriptive Statistics Responses – *N* = 58

Construct	Mean	Std. Dev.	Skew	Alpha	Causal	Proficiency	Rent	Value	Effic.
Competence	31.61	2.63	0.26	0.85	0.26*	0.32*	0.29*	0.25*	0.14
Causal Understanding	55.97	5.86	-0.36	0.90	-	0.40**	0.12	0.01	0.23
Team Proficiency	39.81	4.12	-0.24	0.88	-	-	0.27*	0.29*	0.24
Rent	555.99	117.30	-0.20	0.90	-	-	-	0.56***	0.40**
Distinctive Value	32.96	3.90	-0.32	0.88	-	-	-	-	0.18
Distinctive Efficiency	7.05	1.30	0.02	0.79	-	-	-	-	-

*: Significant at 0.05-level.

**: Significant at 0.01-level.

***: Significant at 0.001-level.

Since the study design was cross-sectional we elected to operationalize these constructs by using the project team members as expert judges of the values of the variables. The team members and the project leaders individually filled out questionnaires that tapped each of the constructs as follows (see the appendix for a summary of main sources and items for each of the constructs).

Causal understanding and *team proficiency* were measured by the team's current assessment of its understanding of critical business elements, such as the customer need being addressed. *Degree of new competence development* was measured by the team's assessment of current performance against key objectives. Increasing ability to meet or exceed objectives is interpreted here as the measure of emerging competence. *Competitive advantage* and *rent* were measured by the team's assessment of being able to capture future rent. One could argue the need to measure these variables with data obtained from some objective source such as accounting data. However, we could not use such objective data on value, efficiency and rent because reliable data on these variables for the evolving innovations will be available only in some distant future. In the absence of direct measures we were obliged to use proxies or estimates for them. We decided to use the expectations of the project team as a proxy. We assume there is significant correlation between the expectational world of managers and the objective world of these relationships. Hence, looking at the relationships within an expectational framework is a proxy for looking at the relationships

where the variables have actual outcomes. We used the expectational data of project team members and project leaders because they were experienced decision makers, who had made decisions that affected the outcomes of past innovation projects in a competitive world. Further, since the performance evaluations (and perhaps careers) of these managers are to some extent affected by the success and failure of these innovation projects, there is some relevance and external validity to the expectations of these managers.

The average of the team's responses for each item was calculated, team averages for each item were then tallied, which provided the overall score for each construct. Separate scores were also developed for each project leader. Cronbach's Coefficient Alphas were calculated for each construct. All Alphas were considerably above the 0.7 level advocated by Nunnally (1978), reported in Table 1 and in the appendix. Most other common forms of reliability check are not appropriate for this study. We expected to find change over time in the variables of interest, so intertemporal stability is not meaningful as a reliability check. We expected to find some differences in assessment among the multifunctional members of the innovation team, hence inter-rater reliability is not meaningful.

Validity was addressed in two ways. First, operationalization of constructs drew upon an extensive review of the literature, both to enhance construct validity and to be cumulative with previous work. Second, research results were "reality-checked" by actively discussing them both with project team members and with

knowledgeable peers and superiors in participant organizations. There was high agreement with the results, providing evidence of the external validity of these results.

Common response bias was addressed by comparing the responses of the innovation team with the responses of the project leader (the individual with arguably the greatest amount of external access, but with a substantial expertise on the status of the project). Correlations among leader and team responses were positive and significant, somewhat reducing our concern about common response bias.

Common method bias was addressed by conducting factor analyses of all the constructs, but using the individual responses to get a large enough sample size ($n = 247$). For all the constructs the factor analyses yielded at least two factors with Eigen values greater than one—thus reducing concern about common method bias.

4.3. Structural Model

Given the fact that the model proposed above is a stage model in which the constructs are linked sequentially but at a point in time may all be evolving contemporaneously, we decided to analyze the interrelations among the variables using LISREL analysis. LISREL was chosen because such covariance based structural modelling allows one to systematically check model identification, allows one to estimate parameters simultaneously and provides overall measures of goodness of fit. The six variables were treated as manifest variables, represented in the path structure shown in Figure 2. This model assumes no feedback effects of any independent variable to itself, so it is nonrecursive. In essence, drawing from the above theory, we argue that competitive advantage emerges from an innovation project in stages. First, causal understanding is the independent variable which enables team proficiency to develop. With the development of team proficiency new competences emerge. In the next stage, the ability to mobilize emerging competences leads to expectations of distinctive efficiency and/or distinctive value advantages. In the final stage, these anticipated competitive advantages lead to expectations of rent. Note that the model tested here is not sequential—at any point in time, current causal understanding is enabling team proficiency, team proficiency is enabling emerging com-

petence, emerging competence is generating expectations of distinctive value or efficiency and current expectations of distinctive value and efficiency are generating expectations of rent.

4.4. Model Identification

Since the model is non-recursive, and our hypotheses specify no feedback effects to any of the dependent variables, the Beta matrix is subdiagonal. We assume that there are no systematic errors besides those which the model predicts, which makes the Psi matrix diagonal. If this is the case, the recursive rule of identification then proves that the model with these characteristics is sufficiently identified (Bollen 1989).

The small sample size, though of concern, is unavoidable given the difficulty of securing access to a large number of innovation projects. Furthermore, the more common difficulties with a small-sample study are mitigated in this study for the following reasons:

1. The model is a path model, not a confirmatory factor model.
2. The model is sufficiently identified.
3. The covariance matrix was used for the study, as recommended by Bollen (1989).
4. At no stage in the analysis did we encounter problems of non-convergence.
5. At no stage in the analysis did we encounter problems of negative residual variances.
6. Bollen (1989) argues that the test for departure from Chi-square tends to lead to a more likely rejection of the null hypothesis, thus the test tends to be conservative for small sample sizes.

5. Results

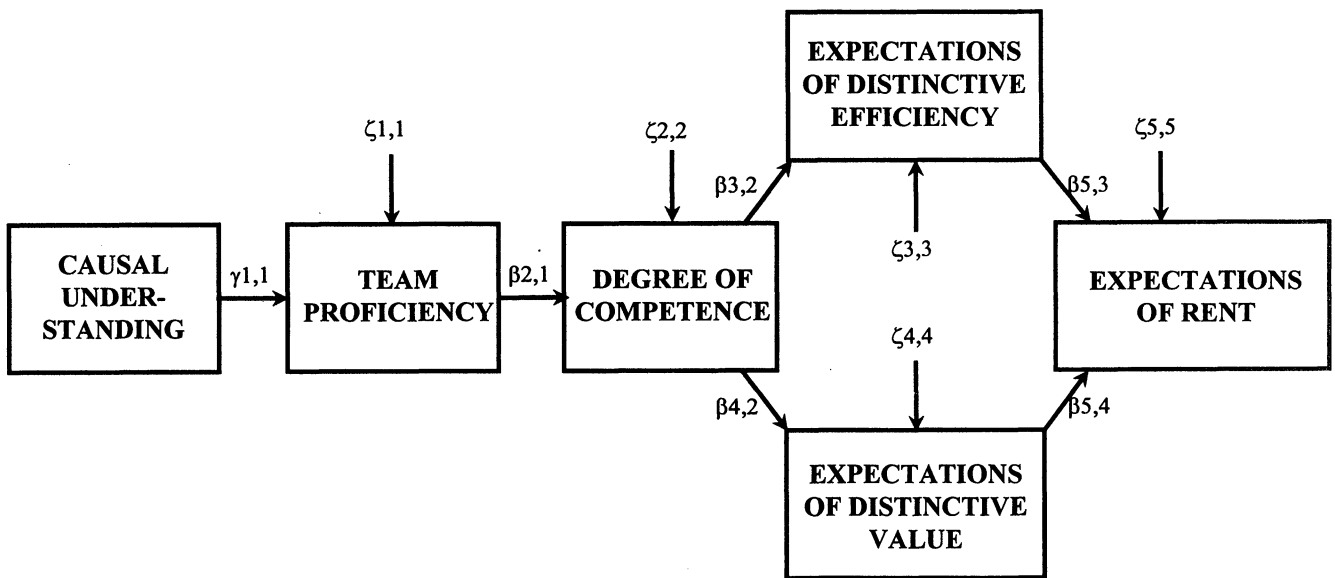
5.1. Descriptive Statistics

Table 1 presents the means, standard deviations, Coefficient Alphas and Pearson Correlation Coefficients for the variables in this study. All variables had means close to the center of their range and were only very mildly skewed. Further, there appears to be adequate variance across all the total scores. Therefore, assumptions of normality are not unreasonable.

5.2. Test of the Model

The analysis was done using LISREL VII. Since the model is sufficiently identified, we chose to use the max-

Figure 2 LISREL Model of Antecedents to Rent



imum likelihood estimation procedure. This procedure produces a robust chi-square value as a goodness of fit measure. A Chi-square test can be computed with maximum likelihood estimation to test the hypothesis H_0

that the observed covariance matrix was generated by the hypothesized model, against the alternative hypothesis H_1 that the covariance matrix is an unrestricted covariance matrix. Rejecting this hypothesis indicates that the model does not adequately reproduce the observed covariance matrix (Scott 1983). Correspondingly in LISREL modelling we use the Chi-square test to test the null hypothesis that the data fit the model, with the alternative hypothesis being that the data do not fit the model. If we cannot reject the null hypothesis at the $p < 0.05$ level, we take this as evidence that the data fit the model. The greater the p -value above 0.05, the better the data fit the model.

Table 2 The Maximum Likelihood Estimates of Model Parameters

Parameter	ML Estimate Standardized	ML Estimate Nonstandardized	t-value
$\gamma(1, 1)$	0.384	0.266	3.086
$\beta(2, 1)$	0.336	0.219	2.647
$\beta(3, 2)$	0.137	0.068	1.022
$\beta(4, 2)$	0.259	0.385	1.990
$\beta(5, 3)$	0.315	37.383	2.978
$\beta(5, 4)$	0.523	13.398	4.960
$\zeta(1, 1)$	0.852	14.184	5.244
$\zeta(2, 2)$	0.887	6.243	5.244
$\zeta(3, 3)$	0.981	1.488	5.244
$\zeta(4, 4)$	0.933	14.352	5.244
$\zeta(5, 5)$	0.615	8211.214	5.244

χ^2 : 12.18; d.f.: 9; p -value: 0.203.
 GFI: 0.933.
 AGFI: 0.843.
 RMR: 145.405.

In this study the resulting Chi-Square value was 12.18 with 9 degrees of freedom and p -value of 0.203. This indicates that null hypothesis that the data fit the model cannot be rejected, and the alternative hypothesis that the data do not fit the model cannot be accepted. The p -value is considerably greater than 0.05, so we have evidence that the data fit the model well. In addition, the adjusted goodness of fit index is 0.843, further indicating a good fit.

The parameter estimates and their t -values are reported in Table 2. The first column in Table 2 lists the parameter symbols of figure 1, the second column lists

the standardized Maximum Likelihood Estimates for each parameter, the third column lists the nonstandardized estimates and the fourth column lists the resulting *t*-values for each estimate. All but one of the coefficients of estimated parameters are positive and significant as predicted. The single exception is the effect from emerging competences to the expectation that distinctive efficiency advantages will be created. In this case, while the coefficient is not significant (*t*-value 1.029), the sign is in the expected direction.

In addition to demonstrating support for the overall model developed in the theory section, the standardized Maximum Likelihood coefficients in the second column of the table can be used to provide information about the impact of a one standard deviation change of each variable in the model. Thus, reading down column two of Table 2:

- a one standard deviation change in causal understanding can be expected to enhance team proficiency 0.384 standard deviations.
- a one standard deviation change in team proficiency can be expected to enhance emerging competence 0.336 standard deviations and so on.

It is interesting to note that the data for this study indicate that there is more perceived rent benefit to be gained from a "value route" than an "efficiency route"—the standardized coefficient for $\beta(4, 2) = 0.259$ from emerging competence to expected value is greater than the coefficient for $\beta(3, 2) = 0.137$ from emerging competence to expected efficiency, and the standardized coefficient for $\beta(5, 4) = 0.523$ from expected value to rent is greater than the coefficient for $\beta(5, 3) = 0.315$ from expected efficiency to rent.

5.3. Comparisons with Alternative Models

In order to validate the model specification internally, we tested the logic of the model that we had derived from the literature by systematically removing links in the logic chain of the model. Thus, we tried alternative specifications by dropping existing path linkages first one at a time, and then dropping combinations of two path linkages for different stages, and then by dropping three path linkages. Each alternative model was compared with our base model by taking the differences in the Chi-square value between the base model and the alternative model and the corresponding differences in the degree of freedom. The results are shown in Table

3. The first group of models drop one linkage at a time, the second group drops two linkages at a time and the third group of alternative models drops three linkages at a time. In Table 3 the first column simply lists the alternative model's identification number. The next two columns list the parameters excluded in the alternative models, the next columns indicate the degrees of freedom for each model, the next shows the Chi-square value of the model, the next column shows the significance of the Chi-square. The last two columns show the difference in degrees of freedom and Chi-square values between the base model and the alternative and indicate the level of significance of these differences.

In the last column of Table 3 we see that all but one of the alternative specifications are significantly different from, and fit worse than, the base model predicted in the theory section of the paper. The only exception is model 3, which indicates that the path from new competences to expectations of distinctive efficiency advantage to expectations of rent is weak.

The overall conclusion from these multiple analyses is that the results largely support the model of strategic innovation proposed in Figure 1, and that no alternative model (other than model three) is significant. We shall discuss the case of model 3 further below.

6. Discussion

6.1. Toward a Model for Generating Rents Through Innovation

The stage model by which an innovation generates rent is generally supported by the results. We see that in the innovation attempts we studied, there is a positive relationship between causal understanding and team proficiency, which in turn is associated with emergence of new competences.⁷ Emerging competences are then associated with expectations of creating distinctive value.

⁷ To test the alternative path (team proficiency to causal understanding to new competence) we ran three regressions. First we regressed causal understanding on new competence—the beta coefficient was significant at the 0.05 level. Next we regressed team proficiency on new competence—the beta was significant at the 0.01 level. Finally we regressed both causal understanding and team proficiency on new competence. The beta coefficient for causal understanding became insignificant while the beta for team proficiency remained significant at the 0.05 level.

Table 3 Comparison of Alternative Model Specifications

Model	Parameters Excluded	D.F.	χ^2	p-value (SIG)	Differences In:	
					D.F.	χ^2
Base	None	9	12.18	0.203		
1	$\gamma(1, 1)$	10	22.12	0.020*	1	9.94**
2	$\beta(2, 1)$	10	18.89	0.042*	1	6.77**
3	$\beta(3, 2)$	10	13.25	0.210	1	1.07
4	$\beta(4, 2)$	10	14.07	0.098†	1	3.89*
5	$\beta(5, 3)$	10	20.29	0.027*	1	8.11**
6	$\beta(5, 4)$	10	32.18	0.000**	1	20.00**
7	$\gamma(1, 1) \beta(2, 1)$	11	27.86	0.005**	2	15.68**
8	$\gamma(1, 1) \beta(3, 2)$	11	22.19	0.025*	2	10.01**
9	$\gamma(1, 1) \beta(4, 2)$	11	25.01	0.009**	2	12.83**
10	$\gamma(1, 1) \beta(5, 3)$	11	29.26	0.002**	2	17.06**
11	$\gamma(1, 1) \beta(5, 4)$	11	41.12	0.000**	2	28.94**
12	$\beta(2, 1) \beta(3, 2)$	11	19.96	0.046*	2	7.84*
13	$\beta(2, 1) \beta(4, 2)$	11	22.79	0.019*	2	10.67**
14	$\beta(2, 1) \beta(5, 3)$	11	27.01	0.005**	2	14.83**
15	$\beta(2, 1) \beta(5, 4)$	11	38.89	0.000**	2	26.77**
16	$\beta(3, 2) \beta(5, 3)$	11	21.36	0.030*	2	9.18**
17	$\beta(3, 2) \beta(5, 4)$	11	33.25	0.000**	2	21.07**
18	$\beta(4, 2) \beta(5, 3)$	11	24.19	0.012*	2	12.01**
19	$\beta(4, 2) \beta(5, 4)$	11	36.07	0.000**	2	23.89**
20	$\gamma(1, 1) \beta(3, 2) \beta(5, 3)$	12	30.30	0.003**	2	17.18**
21	$\gamma(1, 1) \beta(3, 1) \beta(5, 4)$	12	42.19	0.000**	2	30.01**
22	$\gamma(1, 1) \beta(4, 2) \beta(5, 4)$	12	33.13	0.012*	2	20.85**
23	$\gamma(1, 1) \beta(4, 2) \beta(5, 4)$	12	45.01	0.000**	2	32.83**
24	$\beta(2, 1) \beta(3, 2) \beta(5, 4)$	12	28.08	0.001**	2	15.90**
25	$\beta(2, 1) \beta(4, 2) \beta(5, 3)$	12	39.96	0.000**	2	27.78**
26	$\beta(2, 1) \beta(4, 2) \beta(5, 3)$	12	30.00	0.002**	2	18.72**
27	$\beta(2, 1) \beta(4, 2) (5, 4)$	12	42.79	0.000**	2	30.61**

†: Significant at 0.1 level.
 *: Significant at 0.05 level.
 **: Significant at 0.01 level.

Finally there is a direct correlation between expectations of generating rent and the expectations of creating both distinctive value and distinctive efficiency.⁸

The only surprising result was that although the sign was in the expected direction, there was no significant correlation between emergence of new

⁸ To test the alternative model (new competence to expectations of rent) we ran three regressions. First we regressed new competence on rent—the beta coefficient was significant at the 0.05 level. Next we regressed expectations of distinctive value on new competence—the beta was significant at the 0.001 level. Finally we regressed both new competence and expectations of distinctive value on expectations of

rent. The beta coefficient for new competence became insignificant while the beta for expectations of distinctive value were significant at the 0.01 level. Similar results were obtained for the comparison of the path new competence direct to expectations of rent and the path new competence to expected distinctive efficiency to expected rent.

competence and the expectation of creating distinctive efficiency.

The positive but non-significant correlation between competence and expectations of distinctive efficiency bears explanation. Perhaps, given the rapid increases in global competitiveness in the past decade, efficiency advantages are perceived as less likely, and further that improvements in efficiency are expected by firms to be met with rapid competitive matching (Prahalad and Hamel 1990).

7. Implications

The objective of the paper was to provide a parsimonious framework which draws upon the concepts of the resource-based view of the firm to assess when an innovation is likely to generate rent. We identified four antecedents of future rent from innovations, suggesting that only firms which can successfully master each of these challenges are likely to capture rent.

We have drawn a clear distinction between the concepts of new competence, competitive advantages and rent, suggesting different reference points for the assessment of each. New competences are assessed with respect to the firm's ability to reliably achieve new objectives. Competitive advantages are decided by the market, in light of competitive offerings. Rent accrues only to the firm whose competences create either distinctive value or distinctive efficiency, preferred by a significant market, and which competitors cannot match. One contribution of this paper has been to clearly distinguish among these constructs, offering the potential to establish definitions useful for further theory development.

This study has extended the theory of the innovation process along two dimensions. First, it has added three new constructs to the discourse, these being causal understanding, team proficiency and the emerging competence of a project team. New competence emerging from an innovation program appears to have a powerful effect on the expectation that the innovation will generate advantage, while causal understanding and team proficiency appear to exert a powerful influence on the ability of a project team to develop new competence. Second, although distinctive efficiency has received considerable attention as a driver for

competence-based rent, distinctive value has received somewhat less attention and yet has more explanatory power.

An interesting contribution is that we can use the ability of a project team to converge on objectives as a leading indicator of emerging competence. This is important because often, especially early on in a project, neither the firm nor the project team can know *ex ante* exactly what competences are needed, and the more innovative the attempt, the more serious this problem. In the early stages of an innovation the only realistic assessments of progress which can be made concern the degree to which a project team is succeeding in building causal understanding and team proficiency. So, to the extent that inroads are not made on causal understanding or to the extent that team proficiency is absent, it is unlikely that new competence will emerge. Later the team should offer increasing evidence of ability to accomplish or exceed objectives. To the extent that competence (in terms of goal-attainment) fails to emerge, it is highly unlikely that competitive advantages will result, since neither high value nor high efficiency is likely. Current degree of goal attainment, which signals emerging competence, is therefore a critical linchpin for linking the results of past efforts to the potential for future rents.

7.1. Summary of Implications for Practice

It may perhaps be useful to summarize two implications of our study which are of direct import to the practice of managing R&D and innovation more broadly.

First, process counts. This study suggest that the team processes of learning and of developing proficiency are not mere niceties, but rather fundamentally shape the *economic* outcomes of an innovation attempt. Ironically, we observe many innovation managers in the field taking such interpersonal issues less seriously than, say, resolving complex technical problems. This has to do in part with the difficulty of measurement, since it is extremely difficult to manage what can't be measured. This implies that R&D managers need firstly to pay attention to processes, need to develop measures of progress (such as those used in this paper), and need to make timely interventions, or suffer damage to the long-run rent potential of the innovation.

Second, avoid the temptation to confuse the creation of competence with the creation of advantage. Field observation reveals a tendency for highly skilled scientists, engineers and other technically gifted people (and their managements) to assume that the accomplishment of highly challenging technical objectives will generate favorable economic returns. Not so, suggest our results. Customers do not buy competences. Customers buy product and service attributes (Penrose 1959) created by deploying the firm's competences. In the absence of customer demand and differentiation from competing offerings, no rents ensue. What this suggests to us with respect to managing the innovation process is additional metrics which might be used to assess innovation progress. In addition to measuring how well objectives are met, managers might also wish to include benchmarks with respect to customer demand attributes and competitor capabilities, even in very technical R&D operations. These measures may well become tools helpful in building insight into those markets external to the firm in which advantage must be gained if the project is to generate rents.

8. Limitations

It should be noted that although our theory suggests a causal sequence to the relations among these constructs, imputations of causality should be conservative. At this point, we do not have intertemporal data. It cannot thus be argued that enhanced team proficiency and causal understanding cause enhanced competence. Our sample does, however, include projects from different developmental stages, which acts to increase our confidence in the general applicability of the results throughout the course of an innovation attempt. Projects in the sample were distributed fairly evenly across three stages: definition of initial concepts, market entry, and growth.

Second, there were many paths that we did not test because there was no theoretical justification for doing so. Our results would have been much stronger if we had been in a position to specify theoretical reasons for rejecting the untested paths. If we had found theoretical reasons for rejecting a path, rather than excluding them for lack of theory, our results would have been much

stronger. We could then have invoked the principle of exclusivity, which says that one can impute causality along a certain path if there are no alternative paths. Because we cannot invoke the principle of exclusivity, we cannot draw such a strong causal conclusion here. Partly to compensate for this shortcoming, research team members conducted in-depth interviews with project managers other than those included in the study sample. Results of these interviews generally support the hypotheses tested here with respect to the structure of the model. There remains, however, a need to be conservative with respect to interpretation of our findings.

9. Conclusion

We began this inquiry with the idea that the innovation process is central to the creation of new combinations of productive resources for firms. Yet, at the same time, the future benefit of any given innovation is difficult to ascertain in advance. A major motivation of this study was to explore the theoretical conditions under which the future contribution to rents of a given innovation project might be predicted.

The results of the study suggest a discrete set of interwoven processes through which advantages emerge, processes which can be identified and measured as the project is in progress. For scholars, this suggests that the study of technology and innovation may be enriched by resource-based theories from strategic management. For practitioners, the study identifies processes which may well be worth attention and concern throughout the duration of an innovation effort. For both, the study identifies potentially valuable arenas for further inquiry and theory development.⁹

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Appendix Construct Operationalization

Construct & Main Sources	Items	Alpha
<p>Construct: Competence Sources: Jackson (1992); Gresov, Drazin and Van de Ven (1989); Block (1982); Ancona and Caldwell (1992); Van de Ven, Hudson & Schroeder (1984); Block and MacMillan (1985)</p>	<p>Performance with respect to: Quality objectives; Reliability objectives; Cost objectives; Efficiency objectives; User/Client satisfaction objectives; Service objectives; Overall objectives</p>	0.85
<p>Construct: Causal Understanding Sources: March (1991); McCaskey (1972); Barney (1986); Alchian and Demsetz (1972); Hackman (1991); Block and MacMillan (1985); Vesper (1990); Zirger and Maidique (1990); Proter (1980)</p>	<p>Team's understanding of: Key sources of revenues or funds; Identity of key customers or clients; Customer needs; Competition faced; Usage patterns; Risks to customers; Pricing issues; Legal and regulatory issues; Risks to the firm; Support services required; Costs of resources; Key operational requirements; Threats to reliability; Threats to quality; Costs; Bottlenecks.</p>	0.90
<p>Construct: Team Proficiency Sources: Hackman (1991); Wernerfelt (1989); Pettigrew (1973); Guth and MacMillan (1986); Tushman (1977); Alchian and Demsetz (1972); Gersick (1988)</p>	<p>Evaluation of these dimensions: Others know what to do; Others are competent; People can depend on one another; People know what information is important to others; Evidence of "hidden agendas"; Information is held up or withheld; Information get distorted; New people are easily assimilated; People understand one another; People will implement decisions; Information is not available; The team is short of key skills; People resist challenging one another</p>	0.88
<p>Construct: Rent Sources: Alchian (1991); Barney (1986); Amit and Schoemaker (1993); Bowman (1974); Day and Wensley (1988); Kamien and Schwartz (1982); Miller, Wilson & Adams (1988)</p>	<p>Probability of achieving: Success for the project overall; Unusually high profits; Higher profits than competitors; Margin improvement; Margin improvement, relative to competitors; Revenue increases; Revenue increases, relative to competitors; Customers achieve savings.</p>	0.90
<p>Construct: Distinctive Value Sources: Zirger & Maidique (1990); Porter (1980); Penrose (1959); Day & Wensley (1988); Barney (1991); Rumelt (1987); Mahoney & Pandian (1992); Winter (1987)</p>	<p>Assessment of extent to which: Customers will get more value than in the past; Customers will get more value than from; competitors; The firm can meet new customer needs The firm can serve entirely new customer segments; Customers will pay a premium price; Responsiveness will be improved; Responsiveness will be better than competitors; Quality will be improved; Quality will be better than competitors'</p>	0.88
<p>Construct: Distinctive Efficiency Sources: Penrose (1959); Mahoney & Pandian (1992); Rumelt (1987); Mansfield (1971)</p>	<p>Assessment of extent to which: Costs will be reduced; Greater efficiency than competitors will be achieved.</p>	0.79

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