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RESEARCH NOTES AND COMMUNICATIONS

TECHNOLOGY'S VARYING IMPACT ON THE SUCCESS OF STRATEGIC BUSINESS UNITS WITHIN THE MILES AND SNOW TYPOLOGY

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The high-tech industry is usually treated as an homogeneous entity, without differentiating between organizations according to the relative importance of technology in their business strategy. This paper investigates the varying impact of technology on the success of strategic business units within the Miles and Snow typology. Although common wisdom might lead to the conclusion that prospectors are more dependent on technological progress than the other strategic types, the results show rather that the influence is greater and more fruitful for the defenders both in the short and the long term.

INTRODUCTION AND THEORETICAL BACKGROUND

Technology is an important variable in the study of organizations in developing comparative organizational analyses and in measuring variance in organizational performance (Gillespie and Mileti, 1977). Nevertheless, there is a lack of clarity and agreement as to the exact meaning of technology and its parameters. The definition suggested by Gillespie and Mileti 'the types and patterns of activity, equipment and material, and knowledge or experience to perform tasks,' expands the meaning of technology beyond the machine or hardware conceptualization to include 'soft technologies', the use of which is one of the characteristics of modern industry.

The term 'high-tech' is usually associated with firms engaged in intensive R&D efforts. Balachandra (1982) found that the most significant variable indicating the high-tech nature of a firm was the ratio of R&D expenses to net sales. A detailed definition provided by Shanklin and Ryans (1984) suggests that a business must meet three criteria to be labeled high-tech:

— The business requires a strong scientific-technical basis.

— New technology can quicky make existing technology obsolete.

— As new technologies come on stream, their applications create or revolutionize markets and demand.

Companies operating in areas such as computers, electronic components, optics, medical devices, telecommunications, lasers and biotechnology meet these criteria since they are frequently and profoundly affected by rapid advances in their respective product technologies (Meyer and Roberts, 1985, 1988). Other researchers have found that there exists a positive correlation between the success of high-tech enterprises, and their level of technological progress, namely their ability to monitor the rapid advances in product and process technologies and

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to adopt relevant technological innovations. The importance of monitoring new technologies was acknowledged by the MIT commission on industrial productivity (Dertouzos, Lester and Solow, 1989). They found that one of the main reasons for the deterioration of American industry was the unwillingness to acknowledge the growing strength of scientific and technological innovation abroad, and hence the possibility of adapting the discoveries for use in the United States.

Miles and Snow (1978) and Porter (1980) in their formulation of business strategy typologies, suggested that there is a linkage between technology and strategy, and that technology plays a major role in the formulation of the various strategies. The business strategies proposed by Maidique and Patch (1978) and Porter (1985), demonstrate the interconnection between technological leadership and competitive advantage. As an example, the 'first to market' strategy requires being close to the 'state of the art,' while the 'me too' strategy requires a strong engineering and development capacity.

Miles and Snow (1978) proposed that organizations develop relatively enduring patterns of strategic behavior that actively co-align the organization with its environment. They viewed the 'adaptive cycle' characterizing this process as involving three imperative strategic problems and solutions sets: an entrepreneurial problem set, an engineering problem set, and an administrative problem set (Conant, Mokwa and Varadarajan, 1990; Miles and Snow, 1978). The adaptive cycle starts with identifying new opportunities during the entrepreneurial phase, and the engineering problem involves the creation of a system which operationalizes management's solution to the entrepreneurial problem. Such a system requires management to select appropriate technology for producing and distributing chosen products and services (Miles *et al.*, 1978). The administrative system has to be viewed as both a lagging and leading variable in the process of adaptation. As a lagging variable, it must rationalize strategic decisions made at previous points in the adjustment process through the development of appropriate structures and processes. As a leading variable, the administrative system must facilitate the organization's future capacity to adapt by articulating and reinforcing the path along which innovative activity can proceed (Miles *et al.*, 1978).

The strategic typology of Miles and Snow (1978), further exemplifies the connection between technology and strategy and the varying impact of technology on the different dimensions of success.

For a prospector, maintaining a reputation as an innovator in product and market development may be as important as, and perhaps even more important than, high profitability, which is usually perceived as short-term success. A true analyzer attempts to minimize risk (long-term commitments) while maximizing the opportunity for profit, while defenders define their entrepreneurial problem as how to seal-off a portion of the total market. They closely monitor technological advancements that are relevant to their product line and build barriers to entry which are difficult for competitors to penetrate. Although Miles and Snow do not explicitly use the terms short- and long-term success, in their model of the adaptive cycle process they use them implicitly. Furthermore, even within a chosen Miles and Snow strategic type, there remains a technology strategy choice, namely how much to invest in monitoring and adopting relevant technological innovations. The impact of this strategic choice on each of the three Miles and Snow strategic types, is phrased in the following hypotheses:

Hypothesis 1: Higher levels of analyzers' investment in monitoring and adopting technological innovations are associated with higher levels of short-term success.

Hypothesis 2: Higher levels of defenders' investment in monitoring and adopting technological innovations are associated with higher levels of both short- and long-term success.

Hypothesis 3: Higher levels of prospectors' investment in monitoring and adopting technological innovations are associated with higher levels of long-term success.

METHODOLOGY

Sample

The electronics and computers industries are probably the best representatives of high-tech industries. Button (1988) who summarized the results of 23 different studies, found that the

electronics and computers industries are always categorized as high-tech industries.

The current research focused on electronics and computer firms having more than 20 employees. Two groups were studied: a group of 78 business units which are part of 15 multibusiness organizations, and a second group of 102 single business units, a total of 180 business units. We found no significant difference in the results between the two groups, since managers of SBUs which are part of multibusiness organizations have full authority and total responsibility for their performance, and they run their businesses as if they were independent business units. Seventy-six business units were surveyed using written questionnaires and verbal interviews. The range of the SBU sizes ($12 million to $120 million in annual sales) as well as the diversity of the output of these SBUs (consumer, industrial and military products) give no reason to expect any systematic bias in the findings.

Each of the 76 SBUs was categorized by its manager into one of Miles and Snow's strategic types, forming four strategy groups, 32 analyzers, 24 prospectors, 19 defenders, and one reactor (which was omitted from the analysis).

Variables and measures

Strategy

Miles and Snow's strategic typology comprising four strategic archetypes–defenders, prospectors, analyzers, and reactors, was used in this research. This typology is academically well accepted and internally consistent (Conant *et al.*, 1990; Shortell and Zajac, 1990; Segev and Weber, 1991), and well suited for the research of the high-tech industries, which can be differentiated into distinct strategic types along the entrepreneurial and engineering dimensions. Self-typing textual description of strategy, was employed.

Performance

Most researchers use only one criterion for measuring performance, usually return on investment (ROI) or a similar measure of financial outcomes. In a previous paper (Dvir and Shenhar, 1992), we showed that the performance of a SBU in the electronics and computers industry should be measured by using four separate dimensions. These dimensions can be characterized and defined as follows:

a. Profitability level—how well does the business unit meet its financial objectives and how well is it doing relative to similar business units.
b. Generating orders—how well is the business unit doing in achieving sales objectives and creating future orders. What is the current backlog and how are these orders going to influence future cash requirements.
c. Generating new opportunities—how successful is the unit in opening new opportunities for new products and for new markets. Are the customers satisfied with the quality of products and services and will they come back for further purchases.
d. Preparing the infrastructure for the future—does the business unit have scientific and technological knowledge, the equipment and the facilities required for the development and production of future products.

The first two dimensions are used in this research as 'short-term' dimensions measuring the results of past activities which do not determine future prospects. The other two dimensions are used as 'long-term' dimensions which determine the SBU's ability to survive in the long run.

Technological progress

Two different constructs were used to operationalize the concept of technological progress. *Monitoring technological innovations*—the level of investment in evaluating new technologies and new ideas, and screening ideas suitable for use by the SBU. The internal consistency of this instrument as measured by Cronbach's alpha coefficient was 0.68.
Adopting technological innovations—the level of integration of ideas and technologies in new products and processes, and how close is the SBU to the state of the art (SOA) in its main line of activity. The alpha coefficient for this construct was 0.76.

The relationship between monitoring and adopting technological innovations and success

was tested using: (a) correlation analysis (Pearson) between the two variables and the four dimensions of success, and (b) *t*-test between SBUs that invest more in monitoring and adopting technological innovations (first quartile) and those that invest less (fourth quartile). The Mann-Whitney test was also used to validate the results when the quartiles were too small for assuming normality and equality of variances.

RESULTS

Table 1 presents the results of the correlation analysis, and Table 2 presents the *t*-tests and the Mann-Whitney tests of the various measures of technological progress and the success of SBUs for the three strategy groups: analyzers, defenders and prospectors.

There exists a positive correlation between the level of investment in monitoring technological innovations and the first three dimensions of analyzers' success (first part of Table 1). Especially strong is the correlation with the third dimension, generating orders (0.459), while the correlation with the fourth dimension of success, preparing the technological and human infrastructure, is almost zero. The correlation between the second measure of technological progress—adopting technological innovations—and success is weaker. Only the correlation with the fourth dimension of success is significant (0.389).

Table 1. Correlations between technological progress and success for strategic types

Technological progress	Success dimensions: Profitability level	Generating orders	Generating opportunities	Preparing infrastructure
Analyzers (n = 31)				
Monitoring Technological Innovations	0.289 p = 0.11	0.459 p = 0.009	0.246 p = 0.18	0.040 p = 0.82
Adopting Technological Innovations	0.146 p = 0.43	− 0.03 p = 0.87	− 0.07 p = 0.71	0.398 p = 0.03
Defenders (n = 19)				
Monitoring Technological Innovations	0.643 p = 0.003	0.711 p = 0.001	0.560 p = 0.015	0.493 p = 0.03
Adopting Technological Innovations	0.415 p = 0.08	0.195 p = 0.43	0.541 p = 0.02	0.607 p = 0.03
Prospectors (n = 24)				
Monitoring Technological Innovations	− 0.184 p = 0.40	0.226 p = 0.30	− 0.046 p = 0.83	0.165 p = 0.44
Adopting Technological Innovations	− 0.074 p = 0.74	0.014 p = 0.95	0.172 p = 0.43	0.266 p = 0.21

The data in Table 2 (the *t*-test and the Mann-Whitney test results—analyzers) serve to support these results; technologically progressive SBUs are more successful in regard to the two short-term success dimensions. These findings support Hypothesis 1 that higher levels of investment in monitoring and adopting technological innovations are associated with higher level of analyzers' short-term success.

The correlation analysis results for the defenders are presented in the second part of Table 1. All correlations between technological progress and the four dimensions of success are positive, and only one is not statistically significant. Hypothesis 2 was thus fully supported.

Finally, the correlations between technological progress of prospectors and their success (third part of Table 1), are not statistically significant. Due to the small sample size of the prospectors strategic group, we used the Mann-Whitney test as a complementary test. The positive correlations between technological progress and the fourth dimension of success (preparing the infrastructure), in the third part of Table 1 and the Mann-Whitney test results (second part of Table 2), support our third hypothesis. The negative correlation between technological progress and the profitability level, provides another indication to the validity of our hypothesis.

Operationalizing technological progress by two complementary measures was especially convenient for analyzing its varying impact on SBU success, using Miles and Snow's (1978) typology. The phases of environmental scanning and learning new ideas and actually adopting and integrating these ideas into new products and processes, are performed rather differently by prospectors, defenders and analyzers. Since the research is focused on one segment of the high-tech industry, the electronics and computers segment where almost all firms are utilizing the same basic technologies and work methods, and their technological work force is sharing a similar background and professional experience, we found no reason to suspect that there might exist a consistent bias in the measurement of technological progress.

DISCUSSION AND CONCLUSION

Some general patterns may be recognized in the way technological progress influences the success of SBUs with regard to the business strategy they adopt. Prospectors, emphasizing technological leadership, are heavily investing

Table 2. Difference in success levels between quartiles *t*-test and Mann-Whitney test results

Success dimensions	Monitoring technological innovations				Adopting technological innovations			
	I quartile	IV quartile	T	M–W	I quartile	IV quartile	T	M–W
Analyzers	(n = 8)	(n = 8)			(n = 8)	(n = 8)		
Profitability	6.46	4.24	2.06*	14*	6.05	3.86	2.45*	12.5*
Orders	11.57	9.62	2.12*	15*	10.73	10.06	0.73	27
Opportunities	11.22	10.38	0.72	23	10.19	10.31	0.12	30
Infrastructure	8.12	8.87	0.95	25	8.81	7.07	2.01*	15*
Prospectors	(n = 5)	(n = 6)			(n = 5)	(n = 7)		
Profitability	4.57	6.30	1.14	8	5.11	5.94	0.66	14
Orders	11.71	10.72	1.44	7.5	10.11	9.42	0.43	13
Opportunities	11.21	11.35	0.22	11	11.06	10.05	1.02	7*
Infrastructure	9.25	8.51	1.43	7*	9.06	9.04	0.06	16.5

*$p < 0.05$

in technology, a fact that narrows the difference between more progressive and less progressive prospectors and reduces the positive relationship between technological progress and success. Nevertheless, there are still some differences between them which, due to the small sample size, can only be seen in Mann-Whitney test results. Furthermore, since prospectors scan technology more widely and perform feasibility studies for new ideas and new technological processes, their short-term results might be impaired, a result already found by Snow and Hrebiniak (1980).

Defenders, on the other hand, are more conservative in their investment in technology and focus on technological areas directly related to their line of business. They invest in new technologies only when they are convinced of their potential contribution to maintaining competitive advantage. Spending resources in a focused way is more effective and contributes directly to short-term results as well as to the establishment of the technological and knowledge-base.

Analyzers follow an intermediate strategy; they are more careful than the prospectors, and decide upon investments in new technologies only after a thorough analysis of the possibilities and watching the actions taken by the leaders in their field. The high correlation between the level of adopting technological innovations and the fourth dimension of success, which was not hypothesized, can be explained by the effectiveness of careful analysis before money is actually spent.

The general pattern of the influence of technological progress on success is easily recognized. Defenders gain from technological progress both in the short and in the long run. Analyzers are mainly influenced by technological progress in the short run. Prospectors, who usually invest in technology more than the others, may gain from these investments only in the long run. One exception to this pattern is the positive correlation between the level at which analyzers are adopting technological innovations and the fourth dimension of success.

These findings do not simply support the intuitive rationale of people involved in high-tech operations and findings of previous research that technological progress contributes to the success of technology-based firms; they indicate that even within a chosen business strategy there remains a technology/strategy choice, how much should the business invest in monitoring and adopting technological innovations? The impact of this strategic decision depends on the firm's selected business strategy. Furthermore, although common wisdom might lead to the conclusion that prospectors are more dependent on technological progress, the results show that the influence is greater and more fruitful for defenders. On the other hand, a firm considering following the prospector's strategy, has to take into account that these investments may prove to be profitable only in the long run.

REFERENCES

Balachandra, R. 'Characteristics of high-tech firms', *New England Business and Economics Association's Tenth Annual Conference*, 1982, pp. 5–8.

Button, K. *High Technology Companies: An Examination of their Transport Needs*. Department of Economics, Loughborough University, Loughborough, UK, 1988.

Conant, J. S., M. P. Mokwa and P. Rajan Varadarajan. 'Strategic types, distinctive marketing competencies and organizational performance: A multiple measures-based study', *Strategic Management Journal*, **11**, 1990, pp. 365–383.

Dertouzos, M. L., R. K. Lester and R. M. Solow. *Made in America: Regaining the Productive Edge*. Harper Perennial, New York, 1989.

Dvir, D. and A. Shenhar. 'Measuring the success of technology-based strategic business units', *Engineering Management Journal*, 1992, (forthcoming).

Gillespie, D. F. and D. S. Mileti. 'Technology and the study of organizations: An overview and appraisal', *Academy of Management Review Symposium: Organizations and Technology*, **4**(1), 1977, pp. 7–16.

Maidique, M. A. and P. Patch. 'Corporate strategy and technological strategy', In Tushman, M. L. and W. L. Moore (eds.), *Readings in the Management of Innovation*. Ballinger, Cambridge, MA, 1978, pp. 273–285.

Meyer, M. H. and E. B. Roberts. 'New product strategy in small technology-based firms: A pilot study', *Management Science*, **32**(7), 1985, pp. 806–821.

Meyer, M. H. and E. B. Roberts. 'Focusing product technology for corporate growth', *Sloan Management Review*, **29**(4), 1988, pp. 7–16.

Miles, R. E. and C. C. Snow. *Organizational Strategy, Structure and Process*. McGraw-Hill, New York, 1978.

Miles, R. E., C. C. Snow, A. D. Meyer and H. J. Coleman, Jr. 'Organizational strategy, structure, and process', *Academy of Management Review*, July 1978, pp. 546–562.

Porter, M. E. *Competitive Strategy*. The Free Press, New York, 1980.

Porter, M. E. *Competitive Advantage*. The Free Press, New York, 1985.

Segev, E. and Y. Weber. 'Strategic types and the planning-performance relationship'. Tel Aviv University, Faculty of Management, (Working Paper) 1991.

Shanklin, W. L. and J. K. Ryans, Jr. 'Organizing for high-tech marketing', *Harvard Business Review*, November–December, 1984, pp. 164–171.

Shortell, S. M. and E. D. Zajac. 'Perceptual and archival measures of Miles and Snow's strategic types: A comprehensive assessment of reliability and validity', *Academy of Management Journal*, **33**, 1990, pp. 817–832.

Snow, C. C. and L. G. Hrebiniak. 'Strategy, distinctive competence, and organizational performance', *Administrative Science Quarterly*, **25**, 1980, pp. 317–336.