

Global Product R&D and the Firm's Strategic Position

The authors investigate coordination and concentration of firms' global product research and development (R&D) and their effect on the firm's global strategic position. Some internal and external antecedents of coordination and concentration also are identified. A conceptual model is developed and tested by structural equation modeling. The results show that coordination of R&D is a key determinant of the firm's global strategic position. Furthermore, coordination of R&D is influenced by global emphasis and human resource flexibility, both internal organizational resources. Similarly, concentration of R&D is influenced by human resource flexibility. The implications of the findings are discussed.

A firm's research and development (R&D) is an important determinant of its market performance in many industries (Calantone and Cooper 1981). In the global market, increased interdependence of world markets (Porter 1986) has changed the competitive dynamics profoundly. Indeed, it has been argued that success or failure of a firm must be judged on a global rather than national basis (Hax 1989). In a globalizing environment, it is timely and important to investigate the relationship between a firm's global R&D strategy and its global strategic position. According to Porter (1986), a global R&D strategy refers to a firm's attempt to concentrate and coordinate its R&D activities in a few countries. Concentration enables a firm to benefit from the locational advantages associated with different countries, and coordination affords it cross-country synergies (Roth 1992).

Although there is significant research on R&D activities and new product development practices in the domestic and, more recently, the foreign market context (e.g., Cooper 1979; Griffin and Hauser 1992), limited research attention has been paid to how firms implement their R&D strategy on a global scale. In particular, knowledge of whether and how concentration and coordination of a firm's R&D activities are related to its global strategic position is sparse. Moreover, internal firm resources and external market factors that are conducive to concentration and coordination of R&D activities have not been investigated. As new products are becoming the focal point of competition in a variety of markets and as the cost of global R&D is increasing (Harrigan 1987), research that explores some of these relationships is needed.

ABSTRACT

**Shaoming Zou and
Aysegül Özsoyner**

*Submitted February 1997
Revised July 1997
November 1997*

©Journal of International Marketing
Vol. 7, No. 1, 1999, pp. 57-76
ISSN 1069-031X

**FRAMEWORK FOR
IMPLEMENTING GLOBAL
R&D STRATEGY**

The primary objective of this article is to investigate empirically the effects of concentration and coordination of a firm's R&D activities on its strategic position in the global market. Such an empirical endeavor has not been undertaken in the literature. Another objective is to identify internal and external factors that are related to the concentration and coordination of R&D. In the remainder of this article, the conceptual model and the research hypotheses are advanced, the research methods are described, and the research findings and their implications are discussed.

In the global context, *coordination* of R&D is defined as the process of integrating R&D activities across different subsidiaries around the world (Porter 1986). Low coordination means that R&D activities in each country are performed independently of all other countries. A high level of coordination means that R&D activities are linked tightly and integrated across countries. *Concentration* refers to the conduct of R&D activities in only a few countries (Zou and Cavusgil 1996). A firm can choose to concentrate R&D activities, or it can choose to disperse them, such that they are being replicated in every country. Thus, concentration is conceptualized on a global scale, rather than based on the number of R&D facilities in a single country.

According to Porter (1986) and others (e.g., Roth 1992), there are two critical concerns in implementing a global R&D strategy: (1) In how many countries should the R&D activities be located so that the locational advantages can be exploited? and (2) How should the R&D activities located in different countries be linked to benefit from cross-country synergies and improve the firm's global strategic position? The first involves configuration, or the pattern of a firm's R&D activities around the globe. Proper configuration enables the firm to exploit the comparative advantages of various countries, such that maximum efficiency can be gained (Porter 1986). The second deals with coordination, which establishes concerted action among R&D activities and, therefore, is critical in managing interdependencies (Roth, Schweiger, and Morrison 1991). Coordination of R&D activities across countries is necessary to capture cross-national scope and learning benefits (Ghoshal 1987; Roth 1992). Thus, two key dimensions of a firm's global R&D strategy are the concentration and coordination of its R&D activities. Building on the global marketing literature, a conceptual model that links concentration and coordination of R&D activities to their antecedents and consequence is presented in Figure 1.

The conceptual model in Figure 1 is based on three premises. First, in global industries, a firm must integrate its R&D activities on a worldwide basis to capture the linkages among countries. Second, implementation of a global R&D strategy,

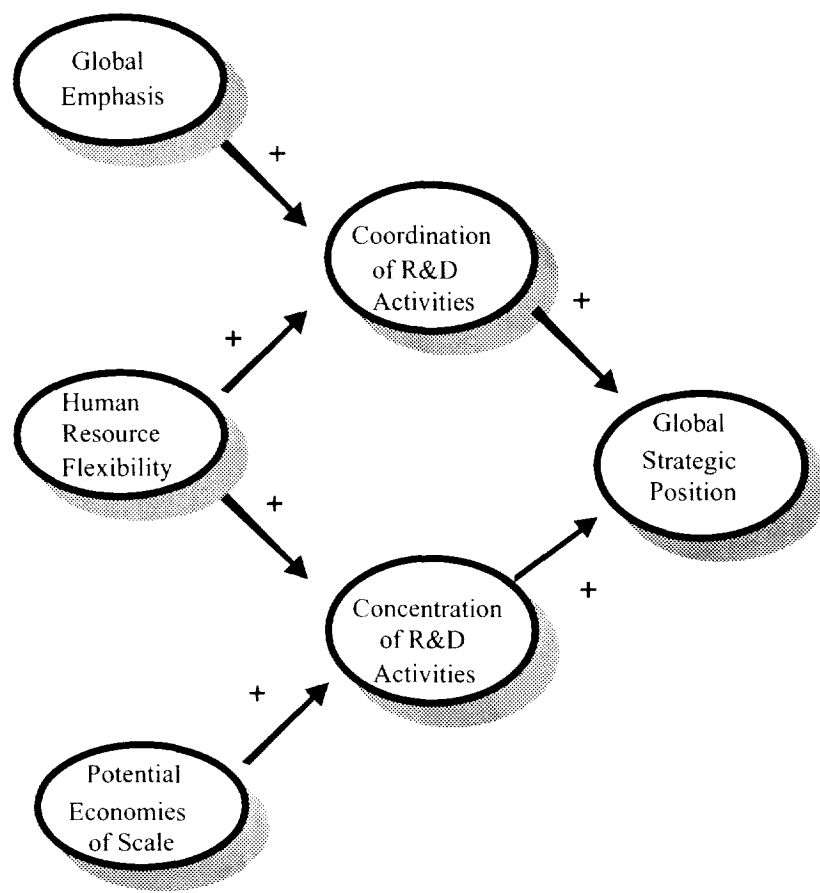


Figure 1.
A Structural Model of
Concentration and
Coordination of Product R&D

as defined by the level of concentration and coordination of R&D, is associated positively with the firm's global strategic position. Third, implementation of a global R&D strategy is facilitated by three factors: global emphasis, human resource flexibility, and global economies of scale.

In this model, "global strategic position" refers to the competitiveness of the firm in the global market relative to major rivals (Ghoshal 1987). A firm can improve its global strategic position by producing a market offering that, relative to the offerings of competitors, is either perceived by some market segments to have superior value and/or can be delivered at lower costs (Porter 1985). In global industries, a firm's marketing activities in one country affect and are affected by what is going on in other countries (Zou and Cavusgil 1996), as demonstrated by tangible and intangible resource flows (Bartlett and Ghoshal 1989; Teece 1986). Tangible resource flows involve the movement of component parts and finished products across national borders. These flows are necessitated by several factors, including economies of scale (Porter 1986; Zou and Cavusgil 1996). Intangible resource flows link international markets through movements of proprietary technology and R&D and other firm-specific resources (Roth, Schweiger, and Morrison 1991). Thus, in global industries, improvement of a firm's global strategic position stems more

often from considering the needs and capabilities of the entire world than from the firm's position in any one country.

Global emphasis and human resource flexibility are two internal factors that are posited to facilitate the implementation of a firm's global R&D strategy. *Global emphasis* is defined as the unity of efforts among subsidiaries and a firmwide focus on success in the global market. Global emphasis may be necessitated by a perception that competitive forces span national boundaries and that the fate of each subsidiary is tied to the fate of others. *Human resource flexibility* refers to the extent to which the human resources of the firm can be transferred to and used in different countries (Bartlett and Ghoshal 1989; Hedlund 1986). Studies show that a global network of mobile managers and employees is vital for success in the global market (e.g., Bartlett and Ghoshal 1989).

The potential of economies of scale is a key external industry factor that, in the model, is hypothesized to influence a firm's global R&D strategy. *Global scale economies* are the cost reductions that can be derived from a large volume of activities performed at a few country locations (Kogut 1989). Economy of scale has been argued to be one of the major benefits associated with pursuing a global marketing strategy (Levitt 1983). When the potential for achieving global scale economies is great, a firm will find it desirable to increase its operations at certain locations.

Antecedents of Coordination of Global R&D Activities

The links from the internal factors of global emphasis and human resource flexibility to concentration and coordination of R&D are supported by the resource-based theory (RBT). The RBT regards competitive advantage as lying "inside the firm" and firms as unique bundles of resources and capabilities (Barney 1991). In this theory, resources are defined broadly as tangible and intangible entities, available to a firm, that enable it to efficiently and effectively produce a market offering that is valuable to some market segments (Barney 1991). In the RBT, strategy is the means for a firm to capitalize on its unique resources. Thus, the internal organizational resources are the antecedents of a firm's strategy.

Global emphasis and human resource flexibility are intangible, higher order resources (Barney 1991) that enable the firm to coordinate its global R&D activities—perhaps better than its competitors—and therefore enhance its global strategic position. Moreover, these resources cannot be purchased in the marketplace, encompass noncodifiable skills that must be learned by doing, and are increasingly effective the longer they are in place. All these factors make it more difficult for a competitor to acquire, imitate, or substitute these resources, which makes them sources of sustainable competitive advantage (Barney 1991). In particular, global emphasis and human

resource flexibility are expected to affect the firm's coordination of R&D activities.

Global Emphasis. A firm with a global emphasis values the performance of the whole business ahead of the performance of its individual subsidiaries. Global emphasis is a mind-set or worldview of the business as an integrated network of differentiated subsidiaries (Bartlett and Ghoshal 1989). Thus, subsidiaries are viewed as interdependent, and this reciprocal interdependency among subunits necessitates greater coordination (Roth, Schweiger, and Morrison 1991). A global emphasis implies that the R&D activities of the firm must be coordinated in a manner that develops and sustains global competitiveness (Bartlett and Ghoshal 1989; Porter 1986). When there is no common goal bringing subsidiaries together, there is little reason to coordinate their R&D activities, particularly because coordination can lead to dissemination of R&D know-how and reduce the relative advantage of the subsidiary in R&D. Thus, when there is a global emphasis, a higher level of coordination of R&D is expected.

Another reason for the positive link between global emphasis and coordination of R&D stems from the unstructured and uncertain nature of R&D knowledge. The actions and decisions of product development teams cannot be well specified in advance (Teece 1986). Therefore, it is difficult, if not impossible, to specify, monitor, and control the behavior and output of R&D teams in different countries. Firms have no choice but to indoctrinate their R&D personnel to common global goals and hope that they act in a way to benefit from the synergies across the countries (Mintzberg 1979). A single or shared mind-set within the entire business unit therefore would support coordination of R&D activities, particularly because a shared global emphasis provides consistency of decisions in the context of geographical and cultural separation (Roth, Schweiger, and Morrison 1991). Therefore, a positive relationship between global emphasis and coordination of R&D is hypothesized:

H₁: A global emphasis is related positively to coordination of R&D.

Human Resource Flexibility. The human resource of a firm is a repository of knowledge about firm-specific knowledge, skills, abilities, relationships, and the work-related values of its employees (Lado and Wilson 1994). Because all resources, including human ones, vary in their level of context specificity and generalizability, their usefulness outside the country in which they were developed can be a source of competitive advantage. The challenge in implementing a global R&D strategy is to allocate this unique pool of human resources throughout the network as needed. The use of ex-

patriates and their frequent rotation and transfer among various subsidiaries are prerequisites for the coordination of global R&D (Hedlund 1986). Coordination of R&D activities across countries involves long distances, language problems, and cultural barriers to communication (Porter 1986). A flexible human resource is an integrating mechanism that is used to develop collaborative efforts among organizational subunits (Lawrence and Lorsch 1967) and that has been identified as the scarcest resource of all (Bartlett and Ghoshal 1990). When a firm's human resources are flexible, personnel can be rotated among different R&D locations, which facilitates the transfer of unique ideas, skills, and capabilities. Human resource flexibility positively affects coordination of R&D through either impersonal procedures of prescribed action or mutual adjustments through personal interaction (Roth, Schweiger, and Morrison 1991).

H₂: Human resource flexibility is related positively to coordination of R&D.

Antecedents of Concentration of Global R&D Activities

Human Resource Flexibility. When the responsibility for research and the development of new products and processes are concentrated in a few countries, the systems rely heavily on the transfer of people (Bartlett and Ghoshal 1990). The careers of engineers and other key personnel must be structured in a way to ensure that they spend significant time in central laboratories engaged in pure research and then more time in product divisions working on applied R&D projects. Constant transfer of personnel working on joint teams in countries where R&D is concentrated is an ongoing process.

Matsushita is an example of a company that has concentrated R&D (Bartlett and Ghoshal 1990). Its ability to create central innovations and exploit them quickly and efficiently throughout the world has enabled Matsushita to build global leadership with its Panasonic and National brands. The vice president in charge of the U.S. subsidiary of the company, though formally posted in the United States, continues to be a member of the senior management committee of the R&D center in Japan and spends approximately one-third of his time in Japan. In his role as vice president of the U.S. subsidiary, he ensures that the local subsidiary implements the agreed product strategy effectively. Similarly, the general manager of the U.S. subsidiary, a veteran of Matsushita Electric, maintains strong connections to the central R&D division and acts as its link to the local U.S. market. A flexible human resource facilitates Matsushita's ability to concentrate R&D in Japan. Concentration of global R&D activities is facilitated when human resources can flow from the rest of the firm to the few countries where R&D is located and from these R&D locations to the rest of the firm.

H₃: Human resource flexibility is related positively to concentration of R&D.

Potential Economies of Scale. The existence of economies of scale is a primary source of global competitive advantage (Ghoshal 1987; Porter 1986; Zou and Cavusgil 1996). Economies of scale necessitate locating R&D in one or a few countries, with the choice of country based on cost and availability of resources (e.g., human and technical). Scale economies have a positive relationship to concentration of R&D for three reasons. First, R&D is an information-intensive process characterized by high set-up costs (Devinney 1995). The increased cost and sophistication of R&D in many industries (e.g., telecommunications, pharmaceuticals), together with already high set-up costs, have made duplication of R&D and lack of scale economies formidably costly. Second, concentrated R&D facilitates a global strategy aimed at capitalizing on the potential scale economies. Many companies, such as Unilever and Procter & Gamble, face pressures to develop globally standardized products that exploit economies of scale in product development, manufacturing, and marketing. These companies are moving toward concentrating the R&D process in a few countries, because this enables them to develop global products. Third, concentrated R&D activities may provide for highly efficient processes based on volume and scale considerations (Roth 1992). Thus,

H₄: Potential economies of scale are related positively to the concentration of R&D.

There is a growing consensus that coordination of R&D and marketing is critical for new product success (Ruekert and Walker 1987). In the global context, a positive influence of coordination of R&D across country locations on the firm's global strategic position is expected. Coordination enables the sharing of know-how among locations and is essential to leveraging learning in R&D throughout the entire global network so that the R&D may be maximally exploited (Roth 1992).

Coordination also may give a firm flexibility in responding to competitors' R&D efforts, enabling it to respond differentially across countries and cross-subsidize competitive battles in different countries (Zou and Cavusgil 1996). In addition, coordination of R&D can lead to increased return to specialization of R&D by country (Porter 1986). Research and development activities must be optimized from a worldwide perspective, which makes their coordination critical for global competitiveness.

It should be noted that coordination of R&D across countries involves costs. Quality and availability of human resources, local infrastructures, and other factors may differ across

The Effect of Coordinated R&D on Global Strategic Position

countries in ways that mitigate the advantages of a common approach or sharing learning. Governments may restrain the flow of information and people required for coordinating R&D. However, the costs of coordination are dropping sharply due to advances in information systems and telecommunications. Thus, the benefits of coordinating R&D are expected to surpass the costs of coordination.

H₅: Coordination of R&D is related positively to the firm's global strategic position.

The Effect of Concentrated R&D on Global Strategic Position

Researchers have argued that the concentration of R&D activities in one or a few locations can improve a firm's strategic position (Porter 1986; Yip 1989; Zou and Cavusgil 1996). It can eliminate duplication, facilitate rapid new product development (which is becoming critical in a quickly changing competitive environment), give a firm greater control over core technologies, and foster cross-product learning among product development teams (Datar et al. 1996).

Selection of countries for R&D activities is made on the basis of cost differentials and availability of resources. Although concentrating R&D necessitates tangible and intangible resource flows that can be costly, the efficiency of resource flows is enhanced because firms are able to exploit location-specific advantages (Zou and Cavusgil 1996). Furthermore, the whole firm is served by a smaller number of locations, thereby exploiting scale economies.

Because global industries are characterized by high interdependencies among markets, concentration of R&D is expected to be related positively to enhanced global strategic position (Porter 1986; Roth 1992). Recent empirical evidence provides support for this positive relationship. For example, Roth (1992) finds that the two archetypes of firms that are successful in global industries are the "concentrated hub" and the "primary global" types, both of which perform product innovation activity in a single or a few countries.

H₆: Concentration of R&D is related positively to the firm's global strategic position.

RESEARCH METHODS

Sampling Design

To assess the conceptual model of global R&D strategy in Figure 1, primary data were collected through a cross-sectional mail survey of business units (BUs) competing in global industries. Global industries were selected as the context of the study because coordination and concentration are particularly important to them (Porter 1986; Roth, Schweiger, and Morrison 1991).

Global industries were identified by adapting the three-stage process suggested by Samiee and Roth (1992). First, a thor-

ough review of the globalization literature (e.g., Bartlett and Ghoshal 1989; Collis 1991; Hamel and Prahalad 1985) revealed that more than 40 industries have been mentioned as global industries. Second, a decision was made to focus on only manufacturing. This reduced the list of global industries to 28. Third, as in Samiee and Roth's (1992) study, the trade ratio of each industry was examined because a high level of intraindustry trade is necessary for an industry to be global (Porter 1986). Using a trade ratio of 30:70 (that is, 30% intraindustry and 70% interindustry) as the minimum limit to control for the global nature of industries, 23 of the 28 industries qualified as global.

The 23 global industries that resulted from this process include consumer goods industries, such as pharmaceutical preparations, soap and other detergents, perfumes, and cosmetics and other toilet preparations, as well as industrial goods industries, such as oil and gas field machinery and equipment, textile machinery, and ball and roller bearings. Within these industries, BUs were identified through Dun and Bradstreet's *America's Corporate Families* and the *Directory of Corporate Affiliations*. These sources list key contacts (including name, title, address, and telephone number) in each BU, usually the chief executive officer (CEO) or president and the vice president for either international operations or strategic planning. Annual sales and number of employees of the BUs are also available from Dun and Bradstreet's database. Three criteria were used to identify the BUs. First, to facilitate data collection, the BU (that is, division and subsidiary) had to be based in the United States, though the parent company could be based elsewhere. Second, the BU had to have at least 200 employees. Third, annual sales had to total at least \$20 million. These criteria were considered necessary to ensure that the sample was consistent with the focus of this research. A total of 434 BUs qualified for the study.

A structured survey questionnaire was developed in several stages. First, the relevant literature on R&D and global competition was searched for the verified scale items that measure a firm's concentration and coordination of R&D activities, global strategic position, global emphasis, and human resource flexibility, as well as potential economies of scale in the industry. New items were developed based on the literature when existing measures were not available. Second, personal interviews were conducted with three executives of multinational corporations, who were responsible for international operations, and four academicians familiar with research in global competition. All were asked to evaluate whether the items were meaningful, understandable, and valid measures of the proposed constructs in the study. On the basis of the interview feedback, some changes were made to the questionnaire items.

Questionnaire and Measures

Third, as a further pretest, 12 BUs were chosen randomly from the sampling frame. The preliminary questionnaire was sent to the CEO or president of each BU for an evaluation of the questionnaire length, the time needed to complete it, and the content of individual items. The questionnaire also was sent to three academicians for an evaluation. Feedback was received from three executives and the three academicians. The questionnaire was finalized on the basis of that feedback.

Following Roth, Schweiger, and Morrison's (1991) study, the measures for coordination of R&D activities focus on the extent to which a BU's R&D activities are coordinated across different countries. Specifically, two items were developed that focus on a BU's R&D and product development. Similar to Roth, Schweiger, and Morrison's (1991) scale, for each activity, a seven-point bipolar scale was used to measure the extent to which the R&D activity of a BU in different countries is coordinated (1 = not coordinated at all, 7 = highly coordinated).

Measures for concentration of the firm's R&D activities were adapted from Roth, Schweiger, and Morrison's (1991) work. Specifically, a seven-point bipolar scale was used to measure the degree to which a BU's R&D and product development activities were concentrated in one or a few countries as opposed to being dispersed among many (1 = dispersed to many country locations, 7 = highly concentrated to a few countries).

Two perceptual measures of a firm's global strategic position were developed and adopted. The first item was stated as follows: "The strategic position of our business unit in the global market is very strong." The second was: "Relative to our major competitors, our business unit is very competitive in the global market." Both items were measured by a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

A BU's global emphasis was measured by two seven-point Likert statements. One item stated: "Our country subsidiaries care very deeply about what happens to sister country subsidiaries." Another item was: "Individual subsidiaries are willing to sacrifice their profitability in order to achieve better performance for our business unit as a whole." Similarly, a BU's human resource flexibility was measured by three items on a seven-point Likert scale. These items assessed the degree to which a BU's personnel were willing to work wherever they were needed, could be transferred from one country to another, and had sufficient talent for global operations. Finally, economies of scale were measured by three perceptual items on a seven-point Likert scale. These items assessed the potential extent to which the economies of scale could be realized by operating globally or by coordination, as well as the importance of achieving economies of scale.

The data collection involved two phases. In the initial phase, a personalized cover letter, questionnaire, and postage-paid business reply envelope were sent to the CEO, president, or vice president for international operations or strategic planning of each BU remaining in the sampling frame. Three weeks after the initial mailing, completed questionnaires had been returned by 72 BUs. Another 15 questionnaires were returned as undeliverable due to the wrong mailing address or because the addressee had retired or was no longer with the BU. Several telephone calls and letters also were received, noting that participation was not possible because of company policy, time constraint, or lack of interest.

The second phase started three weeks after the initial mailing. A personalized cover letter, replacement copy of the questionnaire, and postage-paid business reply envelope were sent to those that had not responded. The cover letter restated the importance of participation and urged the executive to take some time to complete and return the enclosed questionnaire. The questionnaire and business reply envelope were identical to those sent in the initial mailing. Four weeks later, completed questionnaires had been returned by another 40 BUs. Overall, 112 BUs returned the completed questionnaires, for an effective response rate of 29.1% (excluding those undeliverable and inappropriate cases). Among these, 42 questionnaires were completed by CEOs or presidents and 70 by vice presidents.

The assessment of potential nonresponse bias was achieved by comparing the responding BUs with the nonresponding BUs (see Armstrong and Overton 1977). According to average annual sales and average number of employees, there was no statistically significant difference between the responding and nonresponding BUs. Thus, it can be concluded that there is no compelling evidence to suggest the existence of nonresponse bias. The characteristics of the sample are shown in Table 1.

Data Collection

Characteristics		Cases	Percentage
Region of parent company	United States/Canada	72	64.3
	Europe	19	17.0
	Japan	21	18.8
	Other	0	0.0
Business units that have	A separate IB department	59	52.7
	No separate IB department	53	47.3
Product category	Consumer products	20	17.9
	Industrial products	51	45.5
	Consumer and industrial	34	34.8
	Other	2	1.8

Note: IB = international business.

Table 1.
Characteristics of the Sample

ANALYSIS AND RESULTS

A two-stage approach was taken to analyze the data and test the proposed model. In the first stage, confirmatory factor analysis (CFA) using the EQS program (Bentler 1989) was applied. In the second stage, the factor scores for the constructs were computed by taking the average of the items that measure the constructs. Then, the path model was fitted by the Generalized Least Squares (GLS) procedure in the EQS program. According to Anderson and Gerbing (1988), the two-stage approach has two main advantages. First, it is less demanding on the sample size because of the reduced model at each stage. Second, the potential confounding effect between the structural and measurement model can be avoided.

Assessment of the Measurement Model

The results of the CFA are presented in Table 2. The model was fitted by the GLS method using the EQS program (Bentler 1989). The model was evaluated following the procedure recommended by Bagozzi and Yi (1989). First, the univariate and multivariate statistics of the input variables were screened. No apparent violation of the normality assumption was detected, suggesting GLS was the appropriate procedure to fit the models.

Second, an examination of EQS output showed no anomalies, suggesting that there was no special problem in the minimization process and that all variance estimates of the independent variables and error terms were significantly greater than 0. Third, the model fit statistics were examined. As shown in Table 2, the chi-square of the model is 241.35, with 91 degrees of freedom. Although the chi-square was significant at the .05 level, it has been well recognized that chi-square is not a reliable measure of model fit because of its dependence on the sample size. When the fit indices were examined, it was found that the Bentler-Bonett normed fit index (NFI) is .967, nonnormed fit index (NNFI) is .979, and the comparative fit index (CFI) is .979, suggesting good fit of the model (Bagozzi and Yi 1989).

Fourth, the internal structure of the model was checked, and no improper solution was found. The normalized residuals were all small, and all significant coefficient estimates were in the hypothesized direction. In particular, all item loadings were positive, high in magnitude, and statistically significant, suggesting that the measurement of the factors had convergent validity. In addition, the correlations among the items and other factors were not high, suggesting the presence of discriminant validity. Fifth, though the moderate sample size of the present study does not allow for meaningful cross-validation, the results are consistent with the expectations, which suggests that the results are theoretically valid.

Combining all aspects of the model evaluation previously described, we can conclude that, on both theoretical and statis-

Factor/Item	Standardized Loading	t-Value
Coordination of R&D Activities^a		
1. Research and development activities	.739	7.284
2. Product development activities	.696	6.714
Concentration of R&D Activities^b		
1. Research and development activities	.764	7.367
2. Product development activities	.810	8.265
Global Strategic Position^c		
1. The strategic position of our business unit in the global market is very strong.	.807	8.315
2. Relative to our major competitors, our business unit is very competitive in the global market.	.782	7.618
Global Emphasis^c		
1. Our country subsidiaries care very deeply about what happens to other country subsidiaries.	.673	4.766
2. Individual subsidiaries are willing to sacrifice their profitability in order to achieve better performance for our business unit as a whole.	.755	6.273
Human Resource Flexibility^c		
1. Our personnel are willing to work in any country market where they are needed the most.	.759	6.402
2. Our personnel can be easily transferred from one country subsidiary to another.	.809	8.067
3. Our personnel have sufficient talent to work in different country subsidiaries.	.822	7.689
Potential Economies of Scale^c		
1. Operating on a global scale is essential to achieve efficiency in our business.	.831	8.696
2. Great cost benefits can be realized by integrating our worldwide operations.	.575	4.509
3. Achieving economies of scale is vital to the survival of our business in the global market.	.589	4.354

^a1 = not coordinated at all, 7 = highly coordinated.

^b1 = dispersed, 7 = concentrated.

^c1 = strongly disagree, 7 = strongly agree.

Note: Model fit statistics are as follows: chi-square = 241.35, degrees of freedom = 91, significant $p = .001$, normed fit index = .967, nonnormed fit index = .979, and comparative fit index = .979.

tical grounds, the measurement model adequately fits the data. Thus, the factors measured by the items in the measurement model can be used for structural analysis.

Factor scores were computed by averaging the items that measure the factors, as determined by the CFA measurement model. The variance-covariance matrix of these factors is shown in Table 3. The structural model in Figure 1 then was fitted by the EQS program. The results of the GLS-fitted structural model are shown in Figure 2.

Similar to the procedure for evaluating the measurement model, the structural model was evaluated in several stages. First, there

Table 2.
Estimates of the
Measurement Model

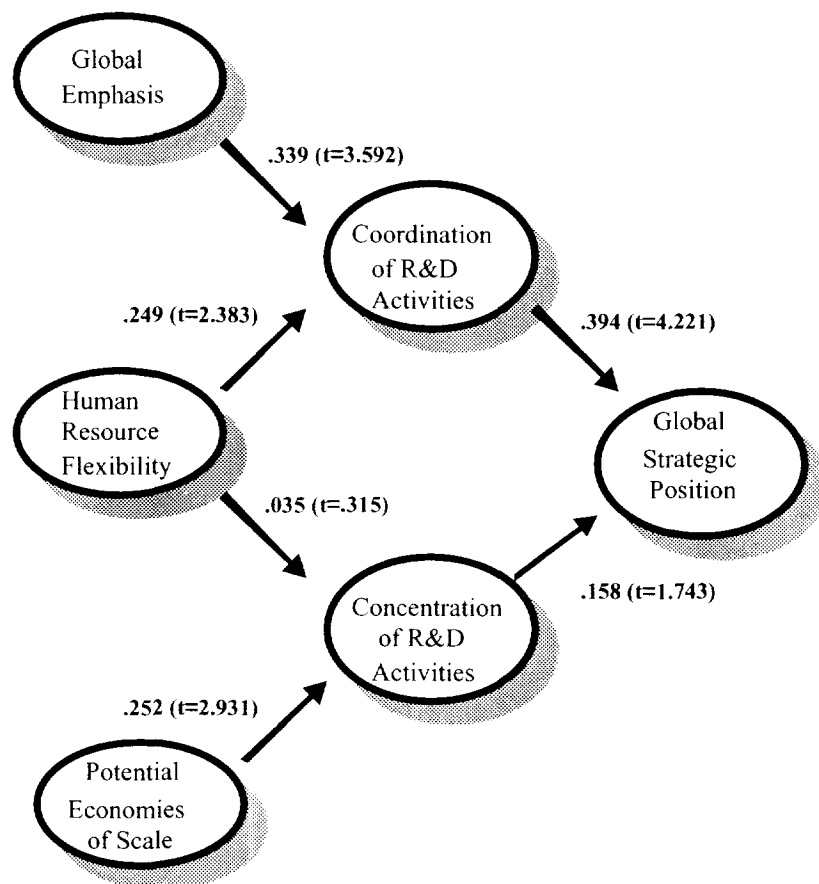
Assessment of the Structural Model

Table 3.
Variance–Covariance Matrix
of the Factors

Factor	PES	COR	CON	GSP	GE	HRF
Potential economies of scale (PES)	.928					
Coordination of R&D activities (COR)	.091	1.444				
Concentration of R&D activities (CON)	.281	.194	1.837			
Global strategic position (GSP)	.164	.711	.346	2.039		
Global emphasis (GE)	.296	.454	.019	.524	1.284	
Human resource flexibility (HRF)	.040	.395	.048	.460	.105	1.429

was no evidence of nonnormality for items measuring the factors, so there was no evidence that any factor was nonnormal. Second, no anomalies or special problems were encountered during the model estimation process. All variance estimates were positive and significant. Third, the model-fit statistics were examined. The overall model chi-square was 23.151, which, with 6 degrees of freedom, is significant at the .05 level (see Figure 2). However, the fit indices of the model all suggested good fit: Bentler-Bonett NFI is .960, NNFI is .923, and CFI is .969. Fourth, the internal structure of the model showed that no improper solution was found and that all path coefficient estimates were in the hypothesized direction, which further suggests good fit of the structural model. Moreover, the results were consistent with the theoretical expectation. Combining all aspects of the model evaluation, we can conclude that the structural model fits the data well and that the path coefficients adequately represent the relationships among the factors.

On the basis of the path coefficient estimates in Figure 2, we find that coordination of R&D activities is positively and significantly influenced by a BU's global emphasis and by its human resources flexibility (in support of H_1 and H_2). In addition, concentration of R&D activities is positively and significantly related to the potential economies of scale in the industry (in support of H_4). However, the effect of human resource flexibility on concentration of R&D activities is not significant (no support for H_3). Furthermore, whereas a BU's global strategic position is positively and significantly influenced by coordination of its R&D activities (in support of H_5), the effect of concentration of R&D on a BU's global strategic position is positive but not statistically significant at the .05 level (no support for H_6). Overall, it can be concluded that the structural model fits the data well and that four of the six hypotheses are supported by the results.



Note: Chi-square=23.151, d.f.=6, p =.001, NFI=.960, NNFI=.923, CFI=.969.

Figure 2.
The GLS Fitted Model of
Concentration and
Coordination of R&D

This study was motivated by a desire to understand the relationship between global R&D activities and a firm's global strategic position. Focusing on coordination and concentration as the two dimensions of implementing global R&D strategies and thereby testing Porter's framework in the R&D context, we find that a firm's global strategic position is determined more by coordination than by concentration of R&D. This is in line with Porter's (1986, p. 36) expectation that "today's game of global strategy seems increasingly a game of coordination." Getting R&D facilities around the world to work together has a significant effect on the global strategic position of firms.

In addition, two intangible firm resources—global emphasis and human resource flexibility—have significant effects on coordination of R&D activities. These results imply that the RBT is a suitable theoretical framework for understanding global R&D strategy (Barney 1991). Finally, economies of scale are significantly related to concentration of R&D, which supports the widely held view that scale benefits lead to concentration of activities (Kogut 1989; Porter 1986; Zou and Cavusgil 1996), though concentration does not lead to significantly enhanced global strategic position.

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

What are the implications of these findings? First, global emphasis and human resource flexibility are resources over which a firm has control and are developed through certain management decisions, philosophies, and worldviews. This empirical support for the view that coordination depends more on a firm's controllable resources has been demonstrated elsewhere (e.g., Cooper 1979; Montoya-Weiss and Calantone 1994) and calls for proactive management practices and processes for developing, nurturing, and disseminating firm resources. If a firm lacks a global emphasis and a flexible human resource pool, internal constraints will inhibit coordination. Together, these findings provide support for the strategic management of global R&D through coordination.

Enhanced global strategic positioning rests on intangible firm resources and the implementation of a global R&D strategy through coordination. How companies implement a global strategy is therefore critical. The outcome, in terms of global strategic position, is to a large extent in the hands of the managers. Each BU should continuously evaluate its present resources, identify and build critical resources, and develop a firm-specific implementation process for coordination of its global R&D activities. If resources are evaluated, updated, and developed continuously, implementation of coordination can be a managerial change mechanism and a source of sustainable competitive advantage. For the BU, the key challenge involves determining how to coordinate its R&D activities.

One way to coordinate R&D activities globally is by establishing worldwide information systems to coordinate product and design development. Companies such as Boeing, ABB, and Motorola have deployed such systems successfully. In developing the Boeing 777, the company employed real-time, computer-aided technology to design components jointly with Japanese partners. The crux of this system is a sophisticated computer network that records development advances and makes them available to product developers in both countries.

Another way to coordinate global R&D is to encourage frequent communication among R&D facilities in different countries. Frequency of communication has been found to enhance coordination in new product development teams (Griffin and Hauser 1992) and should have the same effect in coordinating R&D globally. Again, worldwide information systems can be used to enhance frequent interchange of ideas. In addition, the human resource management (HRM) practices of firms should facilitate and encourage frequent communication. Career paths and performance evaluation structures should motivate rotation of R&D teams, and employees who rotate should be rewarded. Companies that successfully coordinate their global R&D activities, such as

Procter & Gamble and Unilever, have developed HRM practices that motivate extensive communication and information sharing among units (Bartlett and Ghoshal 1990).

An implication of the model tested in this study is that certain internal resources (e.g., global emphasis and human resource flexibility) are intrinsic to coordination of global R&D. Therefore, the internal organization of R&D could be independent of where the BU originates and where it conducts business. This framework provides a starting point for understanding the effect of coordinating R&D on the global strategic position of the firm, regardless of national or cultural origin. Using the hypothesis that similar patterns of internal organizational responses can be found, international marketing researchers should be able to test these relationships by comparing U.S., Japanese, and German firms, or those of any other national origin. These are issues that researchers will need to tackle in the future.

What are the implications of the findings in terms of concentration of R&D activities? The lack of a significant relationship between concentration and global strategic position is intriguing. Although concentrating R&D fosters cross-product learning among researchers and developers (Datar et al. 1996), it also leads to R&D teams being separated from end users and markets. Thus, local learning benefits are sacrificed (Ghoshal 1987). The erosion of local learning benefits may have confounded the cross-product and cost benefits of concentration. One of the issues that led to the development of a dispersed R&D structure at Unilever was "the need to benefit from everybody's creativity and experience" (Maljers 1992, p. 46). There is also recent empirical evidence that dispersing R&D activities in multiple countries can achieve a shorter time to market compared with concentrating R&D (Datar et al. 1996). Better management of customer interaction enables companies that disperse R&D to benefit from both customer input and product/process coordination at the plant level. This is a fertile area for further research.

Another possible explanation for the insignificant effect of concentration of R&D is that the sample size in this study may be too limited to detect the significance of the effect. Additional research should investigate this relationship further.

Several limitations of the study should be kept in mind when interpreting the findings. First and most important, only two firm resources and one external environmental factor were investigated. Other external factors, such as industry concentration, entry and exit barriers, first-mover advantages, and industry competitiveness, can influence concentration and coordination of R&D (Porter 1985). For example, if a firm believes it can block a competitor from

Limitations of the Study

THE AUTHORS

Shaoming Zou is assistant professor of marketing and international business at University of Missouri-Columbia.

Aysegül Özsoy is assistant professor of marketing and international business at Koç University, Istanbul, Turkey.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the financial support of this research by MSU-CIBER and the helpful comments of three anonymous *JIM* reviewers on previous versions of this article.

REFERENCES

global expansion by being a first mover into the global market, it may have a greater desire to coordinate R&D activities to speed the product development process.

Similarly, other firm resources, such as market orientation, technical and management skills (Cooper 1979), and information technology implementation are expected to facilitate coordination of R&D globally. Although a global emphasis and human resource flexibility are important, this empirical validation should be considered a preliminary study. Further research should expand the scope of this study by including other internal and external factors.

Second, the findings are valid only within the 23 global industries explicitly identified here. Further research is needed to determine whether, in other global industries and/or multidomestic industries, similar findings can be obtained. Third, the study is limited to BUs operating in the United States. Additional research should extend the study to other countries to gain insight into the cross-cultural generalizability of the findings.

- Anderson, James C. and David W. Gerbing (1988), "Structural Equations Modeling in Practice: A Review and Recommended Two-Step Approach," *Psychological Bulletin*, 103 (3), 411-23.
- Armstrong, Scott J. and Terry S. Overton (1977), "Estimating Non-response Bias in Mail Surveys," *Journal of Marketing Research*, 14 (August), 396-402.
- Bagozzi, Richard R. and Youjae Yi (1989), "On the Use of Structural Equation Models in Experimental Designs," *Journal of Marketing Research*, 16 (3), 271-84.
- Barney, Jay (1991), "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, 17 (1), 99-120.
- Bartlett, Christopher and Sumantra Ghoshal (1989), *Managing Across Borders: The Transnational Solution*. Boston, MA: Harvard Business School Press.
- and ——— (1990), "Managing Innovation in the Transnational Corporation," in *Managing the Global Firm*, C.A. Bartlett, Y. Doz, and G. Hedlund, eds. London: Routledge, 215-55.
- Bentler, Peter M. (1989), *EQS Structural Equations Program Manual*. Los Angeles: BMDP Statistical Software.
- Calantone, Roger and Robert G. Cooper (1981), "New Product Scenarios: Prospects for Success," *Journal of Marketing*, 45 (Spring), 48-60.
- Collis, David J. (1991), "A Resource-Based Analysis of Global Competition: The Case of the Bearings Industry," *Strategic Management Journal*, 12 (Summer), 49-68.
- Cooper, Robert G. (1979), "Identifying Industrial New Product Success: Project NewProd," *Industrial Marketing Management*, 8 (2), 124-35.

- Datar, Srikant, Clark Jordan, Sunder Kekre, Surendra Rajiv, and Kannan Srinivasan (1996), "New Product Development Structures: The Effect of Customer Overload on Post-Concept Time to Market," *Journal of Product Innovation Management*, 13 (4), 325-33.
- Devinney, Timothy M. (1995), "Significant Issues for the Future of Product Innovation," *Journal of Product Innovation Management*, 12 (1), 70-75.
- Ghoshal, Sumantra (1987), "Global Strategy: An Organizing Framework," *Strategic Management Journal*, 8 (5), 425-40.
- Griffin, Abbie and John R. Hauser (1992), "Patterns of Communications Among Marketing, Engineering and Manufacturing: A Comparison Between Two New Product Teams," *Management Science*, 38 (3), 360-73.
- Hamel, Gary and C.K. Prahalad (1985), "Do You Really Have a Global Strategy?" *Harvard Business Review*, 67 (May/June), 63-76.
- Harrigan, Kathryn Rudie (1987), "Strategic Alliances: Their New Role in Global Competition," *Columbia Journal of World Business*, 22 (Summer), 67-69.
- Hax, A. (1989), "Building the Firm for the Future," *Sloan Management Review*, 31 (Spring), 75-82.
- Hedlund, Gunnar (1986), "The Hypermodern MNC: A Heterarchy?" *Human Resource Management*, 25 (1), 9-36.
- Kogut, Bruce (1989), "A Note on Global Strategies," *Strategic Management Journal*, 10 (4), 383-89.
- Lado, Augustine A. and M. Wilson (1994), "Human Resource Systems and Sustained Competitive Advantage: A Competency-Based Perspective," *Academy of Management Review*, 19 (4), 699-727.
- Lawrence, Paul R. and Jay W. Lorsch (1967), *Organization and Environment*. Boston, MA: Harvard University Press.
- Levitt, Theodore (1983), "Globalization of Markets," *Harvard Business Review*, 61 (May/June), 92-102.
- Maljers, Floris A. (1992), "Inside Unilever: The Evolving Transnational Company," *Harvard Business Review*, 70 (September/October), 46-51.
- Mintzberg, Henry (1979), *The Structuring of Organizations*. Englewood Cliffs, NJ: Prentice Hall.
- Montoya-Weiss, Mitzi and Roger Calantone (1994), "Determinants of New Product Performance: A Review and Meta-Analysis," *Journal of Product Innovation Management*, 11 (5), 397-417.
- Porter, Michael E. (1985), *Competitive Advantage*. New York: The Free Press.
- (1986), "Changing Patterns of International Competition," *California Management Review*, 28 (Winter), 9-40.
- Roth, Kendall (1992), "International Configuration and Coordination Archetypes for Medium-Sized Firms in Global Industries," *Journal of International Business Studies*, 23 (3), 533-49.

- , David M. Schweiger, and Allen J. Morrison (1991), "Global Strategy Implementation at the Business Unit Level: Operational Capabilities and Administrative Mechanisms," *Journal of International Business Studies*, 22 (3), 369–402.
- Ruekert, Robert W. and Orville C. Walker (1987), "Marketing's Integration with Other Functional Units: A Conceptual Framework and Empirical Evidence," *Journal of Marketing*, 51 (1), 1–19.
- Samiee, Saeed and Kendall Roth (1992), "The Influence of Global Marketing Standardization on Performance," *Journal of Marketing*, 56 (2), 1–17.
- Teece, David J., ed. (1986), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*. Boston, MA: Ballinger.
- Yip, George S. (1989), "Global Strategy ... in a World of Nations?" *Sloan Management Review*, 31 (Fall), 29–41.
- Zou, Shaoming and S. Tamer Cavusgil (1996), "Global Strategy: A Review and an Integrated Conceptual Framework," *European Journal of Marketing*, 30 (1), 52–69.

Visit the AMA Website!

<http://www.ama.org>

**Here's a sampling of what you'll find
on the AMA website:**

- ◆ Selected articles and abstracts from *Journal of International Marketing* and other AMA publications
- ◆ Updated information on advertising in AMA publications
- ◆ Other advertising, sponsorship and exhibit opportunities
- ◆ Marketing discussion groups
- ◆ Information on the American Marketing Association, its members, and benefits

Plus much more!