

NATIONAL CULTURE AND RESEARCH AND DEVELOPMENT ACTIVITIES

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Abstract. Considering the effects of national culture on the process of innovation and on the establishment of research and development activities in the subsidiaries, a study of the national culture dimensions and its effect on the performance of these activities is conducted. Beginning with an analysis of the activities of research and development and the relationship with the national culture is tested using a sample of 222 subsidiaries of industrial multinational firms in five European countries. The influence of national culture is verified and a typology of national dimensions is set to reinforce certain types of innovation activities. The influence of the management type model associated with the origin of the multinational's country is also examined.

Keywords: National Culture; Innovation, Research and Development, Technological Capacity

Introduction

The global context in which firms develop and implement business strategies has changed significantly. The knowledge-based economy has made multinational companies to increase the transfer of the innovation processes, to their foreign subsidiaries in order to adapt to local needs and to tap in to the local knowledge available. The initiatives to optimise the innovation capabilities and seek competitive advantages has led to a major research effort at the subsidiary level. The benefits of decentralized R&D are present in the literature (Birkinshaw, 2000; Holm/Pederson, 2000; Jones/Davis, 2000; Pearce, 1997; Birkinshaw/Hood, 1998a, 1998b, 1997).

This paper builds on the responses of subsidiaries managers and analyses R&D activities of the subsidiaries of Multinational Companies. The relationship of these activities with national culture and the management approach, according to the multinational company origin are explored. To analyse these relationships we draw on the results of an empirical survey of MNC's subsidiaries in five European countries: Germany, France, Sweden, United Kingdom and Portugal.

The results permit to establish two findings. First, that cultural dimensions influence research and development activities at the subsidiary level; namely, that the higher the uncertainty avoidance and individualism and the lower the power distance and masculinity references the higher the levels of research and development activities performed. Second, that the type of management model, associated with the location of the parent company, can influence the organization of research and development activities of the subsidiaries.

Literature Review

The references on multinational motivations to internalise R&D, the decentralization process and its relation to location advantages has increased in the literature (Casson /Singh, 1993; Pearce 1989; Cantwell, 1989; Teece, 1976; Ronstadt, 1978). The location of R&D can be attributed to various motives: drivers for the internationalization process (1); firm's geographic orientation on R&D activities (2); strategic role of the foreign subsidiary (3) (Casson/Singh, 1993, De Meyer, 1992, 1993; Dunning/Narula, 1995, Cantwell, 1992).

The R&D activities of subsidiaries can be very different. They can range from a role of receiver of technology from other locations on the multinational network, to an adaptive role to local needs, or an autonomous activity (Davis, 2000; Pearce, 1997; Taggart, 1997). In the context of subsidiary strategy, the subsidiary's manager role in developing initiatives and the relation with the affirmation of R&D capability has been reinforced (Birkinshaw/Hood, 1998a, 1998b, 1997; Holm/Pedersen, 2000). In this sense the importance of R&D to strategic role determination has been focused as a key element of subsidiary strategy (Forsgren/Ulf/Johanson, 1992; Kogut/Zander, 1993; Dunning, 1992; Papanastassiou/Pearce 1996, 1997).

The aspect of national culture influence on the location of R&D activities is a factor also present in the decision process. The national culture, as an approach to cultural boundaries, is related with Hofstede's (1987) culture dimensions and has been related to invention and innovation (Shane, 1992, 1993), new product development (Nakata/Sivakumar, 1996), (Morris/Davis/Allen, 1994) and models of relationship implications have been established (Jones/Davis, 2000).

The influence of local culture on innovation and its importance to R&D competitive advantages has been pointed out by Nakata/Sivakumar (1996) when they refer that implicit in every site selection decision is the selection of a national culture.

Studies on the relationship of cultural dimensions and innovation activities have been conducted by Kedia, Keller and Julian (1992); Morris, Davis and Allen (1994); Nakata and Sivakumar (1996) Shane (1992, 1993). These studies reveal significant relations of cultural dimensions and innovation activities and suggest that low power distance and uncertainty avoidance and high masculinity and individualism can foster higher innovation. These results confirm Hofstede (1987) statement that lower power distance societies and lower uncertainty avoidance would have positive influence on innovation.

A framework that integrates the factors underlying global Research and Development has been proposed by Jones and Davis (2000). They establish a classification of foreign location roles and relate them to contingency factors. The roles range from: locally oriented support and adaptation; locally-oriented R&D; globally-oriented R&D, competitor market/technology scanning; to other roles non-technologically related. They relate these roles with the contingency factors of motivation focus, geographic orientation, and R&D mission. They go on to establish a theoretical relationship to Hofstede's cultural dimensions. According to these authors the differentiation from locally oriented support and adaptation to a globally oriented R&D would mean a change from high power distance, uncertainty avoidance and masculinity to a lower level of these indicators. The individualism would also change from low to high and the Confucian dynamism would remain positive in all technological roles.

Hypotheses

In this paper we put forward two hypotheses: a first, regarding the significant effect of cultural dimensions on the R&D of the subsidiary and second, related with the influence management model of the multinational to the establishment of the subsidiaries R&D activities.

In hypothesis one it is sustained that: *the national cultural dimensions influence the R&D activities.*

The first hypothesis is founded in a vast literature where the works of Hofstede (1987), Ronen and Shenkar (1985), Kogut and Singh (1988) and Schneider e Barsoux (1997) are some of the best known. Other authors like Porter (1990) and Dunning (1998) stress the importance of national elements in the international location and the importance of international “cluster’s” to the composition of subsidiary portfolio as a factor of great competitive relevance. The aspects of technology and innovation have been stressed by various authors (Forsgren, Ulf and Johanson, 1992; Kogut and Zander, 1993; Dunning, 1992; Papanastassiou and Pearce 1996, 1997).

The technological capabilities are considered as a determinant factor to the definition of the strategic roles of the subsidiaries. This is a factor that Porter (1990) considers essential in the competitive capacity of a nation, and is referred by Forsgren, Ulf e Johanson (1992); Kogut e Zander (1993); Birkinshaw e Hood (1997); Dunning (1992); Dunning e Narula (1995); De Meyer (1993); Papanastassiou e Pearce (1996,1997).

Papanastassiou and Pearce (1997) defend that the competitive conditions of the global economy requires that multinational companies adopt a process of decentralized use and development of technology. These authors underline the diverse preferences of consumers, as the specific technological capacities of a country are made available as an important resource for the foreign subsidiary. They state that the value of this location is restricted by the availability of these advantages in other locations. In this manner the authors relate R&D with country location. Papanastassiou and Pearce (1998) refer that as many subsidiaries evolve from product development to more creative develop country location is more important.

Forsgren and Pedersen (1998) analyse the concept of “centers of excellence” as subsidiaries that acquire unique capabilities that can be used as a reference. A condition to be considered one of these subsidiaries is the high knowledge and interconnecting with the local environment.

Hedlund (1990) studied the importance of knowledge and identified two dimensions of knowledge: (1) intensive and (2) extensive. Based on these dimensions he has established a typology of subsidiaries: “local creator”, “global creator”, “local explorer” and “global explorer”. As an example of “local creator” he refers the starters of Silicon Valley, as “local explorer” building and construction, as “global creator” the transnacional companies and as “global explorer” the *Fast Food*, hotel or *franchising* chains.

In order to test this hypothesis and measure national culture we considered Hofstede’s (1987) cultural dimensions. The first dimension is “power distance”, that is defined as the level of acceptance of uneven distribution of power in the society. This varies by country and is reinforced in the different social arenas. The second indicator is “individualism” that is defined as the importance of the individual goals and efforts versus the collective goals and efforts.

The third indicator is “masculinity”, defined as the level of assertiveness that is promoted by the national culture to either genders. The fourth indicator is referred as “uncertainty avoidance”. This relates to the level of uncertainty in relation to future events that people from one national culture are able to accept without being incapable of performing. Altogether these indicators would be able to classify and distinguish national culture.

Hofstede developed a fifth indicator in order to distinguish oriental cultures from the occidental counterparts, which are designated as Confucianism. This indicator relates to the importance of honour, virtue and the recognition of group values. We do not analyse Confucianism, because in this work we only covered subsidiaries located in Europe. The culture of the country of origin is represented by the management model included in the second hypothesis.

Hypothesis two states that: ***the type of management model of the parent company influences the R&D activities.***

The second hypothesis introduces the type of management model of the parent company as a determinant to subsidiary R&D activities. For this purpose we considered the classification of the companies in to three distinct models, according to their relative proximity: a European model, an American and a Japanese model.

The geographical proximity is one of foreign investment determinants, and it can be associated with culture proximity. In this sense, the Japanese “*Kaisha*” and the Southeast Asia economies suggest that there is more than one way to organize the business activities and that particular institutional environments can foster local adaptations. In terms of market organization, Japanese firms develop a more extensive network of companies associated with family and loyalty relationship than the more “professional manger” American Firms, where activities are managed as “portfolio” with planning and control mechanisms (Whitley, 1992).

While in the occident competition is a common form of market organization, in the oriental countries there are more cooperative efforts with companies relying in mutual dependence, sharing information and developing long- term relations. (Orru et al, 1989). In terms of decentralization of functions and authority there is more diversity in American firms than in Japanese firms. The result of this approach is that control is exercised in a more personalized manner and based on personal contact and common values that in formal processes. (Kagono, et al. 1985). Calori and De Woot (1994) state that, compared with American and Japanese managers, there is a distinctive European management model. Although the diversity of countries in Europe they consider that the approach to a social market economy, a more active interface with the community and a more orientated workers decisions process are distinguishing factors of an European management model. They refer that American and Japanese companies operating in Europe do not follow this model.

Abramson, Keating and Lane (1996) made a comparison of Canadian, America and Japanese managers, regarding their cognitive process. They found that Canadians were more theoretical, and Japanese were more long term oriented than American managers. These authors refer these differences can be important in types of actions taken, organization design and type of performance indicators selected. Yip, Johansson e Roos (1997) studied the influence of management processes on the globalisation of industries and the definition of global strategies and found that there are significant differences due to national effects, and that European and Japanese companies use more global strategies than American companies.

In this context we consider that the origin of the subsidiary can influence their strategic roles and determine the type of R&D activities.

Methodology of the Study

The first step in defining the sample was the identification of Hofstede's indicators that were used to select the countries to use in the study. The countries selected were United Kingdom, Sweden, Germany, France and Portugal, representing different groups of European nations: Anglo-Saxonic, Nordic, Germanic, Central Europe and Southern Europe. Identified the countries to use in the study a sample of subsidiaries was taken, according to the proportion of foreign subsidiaries existent in each country.

The main source of data was a questionnaire that was developed to test the hypotheses and applied to the foreign subsidiaries in the selected countries. This questionnaire was directed to the managers of the subsidiaries with the indication that should be them supplying the date, or, in alternative the questionnaire should be filled by someone involved in the planning processes.

From this questionnaire we obtained the variables used in the study that relates research activities with the cultural dimensions and type of management model. The Activities of research were classified as 1= activity not performed, 2 activity performed within country and 3= activity performed to multiple countries. The management model was classified as a 1=European model, a 2=American model or as 3=Japanese model, according to parent company location. In this way both the dependent variable of research activities and the independent variable of management model are ordinal variables. These independent variables were combined with the Hofstede indicators of individualism, power distance, masculinity and uncertainty avoidance, derived from the country the foreign subsidiary operates.

The Empirical Model

Given the ordinal nature of the dependent variable, the ordered probit model seems suitable to explain it. Consider that the propensity of firm i to choose (answer) a given alternative is generated by the following process

$$I_i^* = \beta' X_i + \varepsilon_i \quad i=1, 2, \dots, N$$

where I_i^* is a latent variable, β is a set of parameters to be estimated, X_i is a set of explanatory variables and ε_i is a random term assumed to be independent and identically distributed $N(0, 1)$.

However, I_i^* is not observed in the data but instead an indicator variable I of the type

$$I = 0 \quad \text{if} \quad I^* \leq \mu_0$$

$$I = 1 \quad \text{if} \quad \mu_0 < I^* \leq \mu_1$$

$$I = 2 \quad \text{if} \quad I^* > \mu_1$$

where μ_k ($k=0,1$) are unknown thresholds to be estimated together with β .

The probability that a firm chooses a given alternative j ($j = 0, 1, 2$) is given by

$$P(I = 0 | X_i) = P(I^* \leq \mu_0) = P(\varepsilon_i \leq \mu_0 - \beta' X_i) = \Phi(\mu_0 - \beta' X_i)$$

$$\begin{aligned} P(I = 1 | X_i) &= P(\mu_0 < I^* \leq \mu_1) = P(\mu_0 - \beta' X_i < \varepsilon_i \leq \mu_1 - \beta' X_i) = \\ &= \Phi(\mu_1 - \beta' X_i) - \Phi(\mu_0 - \beta' X_i) \end{aligned}$$

$$P(I = 2 | X_i) = 1 - P(I^* \leq \mu_1) = 1 - \Phi(\mu_1 - \beta' X_i)$$

where Φ stands for the cumulative standard normal distribution.

The marginal effects of the continuous explanatory variables on the probability that a firm falls into a particular group are then given by

$$\frac{\partial P(I = 0)}{\partial X_f} = -[\phi(\mu_0 - \beta' X)]\beta_f$$

$$\frac{\partial P(I = 1)}{\partial X_f} = [\phi(\mu_0 - \beta' X) - \phi(\mu_1 - \beta' X)]\beta_f$$

$$\frac{\partial P(I = 2)}{\partial X_f} = [\phi(\mu_1 - \beta' X)]\beta_f$$

where the subscript f indicates the variable of concern and ϕ stands for the standard normal density function.

For discrete (dummy) explanatory variables the marginal effects can be calculated through the formula $\Delta = P(I = j | d = 1) - P(I = j | d = 0)$, $j = 0,1,2$ which yields the marginal effect on the probability when the dummy variable changes from 0 to 1.

This model can be estimated by maximum likelihood being the log-likelihood function to be maximised written as

$$LogL = \sum_{i=1}^N \sum_{j=0}^2 Z_{ij} \log\{\Phi(\mu_j - \beta' X_i) - \Phi(\mu_{j-1} - \beta' X_i)\}$$

where Z_{ij} is an indicator function of the type

$$Z_{ij} = 1 \quad se \quad i \in j$$

$$Z_{ij} = 0 \quad se \quad i \notin j \quad i = 1, \dots, N \quad j = 0, 1, 2$$

Since X_i includes a constant the parameters are not identified. In order to overcome this problem we set $\mu_0 = 0$ (see Greene, 1998). Furthermore, $\mu_{0-1} = -\infty$ and $\mu_3 = +\infty$.

Estimation Results

The percentage of responses to the questionnaire was of 23.1%, varying by country, and can be found in Table 1. We can verify that the subsidiaries located in Portugal and the United Kingdom are the ones with higher response rates. Analyzing the distribution of responses by country we can see that the country with the highest percentage of valid questionnaires is France (28.6%) followed by Germany (26.8%), United Kingdom (18.2%), Portugal (16.9%) and Sweden (9.5%).

Considering that the distribution of responses by country do not diverge from the initial setting of the questionnaires, we can consider that the distribution of responses does not alter the significance of the sample.

Table 1 – Percentages of Answers by Country

Countrys	Questionnaires Received	Questionnaires Sent	Response Rate	Percentage By Country	
United Kingdom		42	170	24,70%	18.2%
Germany		62	300	22,00%	26.8%
France		63	290	21,40%	28.6%
Sweden		16	100	22,00%	9.5%
Portugal		39	140	27,90%	16.9%
Total		222	1000	23,10%	100,00%

The statistics for the average, standard deviation and correlations of the variables can be found in Table 2. We can see that the more significant correlations are the ones observed between the different Hofstede indicators.

Table 2 – Average, Standard Deviation and Correlations

Descriptive Statistics	Mean	Deviation	Correlations					
			1	2	3	4	5	6
1 Individualism	65,7	19,1						
2 Masculinity	48,3	19,4	-0,45					
3 Power Distance	48,4	15,9	-0,76	-0,20				
4 Uncertainty Avoidance	68,6	25,5	-0,03	0,35	-0,20			
5 Location of Parent	1,9	0,8	-0,10	-0,30	0,12	0,12		
6 Research & Development	1,8	0,8	-0,01	-0,03	0,03	0,03	0,03	

The estimation results are included in Table 3. As we can see, the null hypothesis that the exogenous variables have no explanatory power is rejected at the 1% level since that value of the test (Chi-squared(6) = 79.6) is far above the critical value of 16.8.

The results indicate that the higher the individualism and the uncertainty avoidance indexes the higher the probability of a firm to choose the level 2 (activity performed to multiple countries) and the lower the probability of choosing the level 0 (activity not performed). The reverse is valid for masculinity and power distance indexes.

Table3: Ordered Probit Model: estimation results

	Coefficient	standard error
constant	-2.9443	1.1559*
individualism	0.0789	0.0173*
masculinity	-0.0619	0.0105*
power distance	-0.1199	0.0226*
uncertainty avoidance	0.1037	0.0204*
United States	-0.3103	0.2296
Japan	-1.0966	0.2454*
μ_0	1.0637	0.1154*
Log-L	-195.1	
Log-L0 (slopes = 0)	-234.9	
Chi-squared (6)	79.6	
# of observations	222	

* significant at the 1% level.

Regarding the geographic variables, United States and Japan have negative impact on the probability of choosing level 2, as compared with Western Europe. However, the difference between Europe and the United States is not statistically significant at 1% level.

A problem with the interpretation of the parameters of the ordered probit model is that the signs only indicate the sign of the impact of the corresponding variable on the probabilities of the lowest and the highest levels of the scale. In order to overcome this shortcoming and determine the effects on the intermediate levels (in this case, level 1) it is usual to calculate the marginal effects for a reference category.

Table 4: Ordered Probit Model: marginal effects

	Level 0	Level 1	Level 2
Estimated Probabilities for the reference category	0,2978	0,4052	0,2970
individualism	-0,0362	0,0000	0,0362
masculinity	0,0284	0,0000	-0,0284
power distance	0,0551	0,0000	-0,0551
uncertainty avoidance	-0,0476	0,0000	0,0476
United States	0,1150	-0,0175	-0,0975
Japan	0,4165	-0,1710	-0,2454

The reference category has the sample mean of the continuous variables (individualism, masculinity, power distance, uncertainty avoidance) and is located in Europe.

Considering the average values of the variables and that the subsidiary is originary from Europe we can analyse this marginal effects. From table 4 we can see that higher levels of individualism and uncertainty avoidance reduce the probability of an average subsidiary to be included in level 0 (activity not performed) and increase the probability of being included in level 2 (Activity performed to multiple countries). Higher level of masculinity and power distance have a reverse effect.

The fact of the parent company being from Japan reduces the probability of being in level 2 and increases the probability of being in level 0. The same is true in the case of the United States, but in a much smaller degree. This reinforces the idea that Japanese Multinationals centralise more their research and development activities than European Multinationals and the United States Multinationals appear in an intermediate level that does not distinguish them from the European companies, in statistical terms.

These results are in accordance with the literature. Jones and Davis (2000) refer that a globally oriented research and development would be associated with a low power distance, uncertainty avoidance and masculinity and a higher individualism. These type of associations are also made by Shane (1993), Nakata and Sivakumar (1996).

The more centralized perspective of research and development shown in Japanese Multinationals is according to the type of structure and level of authority committed to the subsidiaries, that tends to be less expressive than in European and American Multinationals. This is referred by Bartlett e Ghoshal (1989) that studied the organization of Japanese companies at the world scale and classified it as a “centralized hub”. They associated this type of organization to historical heritage, being characterized by centralization of capitals, resources and responsibilities and giving less freedom to create new products and define strategies by the local subsidiaries.

Discussion and Conclusions

With the data used and applying the methodology described we can point out the following results: (1) the confirmation of the hypothesis that the cultural dimensions can influence the level of research and development performed by the foreign subsidiaries; (2) that the type of management model, associated with the origin of the multinational company can influence the type of research activities performed by the subsidiaries.

These results suggest that the location of the foreign subsidiary in countries where the national culture has a given type of dimensions can enhance their development capabilities. The association of higher development in cultures of high uncertainty avoidance and individualism show that the need to control the environment and the individuals effort can be a determinant in the process of innovation and that collective societies and the acceptance of given conditions reduces the development results. On the other hand the fact of having high power distance tends to reduce communication and that reduces the development process. The fact that societies with lower masculinity references as positive effect in innovation suggest that this process requires a better organization climate and more cooperative efforts rather than competitive attitudes.

The fact that the origin of the foreign subsidiary and the location of parent companies has positive influence on the organization and culture of the multinational companies and can imply that the type of management set of values and model of operations will determinate the subsidiary research and development activities. That suggests that the location of parent company or the model of management associated with certain values is an important element in analysing the subsidiaries research and development activities and has to be considered in studying these aspects.

As practical implications of this study we can refer to three different aspects: (1) multinational management and (2) subsidiary management and (3) local governments.

In the case of multinational management there is the importance of considering that national culture profile, as a management tool, can have a positive relationship with results of R&D activities. The absence of this variable can reduce the understanding why certain initiatives are more successful than others due to location aspects, related to national culture.

In the case of subsidiary managers this knowledge can help to orient their efforts in reinforcing the strategic role of their subsidiaries, by endorsing this types of activities when the national culture of their host country is more well adapted to this type of initiatives.

In the case of local governments this relationship of national culture aspects and R&D activities can represent an added argument to attract foreign investments into certain countries. By supporting these activities, local governments can foster the creation of new clusters of activities with potential competitive advantages and attract more foreign investment with positive impact to their country economic development.

As limitations of the study we can point to aspects that need further analysis: (1) the use of a broader sample of subsidiaries including other countries with a wider number of regions represented and that could include an evaluation of the effects of Confucianism and (2) investigate with more level of detail the type of activities that are performed by the subsidiaries and examine if there are still important relationships with national culture.

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Appendix

Table A - Location of Company and Research & Development Activities

	Activity not performed	Activity Performed in Host Country	Activity Performed Multiple Countries	Total
Reino Unido	36	6		42
França	15	32	15	62
Alemanha	30	15	18	63
Suécia	3	1	12	16
Portugal	18	15	6	39
Total	102	69	51	222

Table B - Location of Corporate Parent and Research & Development Activities

	Activity not performed	Activity Performed in Host Country	Activity Performed Multiple Countries	Total
Europa	27	15	33	75
EUA	27	42	15	84
Japão	48	12	3	63
Total	102	69	51	222

Table C - Number of Workers and Research & Development Activities

	Activity not performed	Activity Performed in Host Country	Activity Performed Multiple Countries	Total
0-100	15	3	3	21
101 a 500	36	30	12	78
501 a 1000	30	21	24	75
> 1000	18	15	12	45
Total	99	69	51	219

Table D - Principal Industry and Research & Development Activities

	Activity not performed	Activity Performed in Host Country	Activity Performed Multiple Countries	Total
Food Products	15	6	6	27
Transportation Equip.	18		6	24
Paper & allied Prod.	2	2		4
Machinery & Metal	12	12	9	33
Electricity & Electronics	28	28	6	62
Textils & Leather		6	12	18
Chemicals & allied Prod.	21		3	24
Measuring instruments	4	8	3	15
Petroleum and plastics	2	7	6	15
Total	102	69	51	222