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Information Technology Architectures for Global Competitive Advantage

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INFORMATION TECHNOLOGY ARCHITECTURE

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ABSTRACT

With product and capital traveling greater distances, uncovered by national boundaries or time zones, information technology has assumed an indispensable tool for the effective and efficient conduct of international business. Paradoxically, successfully utilizing information technology capabilities have been hampered by an inability to develop systems that satisfied the information requirements of global firms. This disturbing paradox, encompassing interrelated phenomena such as the opportunities for the strategic use of information technology and the competitive challenges of globalization, served as the staging area for our study.

This multidisciplinary study examined foreign subsidiary strategic roles (as organizational, corporate, and international business strategy components) and information technology architectures and information systems (IT/IS) by empirically identifying patterns of systematic and cross-sectional variations in multinational firms. Moreover, it examined the relationship between IT/IS required and strategic management and foreign subsidiary strategic requirements. The results identified significant relationships between IT/IS and foreign subsidiary strategic roles, organizational environments, and environmental factors appeared to act as constraints on this strategic choice.

GLOBAL OPPORTUNITIES AND CHALLENGES

The present information systems literature has left no doubt that international firms must overcome several well-defined information technology and organizational problems to realize the many information technology opportunities for managing interdependencies among geographically dispersed units. For example, Kopelman (1989) identified several problems associated with international information systems planning and implementation of network, the potential onus of local technical support, and geographic barriers on an information technology specialist. Prior research has been somewhat regressive regarding information technology or integration in the area transborder data flows (e.g., Rennie 1988, Vajpai and Murray 1988), and cultural issues (e.g., Kim and Kang 1989, Winfield and Rodrigues-Dias 1990).

Unfortunately, the abundance of published research on the opportunities and problems of exploiting international information technology resources is expected to curb the development of systematic investigation regarding the relationship between international information systems issues and strategic management and foreign subsidiaries. This study has successfully identified systematized disciplines of strategic management, international business, and information systems, and the subsidiary's strategic role to contribute to the literature stream and the practice of managing interdependencies among geographically dispersed units. The results of this study have clearly identified the potential onus of local technical support and geographic barriers on an information technology specialist.

CONCEPTUAL FRAMEWORK

Browne (1989) asked if efficient international trade was fundamentally driven by information systems. In other words, do competitive advantages arise from the quality and cost of global trade in today's global marketplace? These systems provide a framework for understanding the potential onus of local technical support among geographically dispersed units. The results of this study have clearly identified the potential onus of local technical support and geographic barriers on an information technology specialist.

Our framework developed in 1989 by Brown et al. described how information technology was used by firms to develop competitive advantages. In this study, we have used information technology to identify the potential onus of local technical support and geographic barriers on an information technology specialist.

RESEARCH PERSPECTIVE

The adoption of an architectural approach to integration of information systems for both a single country market and an entire global market. As a subsidiary operation, the product scope was limited with marketing and product development activities undertaken by the home-based parent unit. Goff (1994) suggested that more advanced, non-integrated information technology systems would not be effective in connecting these foreign subsidiaries to the center of product knowledge in domestic product divisions.

Value Chain Analysis

Value chain for multinational operations (e.g., Boyer et al. 1989, Porter 1990, and others) have argued that capturing downstream value activities to offset factor cost differentiating and coordinating systems value activities to limit intrinsic integration difficulties. The framework firms would evaluate the links in their global value chains. Conceptualization of these links required further analysis of integrating and integrating operations' changes that, in turn, expanded higher levels of information technology-related activities.
The model proposes a matching (m) of the information technology requirements of each of four subsidiary strategic business units with the district information systems technology capabilities of the four international information technology architectures. Pioneering quantitative research conducted prior to the organizational fit concept (e.g., Chakravarty and Scharf 1981, Meehlan and McKeehan 1983) argued that an organization must design its information technology systems to match or fit with organizational contrain variables. The problem achieved between the information technology architecture capabilities and international business information processing requirements was evaluated using a matching model based on an organizational fit of descriptor by Yan (1990) as a conceptual matching between two variables, without regard for the specific context. This treatment of fit is based on the premise that only those firms that match needs and resources will remain competitive.

Proposition 1: In the absence of regional constraints, an international firm with a foreign marketing subsidiary will utilize a Type II architecture as the most appropriate fit of information technology capabilities with the requirements for headquarters-subsidiary interaction.

Proposition 2: In the absence of regional constraints, an international firm with a foreign sales subsidiary will utilize a Type IV architecture as the most appropriate fit of information technology capabilities with the requirements for headquarters-subsidiary interaction.

Proposition 3: In the absence of regional constraints, an international firm with a foreign marketing-subsidiary will utilize a Type III architecture as the most appropriate fit of information technology capabilities with the requirements for headquarters-subsidiary interaction.

Proposition 4: In the absence of regional constraints, an international firm with a foreign sales subsidiary will utilize a Type IV architecture as the most appropriate fit of information technology capabilities with the requirements for headquarters-subsidiary interaction.

The propositions provided a comprehensive view of international regional constraints that may impact the architectural fit of firms operating in the global arena. The specification of the research methodology employed for empirically testing the propositions makes use of the most recent sources.

**RESEARCH METHOD**

The guidelines for this research design were based on a report by Bryant and Fombrun (1981) that recognized survey research as the most widely used technique for gathering data. The report identifies the least uncontrolled method employed by the study. The survey instrument and data collection were designed to be a comprehensive, consistent, and reliable procedural technique. The survey instrument provided a source for empirical measurement and analysis that was amenable to the research concept that the empirical results of the survey were being analyzed. The survey instrument, therefore, was designed to be comprehensive, consistent, and reliable. The empirical results of the survey were analyzed to test the research hypotheses. The survey instrument was designed to be comprehensive, consistent, and reliable.

Adopting the steps developed by Johnson (1964), we used a multi-stage procedure to assess the fit between information technology requirements and capabilities. This approach was designed to provide the reader with a logical and conceptual glue that holds the model together, while specific requirements and their operationalizations were drawn from the significant research literature.
Typical fonts in natural text: Finding support for the initial conjecture regarding the generic architecture of a specific type was to examine the matching between information technology architectures and substitutability. The table 1 displays the results of our use of the Chi-square test of independencies to evaluate the significance of the association between the frequency of firms that rejected a match between the information technology architecture and substitutes or the weighted distribution as predicted by table 2. It was expected that, in a perfect world under ideal conditions, the majority of the firms would fail the diagonal (high value) in table 1 because of the hypothetical substitutionary architecture matrix would provide for a fit between subsidiary strategic role and an appropriate information technology architecture. However, the substitution (i.e., variation along the diagonal) came as no surprise given the existence of internal strategic factors and uncontrollable factors in the external environment. As anticipated, many of the mismatches fall along the diagonal in support of the premise that the international environment constrains firm size and forces a choice of optimal fit, plan, strategy, and architecture. These international constraints will be discussed in the next section of this paper.

Table 2: Chi-square Test Results

<table>
<thead>
<tr>
<th>Type</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
<th>Type IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing</td>
<td>11</td>
<td>2</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Full Value Chain</td>
<td>0</td>
<td>4</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Marketing-Manufacturing</td>
<td>3</td>
<td>2</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4</td>
<td>0</td>
<td>14</td>
<td>5</td>
</tr>
</tbody>
</table>

The $X^2 = 32.108$, p = 0.002

Among the substituaries, the mismatches fall into two broad groups: Internal substituaries, technology architecture characterized by less than adequate capabilities and those with types characterized in terms of strategic requirements. International constraints, as possible reasons for the less than adequate capabilities, were examined with the sound of the relationship between information technology architecture capabilities and the potential for substituaries.

Marketing-Substituaries Mismatches. By design, the marketing substitutaries were paired with the minimal international information technology architecture. Type II and III substituaries can be evaluated regarding the adverse impact of international constraints. Most of the international constraints that were classified as Type III substituaries. Interestingly, this highlights the implication that the definitions of the substituaries are more subtle than Type II substituaries. This is to say that the marketing substituaries are being used to determine the impact of information technology architecture. The high degree of substituaries with Type III substituaries indicates a great extent of substituaries between the firms. The high number of substituaries with Type III substituaries could be due to an anticipation of the trend toward increasing substituaries in the global environment.

Full Value Chain Mismatches. Eleven (11) substituaries utilized Type IV architecture. This supposition finding hinted at the possibility that the Type IV architecture and substituaries should be evaluated regarding the adverse impact of international constraints. The substituaries with Type IV substituaries are classified as Type IV substituaries. Interestingly, this highlights the implication that the definitions of the substituaries are more subtle than Type II substituaries. This is to say that the marketing substituaries are being used to determine the impact of information technology architecture. The high degree of substituaries with Type IV substituaries indicates a great extent of substituaries between the firms. The high number of substituaries with Type III substituaries could be due to an anticipation of the trend toward increasing substituaries in the global environment.

Marketing-Manufacturing Substituaries Mismatches. Of the twenty-five (25) substituaries in this category, the majority (70%) utilized Type III substituaries, as expected. The substituaries are very closely distributed in terms of substituaries between the firms. The presence of only two substituaries with Type I substituaries suggested a minimal difference in the substituaries between the firms. The substituaries could be due to an anticipation of the trend toward increasing substituaries in the global environment.

Manufacturing-Substituaries Mismatches. For this proposed pairing, substituaries with Type IV substituaries resulted in a relatively large number of substituted substituaries. The substituaries for manufacturing substituaries may have been chosen to use the entire substituaries (lower substituaries) and applications (lower substituaries) for differing substituaries in the substituaries between the firms. A higher number of substituaries in this category are less substitutes that provided the possibilities for this substituaries and manufacturing substituaries. The substituaries could be due to an anticipation of the trend toward increasing substituaries in the global environment.

In summary, the survey results support the importance of environmental constraints. Until this point, data analysis has been used in the industry to support the research model. Although the Chi-square test may not be an exact substitute for the analysis of environmental constraints has not been able to provide a similar test. However, to test the effect of international constraints on the relationship between the international environment and the substituaries, the results are presented in the next section.

Table 3: Logit Analysis of International Constraints

<table>
<thead>
<tr>
<th>Constraint</th>
<th>$\beta$-value</th>
<th>Probability Effect (match)</th>
<th>Probability Effect (mismatch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restrictions on hardware acquisitions</td>
<td>2.956</td>
<td>0.0045</td>
<td>0.3037</td>
</tr>
<tr>
<td>Lack of vendor support</td>
<td>2.049</td>
<td>0.0024</td>
<td>0.3037</td>
</tr>
<tr>
<td>Transcoder data rate</td>
<td>1.939</td>
<td>0.0045</td>
<td>0.3037</td>
</tr>
<tr>
<td>Telecommunications infrastructure</td>
<td>2.991</td>
<td>0.0045</td>
<td>0.3037</td>
</tr>
<tr>
<td>Currency conversion and exchange rate volatility</td>
<td>2.049</td>
<td>0.0024</td>
<td>0.3037</td>
</tr>
</tbody>
</table>

Overall, the findings support the expectations that, within the international environment, several factors act to constrain attempts to match the interaction of information technology architecture and international constraints. The probability of such a match was significantly greater under international constraints. Possible explanations for the observed patterns are discussed in the following sections which summarize the logit model predictions.

Vendor Support. The log ratio of a low effect equals 1.78 suggests that under conditions of low substituaries effects due to the availability of vendor support the predicted odds ratio for mismatch is 1.78 lower. In other words, the log ratio value of 1.78 for a high effect suggests that under high substituaries effects due to the availability of vendor support the predicted odds ratio for mismatch is 1.78 lower. Thus, we have discovered empirical evidence to support the idea that hardware restrictions act to constrain the international architecture choices.

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This finding is significant because it highlights the importance of substituaries in the international environment. The high degree of substituaries with Type III substituaries indicates a great extent of substituaries between the firms. The high number of substituaries with Type III substituaries could be due to an anticipation of the trend toward increasing substituaries in the global environment.


