

INTEGRATION METHODOLOGIES AND PERFORMANCE IN JAPANESE AND AMERICAN PRODUCT DEVELOPMENT

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ABSTRACT

Do New Product Development (NPD) integration mechanisms differ across national subsets and, if so, does this make a difference to overall NPD performance? To answer these questions we studied the NPD programs of 141 firms from Japan and the USA. We explore whether there are differences between Japanese and American firms as to the use of integration methodologies and any effects thereof on performance. We find that the Japanese firms we survey did differ substantially from the American firms in using integration mechanisms. However, only innovation capabilities were significantly linked with both overall performance and nationality.

Keywords: New Product Development (NPD); Cross-country comparison; Japan; USA

New product development (NPD) is an important business activity across the globe and has been studied from both academic and practitioner perspectives. However, little research has focused explicitly on inter-national differences in NPD practices [9]. Instead, previous research has focused on the factors related to product success that are managerially controllable through better utilization of marketing and technical resources- skills to understand the marketplace and develop desirable products for it. Recently factors related to integration mechanisms, both within the firm and with external partners, are seen as important to increasing NPD performance. Improving the NPD process can also result from developing a well communicated, successful strategy that identifies areas of focus for product development. Most of the extant literature findings, however, are based on studies of large North American firms. Whether the importance of these factors is different in other parts of the world, such as Asia or Europe, is still an under-researched topic [3]. Few studies have taken an inter-country comparison approach with the exception of [1] [7] [8] [17] [19]. Given the global emphasis of business today [11], a better understanding of both practices and strategic aspects of NPD across countries is imperative.

We focus on Japan and the USA because they provide substantial cultural distance between them as distinct examples of an Asian and Western culture, respectively [4] [5]. We ask whether significant differences exist between Japanese and American NPD practices. We focus on the practices associated with integration across the firm and with entities outside the firm. Thus, integration takes the form of internal, external and strategic perspectives. We hypothesize that differences exist primarily due to different cultural attitudes (e.g. individualism versus collectivism) of these countries. We inquire into whether any differences found had an effect on performance for the NPD programs examined.

NEW PRODUCT DEVELOPMENT IN A GLOBAL CONTEXT

Few studies specifically address international differences between NPD practices and performance across multiple country sets. In the broad area of management, research has shown that managers in different countries make different strategic decisions and adopt different types of organizational practices [15]. In light of the rapid pace of globalization, it has become more important for companies to understand the management practices of foreign competitors and to accept those practices, if they prove to be superior. Without such effort companies could not maintain their competitiveness in the present age of global competition.

The limited findings to date have shown some surprises. For example, one study surveyed marketing managers from 144 Korean firms that provided information about 288 successful and unsuccessful products and compared their findings with similar studies of Canadian and Chinese firms [8]. Differences in NPD success factors were found across the global sample but the researchers were

surprised to find, contrary to their expectations, that the Canadian and Chinese responses showed the greatest similarity among the three countries studied. Another study compared 26 US and 29 New Zealand high technology firms and found differences across the country samples in NPD practices and outcomes [19]. For example, New Zealand managers reported higher levels of NPD performance and greater use of customer-focused NPD practices. In a study of 788 Japanese and 612 American NPD projects Japanese firms were posited to do a better job of converting product differentiation advantages into product performance outcomes [17, p.11]. Extending from these studies, we develop a conceptual model of integration mechanisms and hypotheses linking them to overall NPD performance and differences across the two national datasets studied.

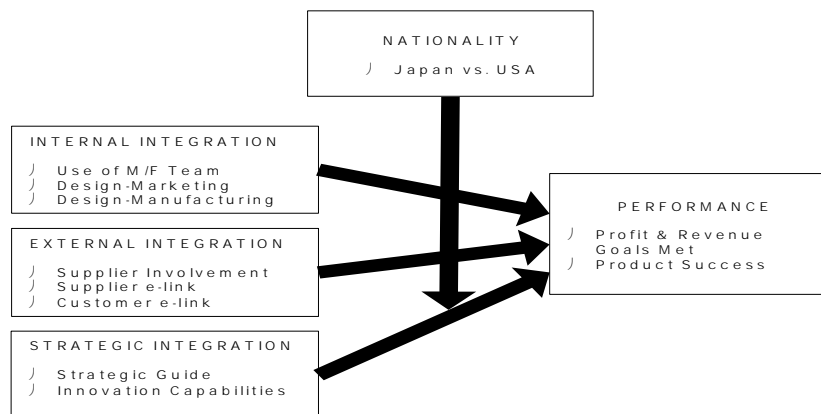
CONCEPTUAL MODEL AND RESEARCH HYPOTHESES

A vast amount of research into cross-cultural differences between individuals from different cultures suggests that attitudes and behavior within the context of national cultures can be delineated and compared. This literature is too vast to tackle in a 6 page paper, but suffice it to say that this is the impetus behind our hypotheses that the NPD practices of Japanese firms will differ from those of American firms.

We can calculate cultural distance as a measure of the distance between average values on attitudes and practices for the individuals within a specific culture. The recent GLOBE study shows Japanese and Americans differ most in the category of performance orientation and the categories of future orientation and assertiveness. The Japanese also differ from Americans in terms of the classic individualism versus collectivism attitudes. For example, Japanese managers tend to be collectivist compared to American managers [6].

We hypothesized that the various integration mechanisms we examined will differ across the Japanese and American dataset. This stemmed partly from a reading of the literature on national culture differences and partly from a preliminary analysis of our larger global dataset, which suggested the Japanese data emphasized process management and the American data emphasized strategic capabilities. This also seems to follow from the general NPD and Operations Management literature on practices in Japan. The model we examine in this paper is depicted in Figure 1. We examine three types of integration mechanisms: internal, external and strategic. Others have argued for a link between NPD practice and the five dimensions of national culture most identified in the literature (Confucian dynamic, individualism, masculinity, power distance and uncertainty avoidance) [9]. Still others suggest that the relative focus on the good of the group (Collectivism) is higher in Asian cultures than in Western cultures, which tend towards the good of the individual (Individualism) [12]. We argue that this focus may have an effect on the integration mechanisms used in NPD practices.

Figure 1: The Conceptual Model



Because of space limitations, we merely list the hypotheses we tested:

H1. Increased internal integration mechanisms will be associated with higher overall performance.

- H2. The Japanese firms will differ in their use of internal integration mechanisms. Specifically, they will use them to a greater extent than the American firms.
- H3. The Japanese firms' performance will be higher than the American firms' with regard to the use of internal integration mechanisms.
- H4. Increased external integration mechanisms will be associated with higher overall performance.
- H5. The Japanese firms will differ in their use of external integration mechanisms. Specifically, they will use them to a greater extent than the American firms.
- H6. The Japanese firms' performance will be higher than the American firms' with regard to the use of external integration mechanisms.
- H7. Increased strategic integration in the form of strategic guides will be associated with higher overall performance.
- H8. The Japanese firms will differ in their use of strategic integration mechanisms in the form of strategic guides. Specifically, they will use them to a greater extent than the American firms.
- H9. The Japanese firms' performance will be higher than the American firms' with regard to the use of strategic integration mechanisms in the form of strategic guides.
- H10. Increased strategic integration in the form of innovation capabilities will be associated with higher overall performance.
- H11. The American firms will differ in their use of strategic integration mechanisms in the form of innovation capabilities. Specifically, they will use them to a greater extent than the Japanese firms.
- H12. The American firms' performance will be higher than the Japanese firms' with regard to the use of strategic integration mechanisms in the form of innovation capabilities.

METHODOLOGY

Our global study of NPD practices gathered survey responses to questions regarding the procedures and performance measures of NPD programs at Machinery Manufacturing and Electrical Equipment firms. All firms were randomly selected from sampling frames of the corresponding populations identified using the B2B databases of the Japan Management Association for the Japanese companies and Dun & Bradstreet for the US companies. Some constraints were imposed *a priori* on the size of firms to select for small and medium enterprises. In accordance with the objectives of the research, the study considered the development program as the unit of analysis. The "development program" was defined as the set of new products developed and launched by a firm in the previous three years. This helps depict long-term relationships between the defined constructs of interest.

A preliminary research questionnaire was tested on some companies to ensure the correct formulation and understanding of the questions. The resulting questionnaire was submitted to the senior manager of the NPD department, accompanied by a letter detailing the purpose of the research, the structure of the questionnaire and the unit of analysis. Phone assistance was provided to ensure that the information gathered was both complete and correct. All firms identified in the database were included in the reference population if their development program had developed at least five new products to ensure consistency at the program level. One hundred and forty one (141) usable questionnaires were returned (79 from Japan and 62 from the USA). This corresponded to a mean response rate of 16.6% across the two country datasets. We also tested for non-response bias and found no statistically significant differences between early and late respondents [2].

RESULTS

Measures. The alphas for all constructs were acceptable [10] ranging from 70.3 to 82.3 and are depicted together with other descriptive information and the correlations between constructs in Table 1. The independent variable of interest was overall performance in NPD programs of the firm in the recent year relative to the past 3 years. We used a 3-item measure ($\alpha = 72.8$) to capture profit, revenue and overall product success. Internal integration mechanisms were measured with a 3-item construct ($\alpha = 71.9$) that captured the use of multi-functional teams as well as the integration of design with both marketing and manufacturing. The external integration construct ($\alpha = 70.3$) utilized 3 items that measured the

involvement of suppliers in the NPD as well as the use of electronic connections with either customers or suppliers in the NPD process. Such a connection demonstrates a solid commitment to collaboration with external partners. Two constructs were examined with regard to strategic integration. The use of strategic guides was captured by a 3-item measure ($\alpha = 82.3$). Innovation capabilities were measured by a 4-item construct ($\alpha = 81.8$) that captured the ability to meet customer needs and integrate the knowledge to provide these needs into the design and manufacturing of a new product. We also use items on culture (measuring the propensity towards innovation for the firm), company size (by number of employees) and the percentage of revenues that were from exports. The sampling design controlled for company size. However, the size of Japanese firms tended to be greater than the American firms statistically significant at 5% in our tests of difference in means.

Table 1: Basic statistics, reliability and correlation analysis

| | N | Mean | S.D. | Alpha | Correlations | | | | | | | |
|-------------------------|-----|------|-------|-------|---------------------|----------------------|----------------------|-----------------|-------------------------|----------|--------------|--------|
| | | | | | Overall Performance | Internal Integration | External Integration | Strategic Guide | Innovation Capabilities | Culture | Company Size | Export |
| Country (USA) | 141 | 0.44 | 0.498 | n.a. | 0.476*** | 0.373*** | 0.222** | 0.071 | 0.526*** | 0.439*** | -0.200* | 0.034 |
| Overall Performance | 141 | 3.09 | 0.671 | 72.8 | | 0.461*** | 0.281** | 0.334*** | 0.676*** | 0.563*** | -0.017 | 0.171 |
| Internal Integration | 140 | 3.56 | 0.856 | 71.9 | | | 0.483*** | 0.382*** | 0.561*** | 0.410*** | 0.021 | 0.125 |
| External Integration | 141 | 2.59 | 0.985 | 70.3 | | | | 0.404*** | 0.463*** | 0.251** | 0.175* | 0.140 |
| Strategic Guide | 141 | 3.85 | 0.980 | 82.3 | | | | | 0.503*** | 0.331*** | 0.097 | 0.145 |
| Innovation Capabilities | 141 | 3.37 | 0.742 | 81.8 | | | | | | 0.720*** | 0.018 | 0.173* |
| Culture | 140 | 3.49 | 1.082 | n.a. | | | | | | | -0.026 | 0.109 |
| Company Size | 141 | 2545 | 6006 | n.a. | | | | | | | | 0.013 |
| Export | 131 | 28.1 | 28 | n.a. | | | | | | | | |

*** Correlation is significant at the .0001 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Tests of hypotheses. Table 2 reports the results of t-tests of the means of each sub-sample. Company size for American firms was different from the Japanese firms at 5%. Export means were not significantly different. All of the constructs had significantly different means for the American versus the Japanese sub-sets except the use of strategic guides. In all cases, it appeared that the American firms rated higher on each of the scales. As a test of hypotheses 2, 5, 8 and 11, the results suggest that only hypothesis 11 is supported. Hypothesis 8 is not supported as the use of strategic guides was not different between the country subsets. Hypotheses 2 and 5 were also not supported but rather the opposite relationship was found. In both cases of internal and external integration, the American subset of firms in our study appeared to have higher propensity towards utilizing these mechanisms.

In order to test the other hypotheses we utilized multivariate regression analysis on the dependent variable of Overall Performance, the results of which are displayed in Table 3. We also tested the direct individual effects of each factor (not depicted here) using OLS. The control variables of company size and (innovation) culture as well as all 4 constructs of interest had a significant relationship with performance when each was examined alone. Nationality did not seem to have an influence (a regression using the variable was not significant even at 10% or less). This supported hypotheses 1, 4, 7 and 10 regarding the positive effects of each on overall performance. In order to test the strength of all of the factors together, both OLS and a hierarchical regression analysis using Bonferroni's method were utilized. We also tested for interaction effects across the nationality subsets. OLS regression tests are shown in Models 1, 2 and 3. All of the other factors were insignificant except innovation capabilities and the interaction of strategic guide and the USA subset. Only innovation capabilities had significant influence and remained in the hierarchical regression test. Innovation capabilities alone explained 45.3% of the variance in overall performance as seen in Model 4. Finally, Model 5 looked at the direct effects of innovation capabilities and its interaction with nationality subsets. The interaction effect was significant at 95% confidence but explained only an extra 1.4% of the relationship with overall performance. Thus, hypothesis 10 was largely supported and hypothesis 12 tentatively supported. However, hypotheses 3, 6 and 9 were rejected.

Table 2: Independent Sample T-tests of Means

| | USA = 1 JAPAN = 0 | N | Mean | Std. Deviation | Std. Error Mean |
|-----------------------------|----------------------|----|---------|----------------|-----------------|
| Overall Performance *** | 1 | 62 | 3.4516 | .64471 | .08188 |
| | 0 | 79 | 2.8101 | .54926 | .06180 |
| Internal Integration *** | 1 | 61 | 3.9290 | .86734 | .11105 |
| | 0 | 79 | 3.2869 | .73909 | .08315 |
| External Integration ** | 1 | 62 | 2.8441 | 1.05706 | .13425 |
| | 0 | 79 | 2.4051 | .88461 | .09953 |
| Strategic Guide | 1 | 62 | 3.930 | 1.1115 | .1412 |
| | 0 | 79 | 3.791 | .8658 | .0974 |
| Innovation Capabilities *** | 1 | 62 | 3.8145 | .66827 | .08487 |
| | 0 | 79 | 3.0299 | .60518 | .06809 |
| Culture *** | 1 | 61 | 4.03 | 1.032 | .132 |
| | 0 | 79 | 3.08 | .930 | .105 |
| Company Size * | 1 | 62 | 1194.71 | 4502.413 | 571.807 |
| | 0 | 79 | 3606.08 | 6805.706 | 765.702 |
| Export | 1 | 52 | 29.35 | 32.382 | 4.491 |
| | 0 | 79 | 27.41 | 25.069 | 2.820 |

* Significant at the .05 level
 ** Significant at the .01 level

*** Significant at the .001 level

DISCUSSION

Previous research has suggested that differences might exist between NPD practices in different countries based on national culture, particularly when viewed from the perspective of different phases of development [7] [9] [18] [20]. The analysis using data from the present study suggests that some statistically significant differences between the Japanese and American NPD integration mechanisms do exist, in particular, with regard to the propensity to utilize integration mechanisms across the board. These differences may indeed be associated with variance in overall NPD performance but the interactions of the different factors examined here are much more complex than anticipated. For example, the data also shows that the Japanese sub-sample suffered significantly in terms of performance with regard to the ability to satisfy customer needs and meeting revenue and profit goal expectations but it is difficult to clearly state that this was due to the use or non-use of integration mechanisms.

Table 3: Regression Analysis (Dependent Variable = Overall Performance)

| Predictor | MODEL 1 | MODEL 2 | MODEL 3 | MODEL 4 | MODEL 5 |
|-------------------------|----------|----------|--------------------|----------|----------|
| Control Variables | | | | | |
| Company Size (SIZE) | 0.014 | 0.010 | - | - | - |
| Country- USA (USA) | 0.104 | 0.024 | - | - | - |
| Culture | 0.141 | 0.164 | - | - | - |
| Export | 0.083 | 0.083 | - | - | - |
| Direct Effects | | | | | |
| Internal Integration | 0.069 | 0.052 | 0.110 | - | - |
| External Integration | -0.043 | -0.092 | -0.116 | - | - |
| Strategic Guide | 0.074 | -0.093 | -0.074 | - | - |
| Innovation Capabilities | 0.466*** | 0.591*** | 0.666*** | 0.676*** | 0.563*** |
| Interaction Effects | | | | | |
| INTxUSA | - | -0.002 | -0.075 | - | - |
| EXTxUSA | - | 0.106 | 0.108 | - | - |
| STRATxUSA | - | 0.765* | 0.596 [†] | - | - |
| INNOV_CAPxUSA | - | -0.804 | -0.495 | - | 0.174* |
| F-Ratio | 117.377 | 11.276 | 18.541 | 116.925 | 62.293 |
| Model p-value | p<0.0001 | p<0.0001 | p<0.0001 | p<0.0001 | p<0.0001 |
| R ² Adj | 0.480 | 0.491 | 0.502 | 0.453 | 0.467 |
| Δ R ² Adj. | - | 0.011 | - | - | 0.014 |

[†]Significant at the .10 level; * Significant at the .05 level; ** Significant at the .01 level; *** Significant at the .001 level; VIF (Variance Inflation Factor) below 1.0

Nevertheless, the findings confirm the importance of integration mechanisms and strategic orientations in general for NPD practices world-wide. Understanding how important these mechanisms are to NPD in general (regardless of national cultural differences) is necessary to provide managers with better ways of approaching the management of their NPD programs. The strong effect of innovation capabilities verifies the importance of developing these capabilities for all firms and the higher propensity in the American sub-sample suggests that Individualist countries may still excel in this area [13] [14].

However, given the contrary findings regarding hypotheses 2 and 5 [i.e. that the propensity towards using internal and external integration mechanisms was actually greater for the American subset of firms (which was contrary to our prediction)], the other findings that were opposite to our predictions in hypotheses 3 and 6 may make more sense. Of course, it might be expected that these relationships would be significant and positive for the American firms; but they were not. Thus, the overall impression is that the linkages among NPD integration mechanisms, national culture and overall performance are very complex. Indeed, previous conceptual work suggested that the effect of national culture may be contingent on the phase of development for any particular project [9]. As we focused at the program level in a cross-sectional manner, picking up on the subtleties of the project-level processes was not possible. This suggests that research into the complexities of the project-level process may benefit from closer scrutiny via more qualitative research designs.

Overall, the findings suggest that there are significant differences among national subsets with regard to the propensity to utilize certain integration mechanisms in NPD programs. Despite the positive association of these integration mechanisms with performance, however, the connection with overall performance differences across nations is more tenuous and further work is needed to look at the contextual subtleties of the relationships.

FUTURE RESEARCH DIRECTIONS

Due to the complexities of the relationships that we discovered, one recommendation for future research is to focus on a case-based design. Ideally, a matched pair experimental design case study would be the most telling regarding the actual complex interactions of integration mechanisms and NPD performance across national cultural boundaries. Of course, such a design is extremely costly both in terms of time and money to implement but the rewards in terms of understanding the causal relationships of these factors would be immense and the finding more conclusive.

Regardless of the specific research direction of future studies, it is quite clear that more work needs to be done examining the global similarities and differences in practices, processes and strategic aspects of innovation related business development. Furthermore, this work should also include a look at the inter-related practices, which could not be captured in our study, across countries [11]. For example, how development within a multinational firm crosses borders and becomes a truly global effort and the subsequent effects of that global NPD on performance of products in different countries.

CONCLUSION

This study provides an important step towards examining the existence of specific similarities and differences in integration mechanisms and strategic aspects of NPD between Japan and the USA. This is timely given the dearth of research and information on global similarities and differences of these aspects of NPD between countries, despite the large amount of research in the area of NPD success factors and the increasing globalization of businesses [16]. Given the global emphasis of business, a better understanding of all the practices, processes and strategic aspects of NPD across countries is important so that NPD managers can design and implement their NPD programs to be more efficient and effective across the global infrastructure.

The overall findings demonstrate that significant differences among national subsets do exist with regard to the propensity to utilize certain integration mechanisms that are linked to greater performance. However, any difference in the linkage between NPD integration mechanisms and overall NPD performance across different national subsets of NPD programs is more tenuous.

References available on request from William HA Johnson at wjohnson@bentley.edu