

Impacts of R&D-Marketing Interaction: Market Performance of New Products

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Abstract—New product development (NPD) involves a variety of interactive activities among departments of research and development (R&D), marketing, finance, manufacturing, and procurement. Studies of high-tech products have shown that the steady collaboration between R&D teams and marketing department members renders beneficial effects upon diverse departmental activities and downstream marketing performance for the product; that is, aligned with efficient and effective communication protocols, close collaboration has a positive impact on new product market performance with regards to financial gains and advanced market penetration. However, in previous research, the explicit communicative ways and decisive factors to perform successful collaboration between R&D activities and marketing department operations have not been seriously addressed. In this research, we first conducted a comprehensive survey with mainstream high-tech companies in Taiwan, then the definitive factors for the collaboration between R&D and marketing departments in high-tech companies were identified. Moreover, the hierarchical relationships and interactions between factors were built and their impacts on final responses obtained. The results show that the outstanding financial performance and market share gain are strongly reflected by well-defined communication procedures, information transparency, and selfless resource sharing within NPD-project team members and their cross-departmental cooperation.

Keywords—New product development (NPD), Market performance; R&D-Marketing collaboration

I. INTRODUCTION

NUMEROUS accounts in the academic and popular press suggest that companies which rapidly develop new products enjoy substantial competitive advantages and higher new product success rates [1]-[3]. This ability to develop new products quickly and successfully has become increasingly important in today's economy of rapid globalization, fierce competition, short product life cycles, and fast-changing technologies.

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Since the late 1980s, Taiwan's high-tech industries, including information technology, electronics and semiconductors, has been capitalizing on advanced manufacturing processes and efficiency to emerge as the growth engine of Taiwan's economy. However, as manufacturing capability matures in other countries, Taiwanese companies need to strengthen their capabilities in new product development (NPD) to stay competitive and penetrate new markets in a global economy.

Over the past few decades, a considerable number of studies have focused on either organizational integration and new product success or the proficiency of NPD process and new product success [4]. It seems to be lacking, however, that the thorough investigation of the relationship among the collaboration between R&D and marketing teams to the proficiency of technical and marketing activities of the NPD process, as well as the impact of these proficiencies on the new product success.

Therefore, by combining previous research involving NPD proficiency and organizational integration, this study identifies the important factors in the collaboration between R&D and marketing functions in the NPD process that significantly impact new product market performance based on the empirical NPD experiences of high-tech companies in Taiwan.

II. THE NPD PROCESS

A. Introduction of NPD Process

The NPD process is a series of activities going from idea generation to idea screening, concept development and testing, design, technical implementation, manufacturing, and commercialization [5]. It is generally divided into three stages. As Table 1 indicates, they are: pre-development stage, development and launch stage, and post-launch stage. The pre-development stage contains strategic planning, business and market opportunity analysis, and new product idea generation and evaluation. During the development stage, attention turns to product specification as product concepts are developed and prototypes are tested with potential customers, product specifications are released to manufacturing, and the sales force is trained for product commercialization. In the post launch stage, attention turns to market feedback and product enhancement [6].

Table 1: NPD Process Stages and Activities**1. Pre-development stage**

- (1) New product strategy development
- (2) Identification of new product idea sources
- (3) Methods for obtaining new product concepts from idea sources
- (4) Initial idea screening
- (5) Preliminary market assessment and idea testing
- (6) Preliminary design assessment
- (7) Preliminary manufacturability assessment
- (8) Concept generation/determination of “ideal” product
- (9) Detailed market study (concept testing)
- (10) Financial/business analysis

2. Development and launch stage

- (1) Prototypes and pilot models development
- (2) Detailed pricing, promotion, and distribution strategy development
- (3) In-house product testing
- (4) Customer product testing
- (5) Market testing/trial selling
- (6) Trial production
- (7) Pre-launch business analysis
- (8) Production start-up
- (9) Market launch

3. Post-launch stage

- (1) New product market strategy implementation
- (2) Customer satisfaction tracking
- (3) Monitoring of product reinvention suggestions/changes
- (4) Observation of product usage/key to redesign
- (5) Tracking of product maintenance/key to redesign

Sources: Millson and Wilemon [4], Cooper and Kleinschmidt [7], von Hippel [8], McQuarrie and McIntyre [9], Crawford [10].

B. The Proficiency of NPD Process and Market Success

As various literatures point out, NPD proficiency, defined as how well NPD activities, stages, and the NPD process as a whole are performed, is important to new product market success. There are significant correlations between overall NPD proficiency and measures of new product success, which are: 1. profits, 2. sales revenues, 3. entering existing markets, and, 4. creating new markets [4]. From the study of the electrical manufacturing industry of US firms, it is confirmed that the proficiency level, performed at various stages of the NPD process, significantly affected the relationship with new product market success [11].

Generally, the activities of the NPD process are classified into two major groups such as the technologically-related activities performed by R&D team members and the customer/market-oriented activities performed by marketing team members. The proficiency of technological activities leads to greater efficiency in NPD and provides companies with superior technological solutions and features, increasing competitiveness and success in NPD activities [12]-[15]. The proficiency of customer/market-oriented activities enables a

company to design and develop products that better match the needs of its customers and markets. Moreover, the combination of technical and marketing capabilities for NPD ensures that firms satisfy customer needs and enjoy market success [12]-[17].

Since the tasks and activities of the NPD process are highly dependent on timely and accurately executed joint efforts of NPD project members, there is a strong relationship between new product success and the collaboration of the members [4]-[11]. However, because the R&D and marketing members come from different functions and departments, it is quite a challenge to achieve clear and effective communication among the members due to their distinct personality, culture, language, position, and physical barriers [18]. Furthermore, as firms grow, each function becomes specialized, thus making cross-functional collaboration even more challenging. Especially in high-tech industries where technology and market conditions change rapidly, the collaboration and communication between the R&D and marketing functions decrease, the ability to combine skills for developing successful products weaken accordingly.

III. THE COLLABORATION BETWEEN R&D AND MARKETING

Over the past few decades, a considerable number of studies have focused on either organizational integration and new product success or NPD proficiency and new product success [4]. What seems to be lacking, however, is the relationship among the collaboration between R&D and marketing teams to the proficiency of technical and marketing activities of the NPD process, and its impact on new product success.

The broader definition of collaboration is “. . . an affective, volitional, mutual/shared process where two or more departments work together, have mutual understanding, have a common vision, share resources, and achieve collective goals.” [19][20]. Cross-functional collaboration refers to the degree of cooperation, the extent of representation, and the contribution of marketing, R&D, and other functional units to the product innovation process [20]-[24].

Cross-functional collaboration can occur at either the project team level or the organizational functions level. Regardless of level, collaboration has been studied in terms of cross-functional communication or interaction frequency, amount and type of information shared, mutually agreed-upon approaches, goal congruence, trust and relationships, physical processes in place, levels of conflict resolution, coordination and so forth [25].

In the NPD context, cross-functional collaboration is “the magnitude of interaction and communication, the level of information sharing, the degree of coordination, and the extent of joint involvement across functions in specific NPD tasks.” [26]. It has long been recognized that NPD represents a team effort which requires the involvement of, and communication among, various functional groups such as R&D, marketing, manufacturing and finance within a firm [27][28].

Increasing both communication frequency and the amount of information flow in the organization can have significant advantages for the development of new products [25]. In particular, R&D and marketing interaction has been viewed as one of the most critical interfaces for new product success [28][29], because the close collaboration between technical and marketing functions not only increases information sharing and transferring [30], but also facilitates learning and concurrent problem-solving ability [31]. It promotes teamwork and improves the proficiency of NPD activities by reducing NPD uncertainties [32][33]. In recent study also shows that the combination of marketing and technical capabilities ensures the newly developed product is able to satisfy customer needs [24].

A. The Barriers of the Collaboration between R&D and Marketing

In general, previous investigations of R&D and marketing collaboration have progressed with two different perspectives: information processing and resource dependence. The information processing perspective suggests that NPD represents a team effort which involves information transfer and

process between R&D and marketing. The resource-dependence view is that R&D and marketing are seldom internally self-sufficient with respect to the critical resources required to perform their roles effectively [29][34].

In addition to information transfer and resource dependence, the R&D and marketing collaboration process is comprised of influence and conflict [14]. That is, the more Group-A depends on Group-B's resources, the higher the influence Group-B has over Group-A. Moreover, because of the struggle for resources, conflict is an inherent part of intergroup relationships. Thus influence and conflict are the norm of R&D and marketing collaboration in the NPD process [29][35].

For the high-tech company, due to the general outcome of personality, cultural, language, organizational, and physical barriers between R&D and marketing means that communication and cooperation are difficult to achieve [18]. Studies in Germany and UK had identified that conflict between engineers and marketers can act as a barrier to effective collaboration [34][36]. Similar cases can also be found in Japan and the United States [37].

B. How to overcome the barriers of collaboration

It is suggested that in order to overcome the barrier of collaboration between engineers and marketers, developing formal but lightly structured bureaucracy in the NPD team is essential. The organization should cultivate a culture and climate to encourage team members share and support the common goals to reduce the differences between expectations, goals and priorities of activities [38][39].

To promote teamwork, jointed seminars are useful to learn more about each other's workflows and progress. As Shaw and Shaw [36] pointed out, marketing training for engineers is clearly beneficial to the interface of engineering and marketing. Furthermore, marketers also need to improve their knowledge of engineering issues so that both sides have a better appreciation of each other's jobs.

For the high-tech industry with high uncertainty and short product life cycle, Yang [40] empirically studied Taiwanese high-tech firms, finding that an adequate and executable communication mechanism can effectively reduce and resolve the conflict among team members. To hold project meetings regularly, to encourage face-to-face conversation and discussion, to use good communication tools, such as teleconferencing, on-line messaging systems, or groupware, etc., in order to promote and increase the collaboration between the R&D and marketing teams [40]. Ernst and Teichert [38] also pointed out that more face-to-face interaction is a better way to improve communication and share information between teams.

IV. RESEARCH DESIGN

Summarizing the previous studies, there is general agreement that the collaboration between R&D and marketing has an effect on the proficiency of the technical process and marketing

process during NPD. The proficiency of these processes in turn has an impact on new product market performance which is measured by financial results, namely, profitability and sales revenues; and new market opportunities created, namely, new product lines and/or new market segments penetrated.

Based on the relationships mentioned above, the conceptual

model of this study is developed as shown in Fig. 1. There are three constructs: construct *A* is the collaboration between R&D and marketing during the NPD project, construct *B* is the proficiency of technical process and marketing process, and construct *C* is new product market performance.

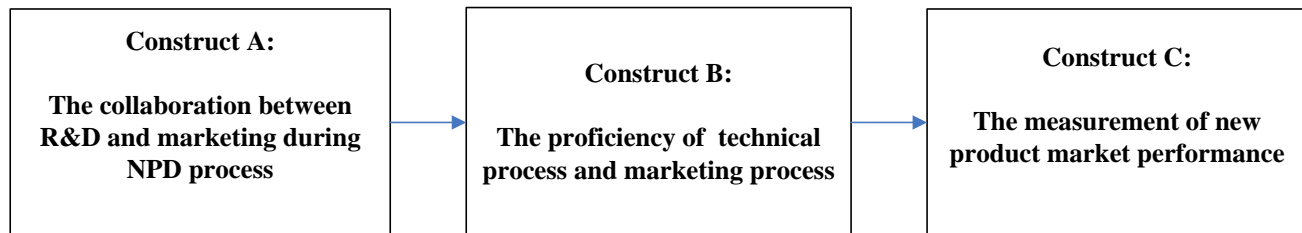


Fig. 1. The Conceptual Model of this Study

To empirically confirm the conceptual model, this study investigates the following 10 hypotheses.

First, we intend to investigate how communication procedure is related to the collaboration between R&D and marketing during NPD. Previous research indicates that influence and conflict are the norm between R&D and marketing in the NPD process that a well-established communication procedure and useful communication tools are ways to improve information processes, and the sharing of resources to eliminate and resolve the conflicts between R&D and marketing teams. So that we have,

H1a: *communication procedure has positive influence on communication effect.*

Communication procedure includes the formalization, amount, and frequency of communication. The communication effect is the result achieved through the communication procedure, such as to eliminate or resolve conflicts, and to avoid improper or biased influence.

H1b: *communication procedure has positive influence on resource sharing.*

Resource sharing includes information process and sharing, inter-departmental support of manpower, budget, facilities and other resources.

The *second* category of hypotheses is sought to determine how the degree of the collaboration between R&D and marketing is related to the proficiency of technical and marketing processes. As mentioned earlier, the NPD process is divided into technical process and marketing process. The technical process is the technologically-related activities performed by the R&D team. The marketing-related process is the customer/market oriented activities performed by the marketing team of the NPD project. It is noticed that the integration and collaboration of R&D and marketing have a positive impact on NPD process. In this study, we further investigate how the collaboration between R&D and marketing teams affects the

proficiency of the technical process and marketing process respectively. There are four hypotheses:

H2a: *communication effect has positive influence on the proficiency of marketing process.*

H2b: *communication effect has positive influence on the proficiency of technical process.*

H2c: *resource sharing has positive influence on the proficiency of marketing process.*

H2d: *resource sharing has positive influence on the proficiency of technical process.*

The *last* question of this study is to investigate the relationship of the proficiency of the NPD processes and new product performance. There is no doubt about the proficiency of NPD the process being a significant contributing factor to new product market success, though in order to study how the proficiency of the R&D process and the proficiency of marketing process impact new product financial results (profits and sales) and new opportunity created (gain market share in existing markets or open new markets) respectively, there are four hypotheses:

H3a: *the proficiency of marketing process has positive influence on financial results.*

H3b: *the proficiency of marketing process has positive influence on new opportunity created.*

H3c: *the proficiency of technical process has positive influence on financial results.*

H3d: *the proficiency of technical process has positive influence on new opportunity created.*

V. DATA COLLECTION AND ANALYSIS

Based upon the research model and hypotheses, a survey questionnaire was developed from the previous studies with minor adaptations to reflect the context of this study. Besides

the profile of NPD projects and respondents, the contents of this questionnaire are composed of three categories in corresponding to the constructs of this study, as indicated in Table 2: **A.** The collaboration between R&D and marketing was measured by 26 items to reflect the effect of communication procedure to the resource sharing and communication effect; **B.**

The proficiency of the NPD process was measured by 21 items to reflect the resource sharing and communication effect to the proficiency of NPD process; **C.** New product marketing performance was measured by 13 items tapping the extent to which the new product achieved its financial results and new opportunity created.

Table 2. The Constructs and Sources of Survey Questionnaire

Constructs	Items	Sources from literature (*note)
<i>A. The collaboration between R&D and marketing during the NPD project</i>		
1. Resource sharing	5	RW/Wang
2. Communication procedure	9	RW/Wang
3. Influence and conflict resolution	8	RW
4. Interaction	4	RW/Wang
<i>B. The proficiency of technical process and marketing process</i>		
1. Pre-development stage	10	ET/MW/UE/Wang
2. Development and launch stage	5	MW/UE/Wang
3. Post-launch stage	4	MW
4. Overall	2	ET
<i>C. Measurement of new product market performance</i>		
1. Financial results	6	Wang/RR
2. New opportunity created	3	Wang/RR
3. Overall and others	4	Wang/RR

*Note: ET:Ernst and Teichert [38], MW:Millson and Wilemon [4], RR:Rochford and Rudelius [41].

The questionnaire was sent to mainstream high-tech manufacturers in information technology, electronics, and semi-conductors in Taiwan. Multiple respondents were sought within each firm to provide insight from R&D, marketing, and various management levels. In addition, personal interviews were conducted for a number of respondents to collect qualitative input and comments as to the practice and experience in NPD within their firms as well as any successes or

failures they could share in the NPD process.

A total of 61 valid questionnaires were received. Respondents included engineers, specialists, project managers, managers and high level management from R&D, marketing and other functions who participated in NPD projects. The job functions and positions of the respondents were summarized as Table 3.

Table 3. The Job Functions and Positions of the Respondents

Job Functions	Total Respondents	% of Respondents	Positions	Number of Respondents
Marketing	7	11.48	Engineers/Specialists	3
			Project managers or managers	2
			High level managers	2
R&D	40	65.57	Engineers/specialists	17
			Project managers or managers	20
			High level managers	3
Supervision and Decision Maker	14	22.95	Project managers or managers	4
			High level managers	10
TOTAL	61	100.00		61

The collected data was validated for reliability. The causal model of factors was then analyzed using AMOS graphics module of SPSS. The result is shown in Fig. 2.

Six out of ten hypotheses show a statistically significant relationship between factors and are listed below in the

descending order of level of significance:

H1a: communication procedure has positive influence on communication effect;

H1b: communication procedure has positive influence on resource sharing;

- H2b:** communication effect has positive influence on the
H2c: resource sharing has positive influence on the proficiency of marketing process;
H3d: the proficiency of technical process has positive influence on new opportunity created;
H3c: the proficiency of technical process has positive influence on financial result.

The other four hypotheses are not significant statistically:

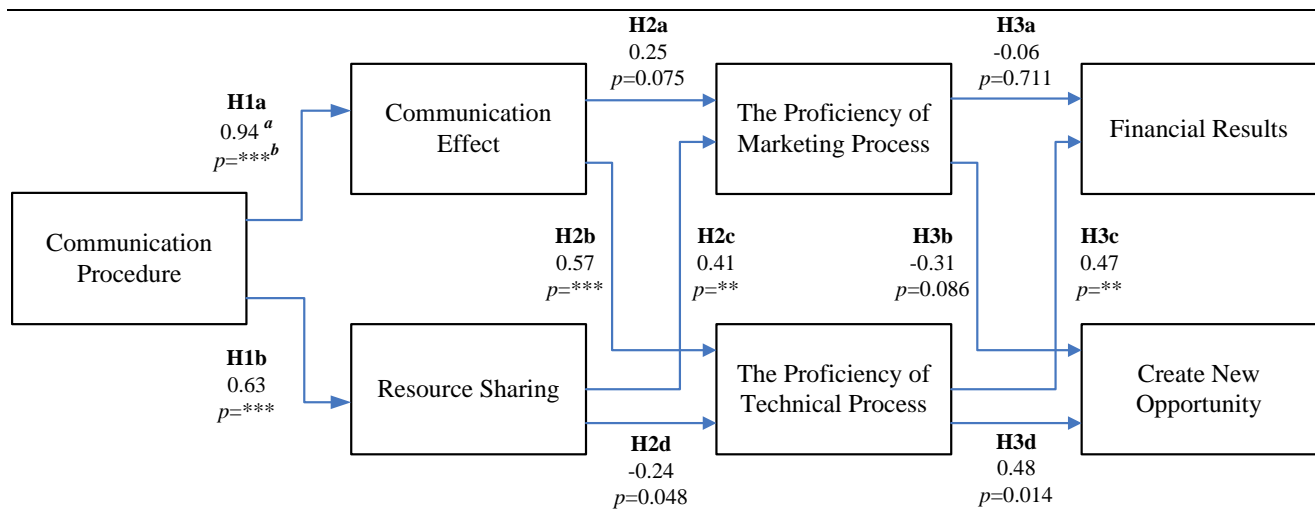
H2a: communication effect has positive influence on the

proficiency of technical process;

proficiency of marketing process;

H2d: resource sharing has positive influence on the proficiency of technical process;

H3a and H3b: the proficiency of marketing process has positive impact on financial result and creation of new opportunity.



a: the standardized estimates b: p-value, *** stands for $p < 0.001$; ** stands for $p < 0.01$

Fig. 2. The Causal Relationships for Factors and Responses

VI. DISCUSSIONS OF FINDINGS

Based on the result of data analysis and the follow-up interviews with various respondents, this study has demonstrated that several factors contribute to the market performance of NPD.

In this section, we discuss the details of our findings and offer NPD managers and scholars several suggestions for improving the practice and understanding of the collaboration between R&D and marketing in the NPD process.

The significant factors include:

- 1) *The communication procedure is the most significant factor.* It impacts information/resource sharing and the communication effect. The communication effect reflects the inter-departmental influence and the eliminating, mitigating and managing conflict between R&D and marketing teams. It suggests that formal communication mechanisms should be established as early as the NPD project is being formed; the operating guidelines, procedures, and channels for communication should also be well-documented and executed with minimal exceptions in the NPD process.

The executives from the responding firms who provided

their hand-on experience suggested that: As one of the formal communication tools, project meetings with predefined agendas must be held regularly to systematically review the project status. In project meetings, project team members exchange information and resolve issues which are brought to the table. Impromptu minutes-meetings held for small groups or few committee members are encouraged, any conclusions during the meetings should be recorded and distributed in a timely manner.

- 2) *The communication effect has a significant impact on the proficiency of technical process.* The result shows that the conflict between R&D and marketing and the influence from the marketing team affect the R&D team's performance. Due to inherent heterogeneities of R&D and marketing in the NPD project, their disputes and conflicts are not uncommon. It is suggested that top-level managers should regularly hold review meetings for open communication so as to prevent disagreements and arguments from being hidden or escalated.
- 3) *The resource sharing has a positive influence on the proficiency of marketing process.* It shows that during NPD, either by request or as planned, the R&D team supports manpower, office and other resources to fulfill marketing processes and activities. It is good for the

collaboration between R&D and marketing because, by supporting marketing activities, the R&D team can get first-hand information from customer or end user which is helpful for product development. However, this is also a source of conflict between the two teams, since too much support from the R&D team for marketing activities often becomes a burden for the R&D team which will negatively impact the progress and result of product development. This is the reason why the hypothesis H2d-resource sharing has a positive influence on the proficiency of technical process shows a negative correlation.

To avoid the marketing team using the R&D team's resources excessively; it is advisable to set up a formal process for requesting support. Top management or high-level managers review the support requests periodically to find inappropriate resource usage and to eliminate potential conflicts between R&D and marketing. It is also suggested that during project planning stage that the R&D team add slack time into project schedule for providing support to marketing activities. Another useful way to reduce the negative impact of resource sharing is to hold the joint seminars regularly to acquire more information and knowledge about the other teams' workflows.

- 4) *The proficiency of technical processes has a significant impact on both financial results and new opportunities created by new products.* It is advisable that, over the NPD project period, the R&D managers should regularly monitor and evaluate the progress of design, manufacturing, and engineering activities, and make necessary adjustments if there is any deviation from the original plan. In addition, a NPD steering committee has to be chaired by top-level or senior managers to make sure that the product development plan and the project management are executed accordingly.

In addition to the above factors, it is worthwhile to note that, in this study, we found that *the impact of proficiency of the marketing process on new product market performance is not significant.* This result seems not to conform to our common knowledge. To further explore this result, we discussed with high level managers of several corresponding companies. We first discovered the result does not mean that the proficiency of the marketing process is not important, rather that there is no guarantee that new products will be successful even if marketing tasks are well executed; Secondly, prior to the product development, the corporate product strategy played an important role. In this sense, the corporate executives need to envision the market trends, plan for the future products and services, and then organize the company resources for developing the right products.

To further investigate whether the proficiency of marketing process is not correlated to new product market performance, we reviewed the profiles of the respondents' companies and the

categories of products. We found that the conclusion corresponds to the current situation of Taiwanese high-tech industries. It is widely known that most Taiwanese high-tech firms have good manufacturing processes, but the products they develop are generally considered to be derivative versions of products developed by leading global manufacturers, rather than products that can create a new market, market their own international brand, or become a market leader in a competition industry. In this regard, the marketing function only plays a supporting, rather than an active role.

VII. CONCLUSION

The empirical study of the collaboration between R&D and marketing during the NPD process of Taiwanese high-tech firms confirmed that the communication procedure is the key element for successful collaboration between R&D and marketing teams. We found that the communication effect has a positive impact on the proficiency of technical process, but is less significant to the proficiency of marketing process. Resource sharing revealed the opposite. It has a positive impact on the proficiency of marketing process, but a negative impact on the proficiency of technical process. Finally, the study showed that the proficiency of technical process has a significant influence on financial results and new opportunities created by new products. However, the proficiency of marketing process does not significantly impact the market performance of new products.

The valuable finding for Taiwanese high-tech firms is the proficiency of marketing process is a *hygiene* factor rather than a *motivator*. This is to say that, during the NPD process, if the marketing activities are performed poorly, then the new product performance will be poor. However, even if performed as well as planned, there is still no guarantee that the new product performance will be excellent.

In this empirical study, there were 61 questionnaire responses received. Compared to the results of data analysis, it unveiled the current situation of Taiwanese high-tech firms, which are engaged in developing derivative products or enhancing existing products while lacking the innovation to create new product markets.

It is widely known that Taiwanese high-tech firms have well-developed manufacturing processes, but seldom become high-profile international brands. To maintain competitiveness in high-tech industries worldwide, it is essential to nurture the capabilities for developing and marketing cutting-edge products in international markets. This is an important and interesting topic to be further discussed and explored seriously.

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