

## **Study on DFSS Activities in Taiwan High-tech Factories**

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### **Abstract**

This study takes science park manufacturers as the empirical research object, and the questionnaires are distributed to the supervisors responsible for new product development activities. 79 valid samples were recovered. The research results show that the higher the implementation level of DFSS activities, the more significant the positive impact on new product development performance. Adopting differentiation strategies (marketing differentiation, innovation differentiation) and goal-oriented, stable, conservative, considerate, supportive, innovative, and adaptive leadership styles will help implement DFSS activities. The higher the degree of rational culture, hierarchical culture, group culture, development culture, and market orientation, the more significant the positive impact on implementing DFSS activities. High-tech manufacturers can implement DFSS activities to adopt differentiation strategies and leadership styles such as goal-oriented, steady and conservative, compassionate and supportive, and innovative and adaptable, and enhance market orientation and rational culture, hierarchical culture, group culture, and developmental culture to improve new product development performance.

**JEL classification numbers:** M10.

**Keywords:** Design for Six Sigma, market orientation, New product development performance.

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## 1. Introduction

Taiwan's high-tech industry is the backbone of Taiwan's economy. According to Taiwan's Ministry of Finance's import and export commodity structure classification standards, industries with high product-added value, complex technology, and a high ratio of technical manpower and R&D investment are classified as high-tech industries. With the advancement of science and technology, shortening the product development process is particularly important. Design for Six Sigma (DFSS) activities solve problems during the new product development stage. This will reduce product time to market and improve product quality during the development and manufacturing stages. Under the pressure of a highly competitive environment, how can high-tech industries choose appropriate business strategies, leadership styles, and organizational cultures and incorporate market-oriented concepts into DFSS activities to provide customers with better product quality and enhance new product development performance has become the focus of many high-tech manufacturers. Current empirical research on the implementation of DFSS activities focuses on exploring the steps, connotations, and timing of implementation of DFSS activities (Banuelas & Antony, 2004; Brue & Launsby, 2003; Harry & Schroeder, 2006; Mader, 2003), as well as related issues such as the application of DFSS activities in industry and the benefits generated (Sithole et al., 2021; Nicolaescu et al., 2014; Hassan et al., 2019; Jenab et al., 2018). However, given the current situation of the implementation of DFSS activities in high-tech industries, the impact of business strategy, leadership style, organizational culture, and market orientation on the degree of implementation of DFSS activities and the impact of the degree of implementation of DFSS activities on new product development performance. Integrated empirical studies of impact are rarely mentioned; Therefore, this study takes high-tech manufacturers as the research object to explore the correlation between business strategy, leadership style, organizational culture, market orientation, DFSS activities, and new product development performance. The purpose of this study is (1) to explore the impact of business strategy on the implementation of DFSS activities, (2) to explore the impact of leadership style on the implementation of DFSS activities, (3) to explore the impact of organizational culture on the implementation of DFSS activities (4) Explore the impact of market orientation on the implementation level of DFSS activities; (5) Explore the impact of the implementation level of DFSS activities on new product development performance; (6) According to the results of this study, providing advice to high-tech manufacturers on implementing DFSS activities and improving new product development performance.

## 2. Literature Review

### 2.1 Business strategy and DFSS activities

Croteau & Bergeron (2001) define business strategy as an organization's actions to achieve its goals. Porter (1980) believes companies can adopt cost leadership, differentiation, and concentration strategies to obtain or maintain competitive

advantages. Miles & Snow (1978) classified business strategies into explorer, defender, analyzer, and responder, based on the company's response to environmental changes. Durand & Coeurderoy (2001) divide business strategies into cost leadership strategies: marketing differentiation strategies and innovation differentiation strategies. This study uses the three strategies proposed by Durand & Coeurderoy (2001): cost leadership strategy, marketing differentiation strategy, and innovation differentiation strategy as the classification of high-tech manufacturers' business strategies. Jenab et al. (2018) emphasized that companies must adopt suitable business strategies to implement DFSS activities effectively. Gijo et al. (2021) argue that organizational strategy significantly influences the effectiveness of DFSS implementation. Chowdhury (2005) noted that promoting DFSS activities necessitates selecting appropriate strategies to develop robustly designed products and services. Blakeslee (1999) asserts that to ensure the successful execution of DFSS activities, suitable strategies must be employed. Based on a literature review, this study proposes the research hypothesis H1: Different business strategies have significantly different impacts on the degree of implementation of DFSS activities.

## **2.2 Leadership style and DFSS activities**

Robbins (2005) believes that leadership is the ability to influence a group to achieve its goals. Quinn (1988) proposed to divide leadership styles into four categories: goal-oriented, steady and conservative, considerate and supportive, and innovative and adaptive. Bass & Avolio (1990) divided leadership styles into transactional leadership and transformational leadership. Hersey & Blanchard (1988) divided leadership styles into four types: informing, promoting, participative, and empowering. The leadership structure proposed by Quinn (1988) is based on the new leadership theory and is more in line with the needs of leadership behavior in the high-tech industry. This study uses the leadership style proposed by Quinn (1988) to classify leadership styles. Patil et al. (2013) pointed out that different leadership styles will affect the implementation of DFSS activities. Srimathi&Narashiman (2021), Laureani&Antony (2016), and Brue & Launsby (2003) pointed out that leadership style affects the execution of DFSS activities. Chowdhury (2005) believes that changes must be made to implement DFSS activities, and managers' leadership style will affect the implementation effectiveness of DFSS activities. Through literature review, this study proposes hypothesis H2: Different leadership styles have significantly different effects on the degree of implementation of DFSS activities.

## **2.3 Organizational Culture and DFSS Activities**

Cristiano & Wazlawick (2008) pointed out organizational culture is the values, beliefs, and norms that organizational members uphold and share. Robbins (2001) believes that organizational culture is a set of essential traits that organizational members value. This trait includes the degree of innovation and risk-taking, the

degree of precision required, the degree of focus on results, the degree of emphasis on employee feelings, the degree of emphasis on teamwork, and the degree of demanding employees. When these characteristics are paired, the degree of positivity and emphasis on stability becomes the organizational culture. Wallach (1983) distinguished organizational culture into bureaucratic, innovative, and supportive cultures. Quinn (1988) proposed four cultural types: rational culture, hierarchical culture, group culture, and developmental culture. Since the types of organizational culture proposed by Quinn (1988) align with the needs of high-tech industries, this study uses the four types of culture proposed by Quinn (1988) as the classification of organizational culture. Silva et al. (2019) pointed out that different organizational cultures have significantly different impacts on implementing Six Sigma activities. Brue & Launsby (2003) pointed out that organizational culture will affect the implementation of DFSS activities. Zu et al. (2006) and Maroofi et al. (2012) believe that organizational cultures are different and impact Six Sigma activities differently. Banuelas & Antony (2002) believe that organizational culture is an important factor affecting the success of Six Sigma projects. After discussing the literature, this study proposes research hypothesis H3: Different organizational cultures have significantly different impacts on the degree of implementation of DFSS activities.

#### **2.4 Market Orientation and DFSS Activities**

Narver & Slater (1990) divided market orientation into three aspects, including (1) customer orientation, fully understanding the needs of customers in the target market and predicting changes in customer needs under market changes; (2) competitor orientation for Analyze current and potential competitors to develop your company's response strategies further; (3) Cross-department coordination: Enterprises coordinate and integrate company resources to create superior value for customers. As defined by Kohli & Jaworski (1990), market orientation includes collecting, delivering, and responding to market intelligence. Narver & Slater (1990) prefer to view market orientation from a cultural level, while Kohli & Jaworski (1990) explore market orientation from a behavioral level. Hurley & Hult (1998) believe that although market orientation can be discussed at many different levels, looking at it from the cultural level is most meaningful. Based on the aspects proposed by Narver & Slater (1990), this study classifies market orientation into three aspects: customer orientation, competitor orientation, and cross-department coordination. Gijo et al. (2021) believe that listening to customers' needs when designing products is an important key factor in the success of DFSS. Tyagi et al. (2017) noted that customer satisfaction affects implementing Six Sigma activities. Eng (2011) argued that market orientation facilitates the execution of Six Sigma activities. Patil et al. (2013) pointed out that DFSS activities focus on collecting and transforming market customer needs, which helps to improve product quality and enhance customer satisfaction. Pande et al. (2006) pointed out that paying attention to collecting and analyzing customer data and confirming market needs will help

DFSS activities. Brue & Launsby (2003) believe that understanding the customer needs of the market is the key to successful DFSS. Based on the discussion of the above literature, this study proposes research hypothesis H4: The higher the degree of market orientation, the higher the degree of market orientation will significantly impact implementing DFSS activities.

## **2.5 Design for Six Sigma (DFSS) activities**

Patil et al. (2013) stated that DFSS is a systematic approach that uses tools, training, and measurement methods to design products and processes that meet customer expectations at Six Sigma quality levels. Banuelas & Antony (2004) pointed out that DFSS is a management philosophy of continuous quality improvement, using tools to reduce process variability and achieve Six Sigma quality. Brue & Launsby (2003) divided the steps of introducing DFSS activities into five stages: the planning stage, the clarification stage, the design stage, the optimization stage, and the verification stage. The activities in the planning phase include selecting a high-profile development project and establishing a project charter; the activities in the clarification phase include defining customers, clarifying and understanding customer needs, clarifying key quality elements, technical requirements, and performance goals, and shifting the focus from key quality Elements are transferred to key process indicators; activities in the design phase include establishing target values and tolerances, evaluating process performance, performing gap analysis and assessment, responding to and managing risks; activities in the optimization phase include clarifying possible failures and developing Develop a robust design; activities in the verification phase include verifying the effectiveness of the product or service and its processes, implementing statistical process control and executing the control plan. Chowdhury (2005) pointed out that the five major stages of six-criteria design activities are identifying improvement opportunities, defining conditions, developing concepts, optimal design, and verification activities. This study uses the five stages and eleven activities proposed by Chowdhury (2005) as the execution items of DFSS activities.

## **2.6 DFSS activities and new product development performance**

In the study of Song & Parry (1997), four indicators were used to measure the relative success level of new product development by manufacturers: (1) comparing the quality of new products with competitors; (2) comparing the sales of new products with competitors; (3) compare the profit margin of its new products with competitors; (4) compare the success rate of new product launches with expected profit targets. Calantone et al. (1995) used return on investment and its growth rate, sales growth rate, market share, and growth rate as new product development performance measures. Dwyer & Mellor (1991) used four indicators to measure the success of new product development. The four indicators are: (1) overall success/failure rating; (2) profit level; (3) sales target; (4) The opportunities that new products can bring to the company's future. Based on the discussion of relevant

literature and considering the operating characteristics of high-tech industries, this study uses 5 indicators as aspects of new product development performance, namely: (1) time to market compared with peers; (2) The quality level of new products compared to the industry; (3) The market share of new products compared to the industry; (4) The successful launch rate of new products compared to the industry; (5) The cost of developing and launching new products compared to the industry. Sithole et al. (2021) stated that DFSS uses an organized approach to designing new products, using statistical tools to reduce product shortcomings. Jenab et al. (2018) believe that using DFSS activities can improve the design and development processes of new products and improve new product development performance. Patil et al. (2013) pointed out that standard deviation design can help improve new product development performance. Aggogeri et al. (2009) pointed out that implementing DFSS activities can improve product development performance and customer satisfaction. Based on the discussion of relevant literature, this study proposes research hypothesis H5: The higher degree of implementation of DFSS activities will significantly impact new product development performance.

### **3. Methodology**

This study explores the correlation between business strategy, leadership style, organizational culture, market orientation, the degree of implementation of DFSS activities, and new product development performance. Based on the discussion of relevant literature, the research hypotheses established in this study are as follows:

H1: Different business strategies have significantly different impacts on the degree of implementation of DFSS activities.

H2: Different leadership styles have significantly different effects on the degree of implementation of DFSS activities.

H3: Different organizational cultures have significantly different impacts on the degree of implementation of DFSS activities.

H4: The higher the degree of market orientation, the higher the degree of market orientation will significantly impact implementing DFSS activities.

H5: The higher degree of implementation of DFSS activities will significantly impact new product development performance.

#### **3.1 Questionnaire collection and data analysis**

This research questionnaire is divided into seven parts. The first part is the manufacturer's scale: the manufacturer's scale is divided into large-scale manufacturers and small and medium-sized manufacturers according to the number of employees; the second to seventh parts are measured on a Likert five-point scale.

The second part, business strategy, mainly includes three aspects: (1) cost leadership strategy, (2) marketing differentiation strategy, and (3) innovation differentiation strategy. Part Three: Leadership Style, which mainly includes four leadership styles: (1) goal-oriented style; (2) steady and conservative style; (3) compassionate and supportive style; and (4) innovative and adaptable style. Part 4: Organizational culture, which mainly includes four types: (1) rational culture, (2) hierarchical culture, (3) group culture, and (4) developmental culture. Part Five: The degree of market orientation, which mainly includes three aspects: (1) customer orientation, (2) competitor orientation, and (3) cross-department coordination. Part 6: The implementation level of DFSS activities, mainly including (1) activities to identify improvement opportunities; (2) activities to define conditions; (3) activities to develop concepts; (4) activities to optimize design; (5) Verification activities and other five aspects. Part 7: Part 7: New product development performance, including five measurement indicators: (1) new product launch time; (2) new product quality level; (3) new product market share; (4) new product success rate of launch; (5) cost of new product development and launch. This study uses 880 high-tech manufacturers in Taiwan's three major science parks as the empirical research subjects. It collected relevant data by mailing questionnaires to supervisors responsible for new product development activities from November to December 2023 and recovered 79 valid samples. The reliability values of each variable in this study are shown in Table 1. Nunnally (1978) mentioned that a Cronbach's coefficient higher than 0.7 is acceptable in exploratory research. The reliability of all variables in this study is above 0.7, so it is reliable.

**Table 1: The Cronbach's coefficients for all variables in this study**

| Questionnaire Dimension             | Cronbach's $\alpha$           |       |
|-------------------------------------|-------------------------------|-------|
| Business strategy                   | Cost leadership               | 0.832 |
|                                     | Marketing differentiation     | 0.794 |
|                                     | Innovation differentiation    | 0.819 |
| Leadership style                    | Goal-oriented                 | 0.846 |
|                                     | Steady and conservative       | 0.805 |
|                                     | Compassionate and supportive  | 0.869 |
|                                     | Innovative and adaptable      | 0.858 |
| Organizational culture              | Rational culture              | 0.827 |
|                                     | Hierarchical culture          | 0.815 |
|                                     | Group culture                 | 0.849 |
|                                     | Developmental culture         | 0.817 |
| Market orientation                  | Customer orientation          | 0.837 |
|                                     | Competitor orientation        | 0.851 |
|                                     | Cross-department coordination | 0.846 |
| New product development performance |                               | 0.873 |

### 3.2 Measurement of variables

The variables measured include business strategy, leadership style, organizational culture, market orientation, implementation level of DFSS activities, new product development performance, and manufacturer scale.

#### 3.2.1 Measurement of Business Strategies

This study uses the three strategies proposed by Durand & Coeurderoy (2001), including cost leadership strategy, marketing differentiation strategy, and innovation differentiation strategy, as the classification of business strategies. Referring to the empirical research questionnaire developed by relevant scholars (Durand & Coeurderoy, 2001; Prajogo & Sohal, 2006), considering the operation type of high-tech manufacturers, the business strategies are divided into:

1. Cost leadership strategy: Contents include: (a) the company will invest in cost-saving technology or equipment; (b) the company will control the cost of its services at a lower level; (c) it will improve operating efficiency and Reduce costs; (d) will strive to reduce costs to provide lower-priced products compared to other competitors.
2. Marketing differentiation strategy: content includes: (a) the company will strive to provide more valuable services than other competitors; (b) the company will provide required services according to the different needs of customers; (c) it will strive to provide Products with higher quality and features than competitors.
3. Innovation and differentiation strategy: content includes: (a) It is difficult for competitors (peers) to imitate the products provided by the company; (b) By redesigning products, it will provide better products than other competitors; (c) the company will use new technologies or methods to provide better products than other competitors

The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 for disagree, and 1 for strongly disagree.

#### 3.2.2 Measuring leadership style

This study refers to the four leadership styles proposed by Quinn (1988) as goal-oriented, steady and conservative, compassionate and supportive, innovative and adaptable as the classification of leadership styles. The leadership style scale used in this study adopts the leadership style developed by Chou (2009) and is modified according to the characteristics of high-tech industries. This study divides leadership styles into four types, including

1. Goal-oriented style: The contents include: (a) company executives shall clearly tell colleagues the company's pursuit of goals; (b) executives shall clearly define each person's area of responsibility; (c) executives shall guide colleagues with standard operating procedures and correct them in due course; (d) executives shall determine the priority of things and the direction of efforts; (e) executives are performance-oriented.



2. Steady and conservative style: The contents include: (a) executives shall attach importance to the details of various written documents; (b) executives shall regularly review the progress of plans; (c) executives shall regularly analyze the company's situation to keep staff informed of the direction of improvement; (d) executives shall establish measures to check performance; (e) executives shall maintain the normal and stable operation of the company.

3. Compassionate and supportive style: The contents include: (a) executives shall put themselves in the employees' shoes; (b) executives shall assist employees in planning their future careers; (c) executives shall communicate the problems raised by employees in a supportive manner; (d) executives shall allow employees to express their personal views and promote consensus fully; and (e) executives shall encourage employees to participate in decision-making.

4. Innovative and adaptable style: The contents include: (a) executives shall solve problems creatively; (b) executives shall clearly state the company's vision and continuously reiterate and reinforce it; (c) executives shall try new things with new ideas and procedures; (d) executives shall encourage colleagues to continuously improve their methods of doing things; and (e) executives shall strive to maintain a good relationship with their superiors.

The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 for disagree, and 1 for strongly disagree.

### **3.2.3 Measuring organizational culture**

This study refers to the four cultures proposed by Quinn (1988) as a classification of organizational culture. The content of the scale design is modified concerning the organizational culture measurement methods proposed by Quinn (1988), Parker & Bradley (2000), Al-Khalifa & Aspinwall (2001), as follows:

1. Rational culture: Contents include: (a) The company focuses on work performance and task achievement; (b) Leaders play the role of guide and promoter to achieve company goals; (c) the company's cohesive strength comes from work performance and task achievement; (d) the company's organizational atmosphere is mutual competition and emphasis on achievements; (e) the company's way of rewarding employees will be based on work goals or tasks Depends on performance achievement.

2. Hierarchical culture: Contents include: (a) The company has clear rules and systems; (b) The company is an organization with clear class divisions, and there are detailed regulations on what everyone should do; (c) The company emphasizes stability, act with caution; (d) the company has formulated many management measures to regulate employees; (e) the company pays attention to authority and is power-oriented in dealing with things.

3. Group culture: Contents include: (a) The company is an organization that values humanity and emphasizes employee autonomy; (b) The company provides employees with a stable working environment and a sense of security; (c) Employees within the company trust each other, good interaction; (d) the company

will use various methods to encourage and reward employees; (e) the company will treat every employee equally.

4. Developmental culture: Contents include: (a) The company's employees are willing to take risks and meet challenges; (b) Encourage employees to pursue innovation and accept new ideas; (c) The company often encourages employees to think and provide new ideas or solutions Plan; (d) The company attaches great importance to growth and acquiring new resources, and is always ready to respond to new challenges; (e) The company will actively collect work-related information. The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 for disagree, and 1 for strongly disagree.

### **3.2.4 Measurement of market orientation**

Based on the market orientation perspective proposed by Narver & Slater (1990), this study divides market orientation into three aspects: customer orientation, competitor orientation, and cross-departmental coordination. Based on the discussion of relevant literature, the activities required for market orientation are divided into

1. Customer-oriented aspect: Contents include (a) will systematically measure customer satisfaction; (b) will take customer satisfaction as the primary goal; (c) will provide customers with perfect services; (d) will abide by its obligations to customers Commitment; (e) will collect relevant information to understand customer needs.

2. Competitor-oriented aspect: Content includes (a) supervisors will regularly discuss the strengths and weaknesses of competitors; (b) will use various channels to collect competitor-related information for reference to each unit; (c) will focus on competition respond quickly to the activities of investors; (d) continue to look for markets that can bring competitive advantages to the company.

3. Cross-department coordination aspect: Contents include (a) each unit will exchange customer-related information and intelligence with each other; (b) all units will be integrated according to the overall strategy; (c) each unit will be able to share resources; (d) Each unit plays an integral role in providing customer value. The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 for disagree, and 1 for strongly disagree.

### **3.2.5 Measuring the degree of DFSS activities**

This study refers to the five major stages of activities proposed by Chowdhury (2005) and lists the activities required for DFSS, including

1. Identify improvement opportunities (Identify): The content includes the company identifying the projects that must be carried out and completing the entire project planning.

2. Defining conditions (Define): The content includes the company's accurate grasp of customers' voices and the definition of the conditions that customers need.

3. Develop concept (Develop): The content includes the company's creative

methods to conceive feasible solutions. The company will use logical and objective methods to evaluate these solutions. After selecting a solution, it will find out the solution—the crux of possible product failure.

4. Optimization design (Optimize): The content includes the company considering various environments or situations to optimize the product's design to adapt to possible variations in actual conditions.

5. Verify: The content includes the company verifying whether the product performance meets customer needs and performing operations with appropriate control methods to maintain results.

The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 for disagree, and 1 for strongly disagree.

### **3.2.6 Measurement of new product development performance**

This study comprehensively compiles relevant literature and adopts five indicators as the measurement indicators of new product development performance, which are: (1) time to market compared to peers; (2) quality level of new products compared to peers; (3) The market share of new products compared with peers; (4) The successful launch rate of new products compared with peers; (5) The cost of developing and launching new products compared with peers.

The 5-point Likert scale was used for scoring, 5 points for strongly agree, 4 points for agree, 3 points for neutral, 2 points for disagree, and 1 point for strongly disagree.

### **3.2.7 Measurement of firm scale**

This study is based on the Ministry of Economic Affairs' domestic industry scale identification standards. The scale of high-tech manufacturers is divided into two categories according to the number of employees: large-scale manufacturers (more than 200 employees) and small and medium-sized manufacturers (less than 200 employees). The scale of manufacturers is measured using a nominal scale.

## **4. Study results and analysis**

### **4.1 The correlation between business strategy and the degree of implementation of DFSS activities**

This study divides business strategy types (cost leadership, marketing differentiation, innovation differentiation) into two groups (high and low implementation levels). It examines whether there are significant differences between them based on the average DFSS activity scores of the two groups. Table 2 shows the ANOVA (Analysis of Variance) test of the impact of business strategies on DFSS activities. The research results accept H1: Different business strategies impact executing DFSS activities significantly differently. Adopting marketing differentiation and innovation differentiation strategies will significantly affect the execution of DFSS activities.

#### **4.2 The correlation between leadership style and DFSS activities**

This study divides the degree of leadership style (goal-oriented, steady and conservative, compassionate and supportive, innovative and adaptable) into two groups (high and low execution level). Based on the average DFSS activity scores of the two groups, check whether there are significant differences between them. Table 3 shows the ANOVA (Analysis of Variance) test of the impact of leadership style on DFSS activities. The research results reject H2: Different leadership styles impact executing DFSS activities significantly differently. All four leadership styles will affect the extent to which DFSS activities are performed. The higher the degree of implementation, the higher the degree of implementation of DFSS benefit improvement service quality items

#### **4.3 The correlation between organizational culture and DFSS activities**

This study divided the organizational culture type (rational, hierarchical, group culture, and developmental culture) into two groups (high and low implementation levels). It examined the differences between the two groups based on their respective average DFSS activity scores. Table 4 shows the ANOVA (Analysis of Variance) test of the impact of organizational culture on DFSS activities. The research results reject H3: Different organizational cultures significantly impact implementing DFSS activities. The degree of these four cultures will affect the degree of promotion of DFSS activities. The higher the execution level, the higher the execution level of DFSS activities.

#### **4.4 The correlation between market orientation and DFSS activities**

This study divides the degree of market orientation (customer orientation, competitor orientation, cross-department coordination) into two groups (high and low execution levels). It examines whether there is any difference between the two groups based on each group's average scores of DFSS activities. Significant difference. Table 5 shows the variation analysis test of the impact of market orientation on DFSS activities. The research results accept H4: the higher the degree of market orientation, it has a significant positive impact on the implementation of DFSS activities.

#### **4.5 Correlation between DFSS activity level and NPD performance**

This study divides the degree of DFSS activities (identify, define, develop, optimize, verify) into two groups (high and low execution levels) based on each group's average new product development performance. scores to see if there are any significant differences between them. Table 6 shows the ANOVA (Analysis of Variance) test of the impact of DFSS activities on new product development (NPD) performance. The research results accept H5: the higher the execution level of DFSS activities, the more significant the impact on new product development performance.

**Table 2: ANOVA of business strategy on DFSS activities**

|                 |         | <b>Cost leadership</b> | <b>Marketing differentiation</b> | <b>Innovation differentiation</b> |
|-----------------|---------|------------------------|----------------------------------|-----------------------------------|
| <b>Identify</b> | Low#    | 3.907                  | 3.704                            | 3.583                             |
|                 | High#   | 4.050                  | 4.067                            | 4.049                             |
|                 | F-value | 0.580                  | 4.682                            | 6.115                             |
|                 | P-value | 0.449                  | 0.034*                           | 0.016*                            |
| <b>Define</b>   | Low#    | 3.750                  | 3.685                            | 3.471                             |
|                 | High#   | 3.958                  | 4.019                            | 4.024                             |
|                 | F-value | 1.746                  | 5.644                            | 12.620                            |
|                 | P-value | 0.190                  | 0.020*                           | 0.001*                            |
| <b>Develop</b>  | Low#    | 3.887                  | 3.679                            | 3.608                             |
|                 | High#   | 4.000                  | 4.039                            | 4.000                             |
|                 | F-value | 0.460                  | 5.932                            | 5.257                             |
|                 | P-value | 0.500                  | 0.017*                           | 0.025*                            |
| <b>Optimize</b> | Low#    | 3.825                  | 3.685                            | 3.647                             |
|                 | High#   | 4.059                  | 4.164                            | 4.097                             |
|                 | F-value | 1.848                  | 10.119                           | 6.432                             |
|                 | P-value | 0.178                  | 0.002*                           | 0.013*                            |
| <b>Verify</b>   | Low#    | 4.075                  | 3.926                            | 3.735                             |
|                 | High#   | 4.178                  | 4.269                            | 4.266                             |
|                 | F-value | 0.406                  | 5.743                            | 10.958                            |
|                 | P-value | 0.526                  | 0.019*                           | 0.001*                            |

Note: Low#: the average score lower than 3.50; High#: the average score above 3.50; \* p < 0.05.

**Table 3: ANOVA of leadership style on DFSS activities**

|                 |         | <b>Goal oriented</b> | <b>Steady and conservative</b> | <b>Compassionate and supportive</b> | <b>Innovative and adaptable</b> |
|-----------------|---------|----------------------|--------------------------------|-------------------------------------|---------------------------------|
| <b>Identify</b> | Low#    | 3.429                | 3.619                          | 3.672                               | 3.565                           |
|                 | High#   | 4.054                | 4.060                          | 4.100                               | 4.098                           |
|                 | F-value | 9.503                | 6.085                          | 6.865                               | 9.808                           |
|                 | P-value | 0.003*               | 0.016*                         | 0.011*                              | 0.002*                          |
| <b>Define</b>   | Low#    | 3.433                | 3.500                          | 3.630                               | 3.525                           |
|                 | High#   | 4.016                | 3.992                          | 4.048                               | 4.034                           |
|                 | F-value | 12.732               | 8.191                          | 9.242                               | 11.834                          |
|                 | P-value | 0.001*               | 0.005*                         | 0.003*                              | 0.001*                          |
| <b>Develop</b>  | Low#    | 3.333                | 3.453                          | 3.543                               | 3.429                           |
|                 | High#   | 4.041                | 4.015                          | 4.109                               | 4.092                           |
|                 | F-value | 16.868               | 9.881                          | 16.582                              | 20.634                          |
|                 | P-value | <0.001*              | 0.002*                         | <0.001                              | <0.001*                         |
| <b>Optimize</b> | Low#    | 3.438                | 3.357                          | 3.586                               | 3.455                           |
|                 | High#   | 4.143                | 4.139                          | 4.240                               | 4.211                           |
|                 | F-value | 17.060               | 19.360                         | 22.247                              | 26.941                          |
|                 | P-value | <0.001*              | <0.001*                        | <0.001*                             | <0.001*                         |
| <b>Verify</b>   | Low#    | 3.719                | 3.786                          | 3.865                               | 3.761                           |
|                 | High#   | 4.262                | 4.231                          | 4.293                               | 4.313                           |
|                 | F-value | 10.974               | 6.298                          | 9.074                               | 15.150                          |
|                 | P-value | 0.001*               | 0.014                          | 0.004*                              | <0.001*                         |

Note: Low#: the average score lower than 3.50; High#: the average score above 3.50; \* p < 0.05.

**Table 4: ANOVA of organizational culture on DFSS activities**

|                 |         | <b>Rational Culture</b> | <b>Hierarchical Culture</b> | <b>Group Culture</b> | <b>Development Culture</b> |
|-----------------|---------|-------------------------|-----------------------------|----------------------|----------------------------|
| <b>Identify</b> | Low#    | 3.636                   | 3.692                       | 3.625                | 3.594                      |
|                 | High#   | 4.061                   | 4.066                       | 4.051                | 4.032                      |
|                 | F-value | 5.792                   | 4.865                       | 5.448                | 4.890                      |
|                 | P-value | 0.018*                  | 0.030*                      | 0.022*               | 0.030*                     |
| <b>Define</b>   | Low#    | 3.583                   | 3.704                       | 3.525                | 3.469                      |
|                 | High#   | 4.046                   | 4.010                       | 4.034                | 4.016                      |
|                 | F-value | 10.788                  | 4.678                       | 11.834               | 11.662                     |
|                 | P-value | 0.002*                  | 0.034*                      | 0.001*               | 0.001*                     |
| <b>Develop</b>  | Low#    | 3.536                   | 3.679                       | 3.550                | 3.500                      |
|                 | High#   | 4.071                   | 4.039                       | 4.040                | 4.057                      |
|                 | F-value | 13.107                  | 5.932                       | 9.663                | 12.962                     |
|                 | P-value | 0.001*                  | 0.017*                      | 0.003*               | 0.001*                     |
| <b>Optimize</b> | Low#    | 3.609                   | 3.685                       | 3.600                | 3.600                      |
|                 | High#   | 4.161                   | 4.164                       | 4.136                | 4.136                      |
|                 | F-value | 12.738                  | 10.119                      | 10.741               | 10.741                     |
|                 | P-value | 0.001*                  | 0.002*                      | 0.002*               | 0.002*                     |
| <b>Verify</b>   | Low#    | 3.913                   | 3.944                       | 3.900                | 3.816                      |
|                 | High#   | 4.250                   | 4.260                       | 4.237                | 4.258                      |
|                 | F-value | 5.032                   | 4.784                       | 4.595                | 7.956                      |
|                 | P-value | 0.028*                  | 0.032*                      | 0.035*               | 0.006*                     |

Note: Low#: the average score lower than 3.50; High#: the average score above 3.50; \*  $p < 0.05$ .

**Table 5: ANOVA of market orientation on DFSS activities**

|                 |         | <b>Customer Orientation</b> | <b>Competitor Orientation</b> | <b>Cross-department Coordination</b> |
|-----------------|---------|-----------------------------|-------------------------------|--------------------------------------|
| <b>Identify</b> | Low#    | 3.571                       | 3.544                         | 3.583                                |
|                 | High#   | 4.023                       | 4.107                         | 4.100                                |
|                 | F-value | 4.682                       | 11.137                        | 9.401                                |
|                 | P-value | 0.034*                      | 0.001*                        | 0.003*                               |
| <b>Define</b>   | Low#    | 3.526                       | 3.554                         | 3.577                                |
|                 | High#   | 4.025                       | 4.098                         | 4.066                                |
|                 | F-value | 10.858                      | 17.425                        | 12.922                               |
|                 | P-value | 0.001*                      | <0.001*                       | 0.001*                               |
| <b>Develop</b>  | Low#    | 3.667                       | 3.691                         | 3.641                                |
|                 | High#   | 4.018                       | 4.039                         | 4.050                                |
|                 | F-value | 5.145                       | 5.660                         | 7.710                                |
|                 | P-value | 0.026*                      | 0.020*                        | 0.007*                               |
| <b>Optimize</b> | Low#    | 3.674                       | 3.679                         | 3.673                                |
|                 | High#   | 4.134                       | 4.117                         | 4.160                                |
|                 | F-value | 8.420                       | 11.306                        | 10.336                               |
|                 | P-value | 0.005*                      | 0.001*                        | 0.002*                               |
| <b>Verify</b>   | Low#    | 3.854                       | 3.904                         | 3.907                                |
|                 | High#   | 4.282                       | 4.274                         | 4.279                                |
|                 | F-value | 8.676                       | 6.607                         | 6.810                                |
|                 | P-value | 0.004                       | 0.012*                        | 0.011*                               |

Note: Low#: the average score lower than 3.50; High#: the average score above 3.50; \*  $p < 0.05$ .

**Table 6: ANOVA of market orientation on NPD performance**

|                 |         | <b>NPD performance</b> |
|-----------------|---------|------------------------|
| <b>Identify</b> | Low#    | 3.000                  |
|                 | High#   | 3.549                  |
|                 | F-value | 6.380                  |
|                 | P-value | 0.014*                 |
| <b>Define</b>   | Low#    | 3.067                  |
|                 | High#   | 3.531                  |
|                 | F-value | 4.711                  |
|                 | P-value | 0.033*                 |
| <b>Develop</b>  | Low#    | 2.867                  |
|                 | High#   | 3.531                  |
|                 | F-value | 8.320                  |
|                 | P-value | 0.005*                 |
| <b>Optimize</b> | Low#    | 3.200                  |
|                 | High#   | 3.938                  |
|                 | F-value | 9.399                  |
|                 | P-value | 0.003*                 |
| <b>Verify</b>   | Low#    | 2.933                  |
|                 | High#   | 3.656                  |
|                 | F-value | 9.905                  |
|                 | P-value | 0.002*                 |

Note: Low#: the average score lower than 3.50; High#: the average score above 3.50; \*  $p < 0.05$ .

## 5. Conclusion

How to make appropriate decisions to enhance competitiveness is an essential aspect for high-tech manufacturers. Few empirical studies have incorporated business strategy, leadership style, organizational culture, and market orientation into DFSS activities to explore their impact on new product development performance. This study takes Taiwan's high-tech manufacturers as the research object to explore the correlation between business strategy, leadership style, organizational culture, market orientation, and new product development performance. This study found that the higher the implementation level of DFSS activities, the more significant the positive impact on new product development performance. Different business strategies have significantly different degrees of impact on the execution of DFSS activities. Adopting marketing differentiation and innovation differentiation strategies will significantly affect the execution of DFSS activities. Manufacturers can adopt differentiation strategies to enhance competitiveness. In addition, adopting leadership styles such as goal-oriented, steady and conservative, compassionate and supportive, innovative and adaptable, rational culture, hierarchical culture, group culture, and developmental culture will help improve the execution of DFSS activities. In addition, the higher the degree of

market orientation, the higher the degree of market orientation has positive impact on the implementation of DFSS activities, which means that to improve the performance of new product development, high-tech manufacturers must regularly collect the advantages and disadvantages of competitors in the market within the organization, and then use organizational resources to negotiate and discuss across departments to find out the company's advantages in the market to assist high-tech manufacturers in proposing competitive strategies, thereby increasing the company's new product development performance. In addition, adopting leadership styles such as goal-oriented, steady and conservative, compassionate and supportive, innovative and adaptable, rational culture, hierarchical culture, group culture, and developmental culture will help improve the execution of DFSS activities. This study suggests that high-tech can improve new product development performance by implementing DFSS activities, adopting differentiation strategies (marketing differentiation and innovation differentiation), and selecting goal-oriented, steady and conservative, compassionate and supportive, innovative and adaptable. In addition, it is necessary to strengthen the implementation of market-oriented activities and enhance rational culture, hierarchical culture, group culture, and development culture to improve new product development performance

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