

# Evaluating Competitive Advantage of a New Product for Designing Successful Product Differentiation

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**Abstract.** Market oriented product differentiation is a critical issue for a business success today. This paper proposes a relatively simple but effective analytical tool to design successful product differentiation especially in conceptualization phase. The author calls the tool as “Competitive Advantage Matrix (CAM)”. The tool utilizes a matrix-based approach to evaluate relative competitiveness of a new product in a market oriented context, focusing on 1) technical excellence, 2) marketing strength and 3) social acceptance. It enables to provide various insights on whether a new product is likely to acquire competitive advantage in a market, not only against competing products, but also in a segment and in a whole market as well. The tool is also functioned as an easy measure to simulate future state of a new product’s competitiveness, considering both actions and reactions from competitors. In this paper, a general concept of the CAM analysis is firstly explained with its development process. Secondly, a practical application of the CAM analysis is illustrated with an example of aircraft manufacturing industry. Finally, benefits and improvements of the CAM analysis are discussed in the conclusion.

## Introduction

**Background.** Excellent strategy enhances possibility for a company to succeed in a competition. Therefore, thousands of books and consultants discuss how to formulate such an excellent strategy so that a company can establish competitive advantage in a market [Walker, 2007]. Most of them stress the importance of “differentiation” in a strategy and attempt to create several analytical tools such as SWOT Analysis, which is used worldwide to make a difference by identifying external opportunity for a company with its internal strength. Benchmarking is common technique to differentiate a company from its competitors in the same or even in the other industry as well. However, “not every company can find many opportunities for differentiating its offer and gaining competitive advantage” [Kotler, Wong, Saunders and Armstrong, 2005].

Importance of “differentiation” in a strategy is thoroughly discussed by Michel. E. Porter [Porter, 1985]. He classifies strategies into three categories based on 1) scope of business and 2)

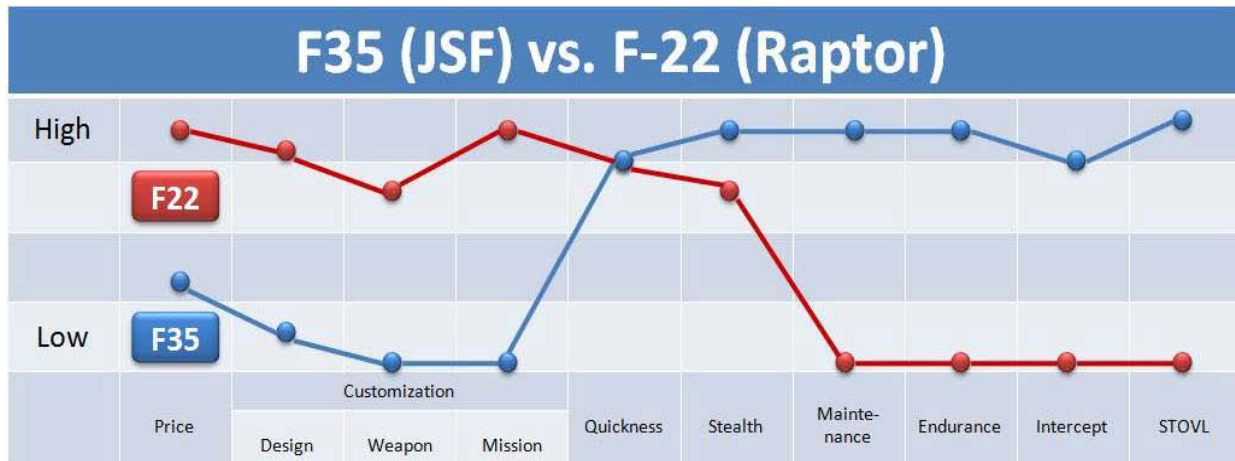
degree of differentiation. Figure 1 shows Porter’s famous categorization of competitive strategy. The first is “differentiation”, which is a “generic strategy associated with achieving a value advantage over competitors” [Walker, 2007]. Second is “cost leadership”, which is a type of strategy for “achieving the lowest costs in an industry” [Walker, 2007]. The last is “focus”, which is a strategy to choose “a few market segments well rather than going after the whole market” [Kotler et al, 2005]. No matter what strategies companies choose, they have no choice but to take distinctive actions against their competitors so as to acquire competitive advantage in a market.

|                           |             |                   |               |
|---------------------------|-------------|-------------------|---------------|
|                           |             | Scope of Business |               |
|                           |             | <b>Broad</b>      | <b>Narrow</b> |
| Degree of Differentiation | <b>Low</b>  | Cost Leadership   | Focus         |
|                           | <b>High</b> | Differentiation   |               |

**Figure 1 Porter’s Matrix for Competitive Strategy**

The importance of “differentiation” is not limited to a corporate strategy. “A company can differentiate its physical product” [Kotler et al, 2005]. Kenya Nakamura, first chief engineer of Toyota Crown, states that “we can be successful at Toyota only when we do something better than our competitors or when we surpass the average for the industry” [Morgan & Liker, 2006]. Companies are always required to compare and improve their own products against other existing products in a market, namely, competitors. The biggest problem here is that how we can design such a successful differentiation for a new product. In particular, in conceptualization stage of a new product development, it is more difficult to analyze appropriate differentiation since given information is extremely limited. Therefore, the author believes that it is necessary to create a relatively simple but effective tool to analyze and design successful differentiation of a new product even when the detailed information is not enough available. The purpose of this paper is to propose such an analytical tool for successful product differentiation.

**Previous work.** W. Chan Kim and Renée Mauborgne propose an analytical tool called Strategic Canvas. It is originally a strategy formulation tool that enables a company to design appropriate differentiation from other competing companies. Without appropriate differentiation, a company is likely to be involved in a mere price competition and thus to suffer from unprofitability. Kim and Mauborgne call this situation as “Red Ocean” [Kim & Mauborgne, 2005]. The word “Red Ocean” symbolizes bloody battle among competing players inside the same market struggling for the same customers only with cheapness of price. In order to prevent such undesirable situation, Strategic Canvas makes a difference. Figure 2 shows an example of Strategic Canvas. It compares two remarkable jet fighters in the world, F35 (JSF) and F22 (Raptor).



**Figure 2 Example of Strategic Canvas, Created on Kim&Maubougne’s Illustration**

In Strategic Canvas, you firstly identify several common characteristics of the competing products. Then you relatively score each characteristic and plot them on the same canvas as Figure 2. In the example, F35 is obviously inferior to F22 in terms of price, customization of design, customization of weapon and customization of mission. However, F35 is designed to hold greater superiority to F22 in terms of maintenance, endurance, intercept capability and short take-off and vertical landing capability. In other words, the designer of F35 intentionally discarded some of the characteristic of jet fighter and put much more stress on the other characteristics so that F35 can be properly differentiated from F22. The intention was to acquire competitive advantage of F35 in jet fighter market with appropriate differentiation against existing competitor F22. In this way, Strategic Canvas enables to visualize the difference among the competing products so that you can analyze what to be added to your product for further effective differentiation.

**Problem.** It is true that Strategic Canvas is useful tool to visualize difference among competing products and therefore widely utilized among business executives for designing differentiation. However, Strategic Canvas contains a risk to mislead optimal direction of differentiation. The primal reason is that it lacks a function of evaluating market value of product characteristic. In other words, it ignores to consider importance of each characteristic in a target market. Without relative value assessment of each characteristic, it is rather difficult to say that the analysis is reliable enough for successful differentiation. Therefore, the author proposes better methodology to evaluate competitiveness of a new product for the purpose of successful product differentiation.

In the following, the author firstly explains a type of trade studies called “Pugh methodology”. “Use of a formal trade study procedure will provide discipline in our decision process, and may prevent some ill-advised decisions” (INCOSE SE Handbook Ver. 3.1, 2007). Secondly, general concept and designing process of the CAM analysis is illustrated. Thirdly, the effectiveness of the CAM analysis is practically examined by applying it to a case of aircraft manufacturing company. Lastly, benefits and future improvement possibility of the CAM analysis are discussed in the conclusion.

## Pugh Methodology

**Pugh Methodology.** The author firstly explains a general concept of Pugh methodology on which the fundamental structure of the CAM analysis is based. Pugh methodology is a decision making

tool with an effective use of a matrix-based approach which is widely used among product development projects. “When engineers at Toyota want to consider various design alternatives or provide feedback or suggest solutions to design challenges, they communicate with matrices.” [Morgan & Jeffrey, 2006] Figure 3 shows a simple example of Pugh Methodology.

|             |         | OPTIONS  |       |      |     |
|-------------|---------|----------|-------|------|-----|
|             |         | Airplane | Train | Ship | Car |
| CRITERIA    | Cost    | 1        | 3     | 5    | 2   |
|             | Time    | 5        | 2     | 1    | 2   |
|             | Quality | 2        | 5     | 1    | 4   |
| Total Score |         | 8        | 10    | 7    | 8   |

Evaluation [5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1:Least Attractive]

**Figure 3 Example of Pugh Methodology (Normal)**

Now assume that you are required to move from point A to point B. Options of transportation are listed on one axis of the matrix while specific evaluating criteria are listed on the other creating multiple cells. In the example of Figure 3, you are required to select a measure of transportation from the four options; airplane, train, ship and car. Evaluating criteria are cost, time, and quality in this case. Then you evaluate each option against each criterion, using evaluating scheme such as, 5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1: Least Attractive. Each option is then evaluated against those criteria and a quantitative and qualitative value is entered in the appropriate cell. [Morgan & Jeffrey, 2006] Finally, you count the total score of each option and then figure out the most favourable option for you. The best answer is taking a “train” which acquired the highest score of “10” in this case.

Pugh methodology is relatively simple but useful tool for evaluating multiple options against multiple criteria. Furthermore, the tool can be more effective by including consideration of “weight” of criteria. In other words, the tool enables to evaluate how important each criterion is for you based on your individual sense of value. This is quite important since sense of value is relative in nature among individuals. For example, cost of transportation is quite important for student travelers while it is not so important for business travelers since companies pay the transportation. On the contrary, time of transportation is quite important for business travelers while it is not so important student travelers since they have plenty of time especially during vocation.

Figure 4 shows an example of the Pugh methodology with considering “weight” of criteria. You firstly evaluate importance of criteria for you based your individual sense of value, using weighting scheme such as, 5: Very Important, 3: Moderate, 1: Not Important. In this case, assume that you are a business executive. Then you are likely to evaluate “Cost” as less important factor, “Time” as very important factor and “Quality” as moderate factor for your business trip in deciding a mean of transportation. Then you multiple the given scores in Figure 3 with weight scores in Figure 4. Finally, you count total scores of each option and then find out the most

favourable option for you. In the following case, the answer is taking an “airplane” which acquired the highest score of “32”. The result has changed from Figure 3 because of the additional consideration of “weight” of criteria in Figure 4.

|             |         | Weight | OPTIONS  |        |       |        |
|-------------|---------|--------|----------|--------|-------|--------|
|             |         |        | Airplane | Train  | Ship  | Car    |
| CRITERIA    | Cost    | 1      | 1×1=1    | 3×1=3  | 5×1=5 | 2×1=2  |
|             | Time    | 5      | 5×5=25   | 2×5=10 | 1×5=5 | 2×5=10 |
|             | Quality | 3      | 2×3=6    | 5×3=15 | 1×3=3 | 4×3=12 |
| Total Score |         |        | 32       | 28     | 13    | 24     |

Weighting [ 5: Important, 3: Moderate, 1: Not Important]

Evaluation [5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1:Least Attractive]

#### Figure 4 Example of Pugh Methodology (Weight Considered)

In this way, Pugh methodology enables to evaluate multiple options against multiple criteria with considering relative importance of criteria to assessor. In addition, when “weight” is considered as “importance of each criterion to market”, then the result turns out to be degree of competitiveness that a new product is likely to acquire in a market. In other words, a new product is examined for its degree of differentiation in relation to market attractiveness. This function of Pugh methodology is an essential part of CAM analysis. In the following, the author describes a general concept of CAM analysis.

#### Concept of Competitive Advantage Matrix (CAM)

**General concept.** There are two main features in the CAM analysis. First, it considers relative importance of each characteristic of a product in a market oriented context. It means that the CAM analysis enables to evaluate relative market competitiveness of a new product. The other feature is that it evaluates the product competitiveness from three different aspects; 1) technical excellence, 2) marketing strength and 3) social acceptance. The result acquires more reliability and objectivity with the holistic view approach rather than solely focusing on a technical aspect as is often the case today. Figure 5 shows the fundamental steps of the CAM analysis and figure 6 shows an example of a matrix for the analysis. In the following, the author explains the procedure step by step.



**Figure 5 Steps of CAM Analysis**

**STEP 1: Identify target market.** Identify target market to which your new product is expected to be delivered. It may be defined either by product type, customer type, region, country, generation, gender or combination of those.

**STEP 2 : Identify players.** Identify competitors of your new product in a target market. It is necessary to find not only existing players but also potential competitors which are expected to enter the same target market in the near futgure. In order to maintain reliability of the analysis, it is desirable to identify more than 70 % of the competing players in terms of market share. In the example of Figure 6, the auther assumes that there are 6 players in a market and call them simply as Product A, Product B, Product C, Product D, Product E and Product F. There are two different segments in the market such as Segment Y and Segment Z. Product A through Product C are categorized into Segement Y and Product D through Product F are categorized into Segment Z in the assumption.

**STEP 3 : Identify differentiation factor.** Identify characteristics that competing products hold or expected to hold in the future. In the CAM analysis, it is required to identify differentiation factors in three different aspects ; 1) technical excellence, 2) marketing strength and 3) social acceptance. Degree of differentiation can be deffered in this stage. In the example of Figure 6, the auther assumes that there are 2 differentiation factors in each aspect and call them simply as Factor 1 and Factor 2 for technical excellence, Factor 3 and Factor 4 for marketing strength, and Factor 5 and Factor 6 for social acceptance.

**STEP 4: Weighting differentiation factors.** Evaluate importance of each differentiation factor in terms of market competition, using a weighting scheme from 1 to 5 such as 5: Very Important, 4: Important, 3: Moderate, 2: Less Important, 1: Least Important. The weighting must be based on common sense of value in a target market. Therefore, the results are relative

and different from markets to market even if a product is the same. In the example of Figure 6, the author simply set single letter code for each weighting result such as W1 for Factor 1, W2 for Factor 2, W3 for Factor 3, W4 for Factor 4, W5 for Factor 5 and W6 for Factor 6.

**STEP 5 : Scoring identified player.** Evaluate attractiveness of each competing product against each differentiation factor, using a scoring scheme from 1 to 5 such as; 5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1: Least Attractive. Then multiple the weight of each differentiation factor and the score of each player. Then sum all the multiplied scores up for each product. In the end, the calculated result shows you competitive advantage of each product in a target market. In the example of Figure 6, the author set single letter code for individual score of each product as A1, A2, A3, A4, A5 and A6 for Product A according to each differentiation factor. The same scoring process for Product B through Product F. The author also sets single letter code for each final multiplied and summed up score such as P1 for Product A, P2 for Product B, P3 for Product C, P4 for Product D, P5 for Product E and P6 for Product F.

The formulas of calculating P1, P2, P3, P4, P5 and P6 are described as follows.

$$P1 = f(n) = \sum_{n=1}^6 (Wn \times An) \quad (1)$$

$$P2 = f(n) = \sum_{n=1}^6 (Wn \times Bn) \quad (2)$$

$$P3 = f(n) = \sum_{n=1}^6 (Wn \times Cn) \quad (3)$$

$$P4 = f(n) = \sum_{n=1}^6 (Wn \times Dn) \quad (4)$$

$$P5 = f(n) = \sum_{n=1}^6 (Wn \times En) \quad (5)$$

$$P6 = f(n) = \sum_{n=1}^6 (Wn \times Fn) \quad (6)$$

**STEP 6: Calculate average.** Calculate scores of market average and segment average. This process enables not only to evaluate competitive advantage of a new product against specific competing product but also to estimate overall competitiveness of a product in a market or even in a segment as well. In the example of Figure 6, the author set single letter code for average score in Segment Y as Y1, Y2, Y3, Y4, Y5 and Y6 according to each differentiation factor. In the same way, single letter code for Segment Z is Z1, Z2, Z3, Z4, Z5 and Z6. Single letter code for Market Average is M1, M2, M3, M4, M5 and M6. The author also sets single letter code for total summed up scores such as YA for Segment Y Average, ZA for Segment Z average and MA for Market Average.

The formulas of calculating Y1, Z1 and M1 are described as follows.

$$Y1 = \frac{A1 + B1 + C1}{3} \quad (7)$$

$$Z1 = \frac{D1 + E1 + F1}{3} \quad (8)$$

$$M1 = \frac{A1 + B1 + C1 + D1 + E1 + F1}{6} \quad (9)$$

The formulas of calculating YA, ZA and MA are described as follows.

$$YA = f(n) = \sum_{n=1}^6 Yn \quad (10)$$

$$ZA = f(n) = \sum_{n=1}^6 Zn \quad (11)$$

$$MA = f(n) = \sum_{n=1}^6 Mn \quad (12)$$

**STEP 7: Analyze competitive advantage.** The final step is to analyze competitiveness of a new product in a target market by comparing the results. Assume that your company is going to launch Product F and you would like to evaluate competitive advantage against market leader which is Product A. Then the formula of calculation is described as follows.

$$\text{Competitiveness of Product F against Product A} = f(n) = \sum_{n=1}^6 \{(Fn - An) \times Wn\} \quad (13)$$

In order to evaluate competitiveness of Product F against Segment Z to which Product F belongs, then the formula of calculation is described as follows.

$$\begin{aligned} &\text{Competitiveness of Product F against Segment Z} = f(n) \\ &= \sum_{n=1}^6 \{(Fn - Zn) \times Wn\} \quad (14) \end{aligned}$$

In order to evaluate competitiveness of Product F against a whole market in, then the formula of calculation is described as follows.

$$\text{Competitiveness of Product F against Market} = f(n) = \sum_{n=1}^6 \{(Fn - Mn) \times Wn\} \quad (15)$$

If the score of your product is more than the market/segment average, then it means that your product is likely to acquire competitive advantage in the target market/segment. On the contrary, if the score of your product is less than the market/segment average, then your product is likely to fail in terms of market competition. Furthermore, if the score of your product is equal to the market/segment average, then competition is likely to reach “equilibrium”. In this case, without further differentiation, existing competitors are likely to



have more advantage in terms of competition since they have already been recognized by customers in a market. In this way, you can evaluate whether or not your new product is enough differentiated against existing competitors and against market/segment with the CAM analysis.

| [STEP 1]<br>Target Market        |          | [STEP 4]<br>Weight   | [STEP 5]<br>Player Evaluation          |           |           |           |           |           | [STEP 6]<br>Average<br>Calculation |                   |                | [STEP 7]<br>Analysis of Product F |                |                |
|----------------------------------|----------|----------------------|--|-----------|-----------|-----------|-----------|-----------|------------------------------------|-------------------|----------------|-----------------------------------|----------------|----------------|
|                                  |          |                      | Segment Y                              |           |           | Segment Z |           |           | Segment Y Average                  | Segment Z Average | Market Average | v.s.<br>A                         | v.s.<br>Segt.Y | v.s.<br>Market |
| [STEP 2]<br>Competing<br>Players |          | Importance in Market | Product A                              | Product B | Product C | Product D | Product E | Product F |                                    |                   |                | (Fn-An)*Wn                        | (Fn-Yn)*Wn     | (Fn-Mn)*Wn     |
|                                  |          |                      | [STEP 3]<br>Differentiation<br>Factors |           |           |           |           |           |                                    |                   |                |                                   |                |                |
| Technical Excellence             | Factor 1 | <b>W1</b>            | A1                                     | B1        | C1        | D1        | E1        | F1        | Y1                                 | Z1                | M1             |                                   |                |                |
|                                  | Factor 2 | <b>W2</b>            | A2                                     | B2        | C2        | D2        | E2        | F2        | Y2                                 | Z2                | M2             |                                   |                |                |
| Marketing Strength               | Factor 3 | <b>W3</b>            | A3                                     | B3        | C3        | D3        | E3        | F3        | Y3                                 | Z3                | M3             |                                   |                |                |
|                                  | Factor 4 | <b>W4</b>            | A4                                     | B4        | C4        | D4        | E4        | F4        | Y4                                 | Z4                | M4             |                                   |                |                |
| Social Acceptance                | Factor 5 | <b>W5</b>            | A5                                     | B5        | C5        | D5        | E5        | F5        | Y5                                 | Z5                | M5             |                                   |                |                |
|                                  | Factor 6 | <b>W6</b>            | A6                                     | B6        | C6        | D6        | E6        | F6        | Y6                                 | Z6                | M6             |                                   |                |                |
| <b>CODE</b>                      |          |                      | <b>P1</b>                              | <b>P2</b> | <b>P3</b> | <b>P4</b> | <b>P5</b> | <b>P6</b> | <b>YA</b>                          | <b>ZA</b>         | <b>MA</b>      | <b>Competitive Advantage</b>      |                |                |

Evaluation [ 5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1: Least Attractive]

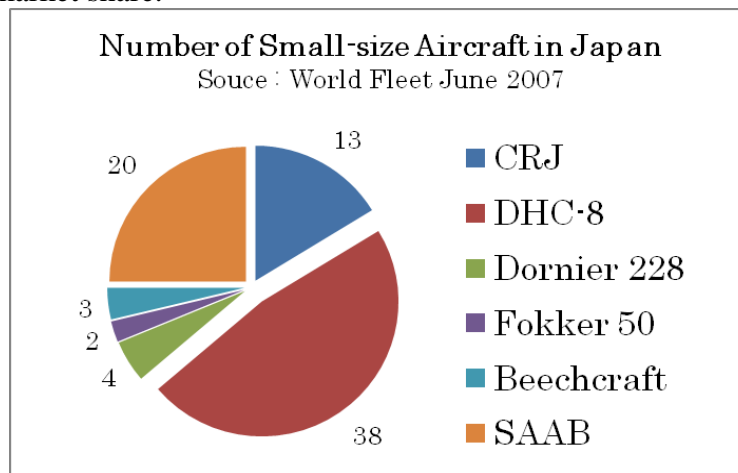
Weighting [ 5: Very Important, 4: Important, 3: Moderate, 2: Less Important, 1: Least Important]

**Figure 6 Example of Matrix for CAM Analysis**

### **Practical Application of Competitive Advantage Matrix (CAM)**

**Introduction.** In the following, the author explains functionality of the CAM analysis more in

detail, presenting an example of the CAM analysis application to aircraft manufacturing industry. The author takes an example of Japanese aircraft manufacturing company called Mitsubishi Aircraft Corporation (MAC), which decided to launch a new regional jet aircraft with 70 to 90 seats in 2007. The aircraft is called Mitsubishi Regional Jet (MRJ). Figure 7 shows the number of small-size aircraft with less than 100 seats in Japan in 2007 (excluding private use), which was likely to be potential replacement target for MRJ. There were 80 small-size aircraft in the market and 13 out of 80 are regional jet aircrafts called CRJ by Canadian Bombardier. The others are all turboprop aircrafts such as DHC-8 also by Bombardier, and Dornier 228, Fokker 50, Beechcraft 1900 and SAAB 340. The fact was that the Japanese market was competitive enough with more than 6 players inside and was increasingly dominated by Bombardier which occupied more than 60 percents of the market share.



**Figure 7 Number of Small-size Aircraft in Japan**

In fact, MRJ was required to enter and penetrate this competitive market. Furthermore, the situation has changed even worse for MRJ since Japan Airline (JAL), the largest airline in Japan, had decided to introduce other regional jets called EMBRAER 170 manufactured by Brazilian company Empresa Brasileira de Aeronáutica in 2008. In addition, in 2009, a new airline called Fuji Dream Airline was established in Japan and it also decided to introduce EMBRAER 170 instead of MRJ. Therefore, MRJ is require to analyze its competitiveness in a market again so that it can figure out whether or not the current aircraft design is enough differentiated to be successful.

Figure 8 shows an application of the CAM analysis to the MRJ case. In STEP 1, the author identifies a target market as Japanese small-size aircraft market with 30 to 100 seats since these are the range of realistic replacement targets for MRJ. Then in STEP 2, the author identifies 6 players in Japanese market such as DHC-8 Q400, SAAB 340, Fokker 50, CRJ 200, EMBRAER 170 and MRJ 70 for the CAM analysis. Then in STEP 3, the author identifies 15 differentiation factors in the market such as; A/C price, STOL Capability, Speed, Comfort, Cabin Quietness, Product Variety, Safety Reliability, Commonality, Fuel Consumption, Air Pollution, Maintenance Cost, Noise Level, Brand Image, Sales Channel and Customer Support.

After the identification process of the CAM analysis, then the author evaluate weight of each

differentiation factor in STEP 4, considering how important each differentiation factor is to Japanese market, using weighting scheme from 1 to 5. The result is shown in Row A in Figure 8. Then in STEP 5, the author relatively evaluates each aircraft against each differentiation factor, using evaluating scheme from 1 to 5. The result is shown in Row B through Row G in Figure 8. The weightings and the evaluations are the agreed scores which are based on the results of the multiple interviews and discussions with some of Japanese trading companies shown in Figure 9. They are the sales agents for the foreign aircraft manufacturing companies and thus know much about both aircrafts and the market.

Once finishing the evaluation of all aircrafts, then the author calculates the score of market average and regional jet segment average in STEP 6. The result is shown in Row H through Row J respectively. Finally, in STEP 7, the author calculates competitive advantage of MRJ against the market leader DHC-8 which is now occupying almost half of the Japanese market. The author also calculates the score against regional jet segment average to which MRJ belongs and against total Japanese market average as well. The result is shown in Row K, Row L and Row L respectively.

|                      |                  | Weight                        | Evaluation     |      |        |                   |     |     | Average    |            |        | Analysis    |            |             |
|----------------------|------------------|-------------------------------|----------------|------|--------|-------------------|-----|-----|------------|------------|--------|-------------|------------|-------------|
|                      |                  | A                             | B              | C    | D      | E                 | F   | G   | H          | I          | J      | K           | L          | M           |
|                      |                  | Importance in Japanese Market | Turboprop (TP) |      |        | Regional Jet (RJ) |     |     | TP Segment | RJ Segment | Market | v.s. Leader | v.s. Segt. | v.s. Market |
|                      |                  |                               | DHC-8          | SAAB | Fokker | CRJ               | ERJ | MRJ |            |            |        | (G-B)*A     | (G-I)*A    | (G-J)*A     |
| Technical Excellence | STOL Capability  | 3                             | 3              | 5    | 5      | 2                 | 2   | 3   | 4.3        | 2.3        | 3.3    | 0.0         | 2.0        | -1.0        |
|                      | Speed            | 4                             | 3              | 1    | 1      | 5                 | 5   | 5   | 3.3        | 1.7        | 3.3    | 8.0         | 13.3       | 6.7         |
|                      | Comfort          | 2                             | 3              | 3    | 3      | 4                 | 5   | 5   | 3.8        | 3.0        | 3.8    | 4.0         | 4.0        | 2.3         |
|                      | Cabin Quietness  | 2                             | 4              | 2    | 1      | 3                 | 3   | 3   | 2.7        | 2.3        | 2.7    | -2.0        | 1.3        | 0.7         |
|                      | Commonality      | 3                             | 3              | 1    | 1      | 3                 | 5   | 5   | 3.0        | 1.7        | 3.0    | 6.0         | 10.0       | 6.0         |
|                      | Fuel Consumption | 5                             | 4              | 5    | 5      | 1                 | 2   | 3   | 3.3        | 4.7        | 3.3    | -5.0        | -8.3       | -1.7        |
|                      | Maintenance Cost | 4                             | 4              | 4    | 4      | 2                 | 2   | 2   | 3.0        | 4.0        | 3.0    | -8.0        | -8.0       | -4.0        |
| Marketing Strength   | A/C Price        | 5                             | 3              | 5    | 5      | 2                 | 1   | 1   | 2.8        | 4.3        | 2.8    | -10.0       | -16.7      | -9.2        |
|                      | Product Variety  | 3                             | 5              | 1    | 1      | 5                 | 5   | 2   | 3.2        | 2.3        | 3.2    | -9.0        | -1.0       | -3.5        |
|                      | Sales Channel    | 5                             | 5              | 3    | 1      | 5                 | 5   | 5   | 4.0        | 3.0        | 4.0    | 0.0         | 10.0       | 5.0         |
|                      | Customer Support | 5                             | 5              | 2    | 2      | 5                 | 3   | 3   | 3.3        | 3.0        | 3.3    | -10.0       | 0.0        | -1.7        |
|                      | Brand Image      | 3                             | 1              | 3    | 1      | 1                 | 3   | 3   | 2.0        | 1.7        | 2.0    | 6.0         | 4.0        | 3.0         |
| Social               | Air Pollution    | 3                             | 4              | 5    | 5      | 1                 | 2   | 4   | 3.5        | 4.7        | 3.5    | 0.0         | -2.0       | 1.5         |

|                              |                    |   |   |   |   |   |   |   |     |     |     |              |             |            |
|------------------------------|--------------------|---|---|---|---|---|---|---|-----|-----|-----|--------------|-------------|------------|
| Acceptance                   | Safety Reliability | 5 | 1 | 5 | 5 | 1 | 5 | 3 | 3.3 | 3.7 | 3.3 | 10.0         | -3.3        | -1.7       |
|                              | Noise Level        | 5 | 4 | 5 | 5 | 1 | 3 | 3 | 3.5 | 4.7 | 3.5 | -5.0         | -8.3        | -2.5       |
| Competitive Advantage of MRJ |                    |   |   |   |   |   |   |   |     |     |     | <b>-15.0</b> | <b>-3.0</b> | <b>0.0</b> |

Evaluation [ 5: Very Attractive, 4: Attractive, 3: Moderate, 2: Less Attractive, 1: Least Attractive]  
 Weighting [ 5: Very Important, 4: Important, 3: Moderate, 2: Less Important, 1: Least Important]

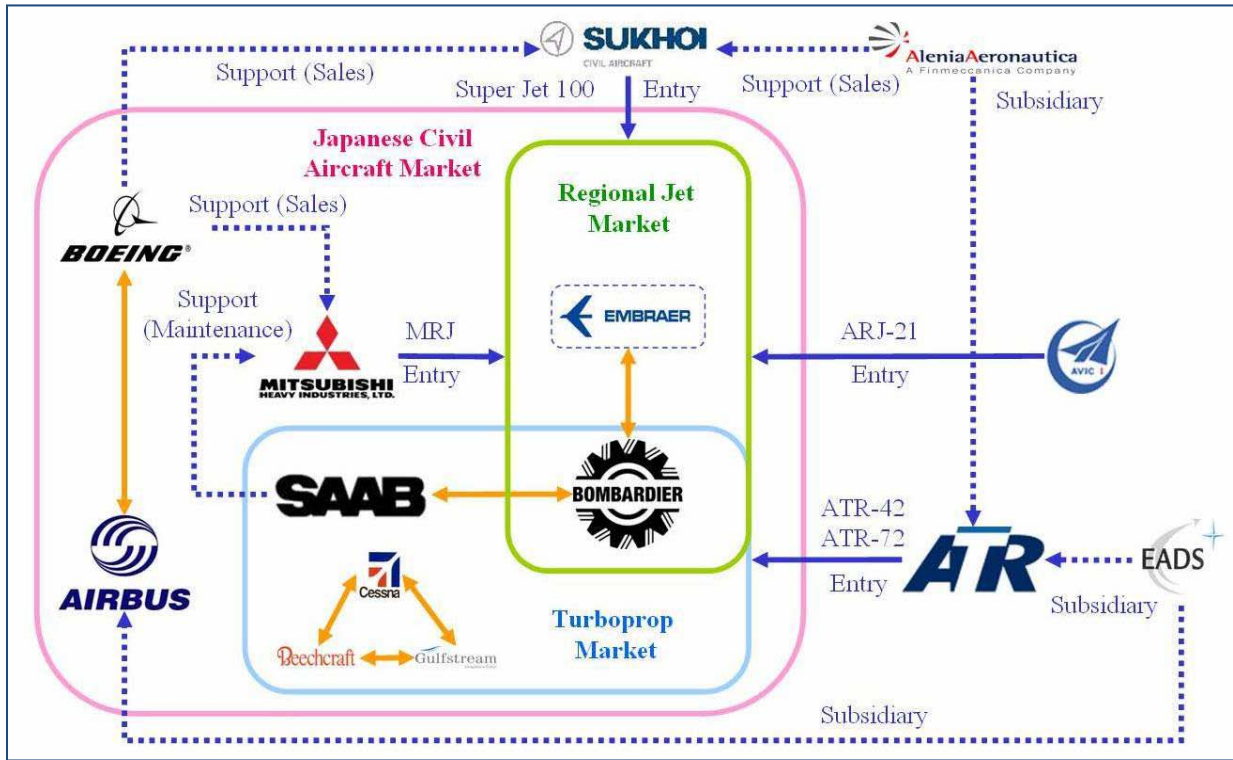
### Figure 8 CAM analysis example for MRJ

As a result of the CAM analysis in Figure 8, the author concludes that MRJ is likely to face equilibrium of competition in Japanese market (0.0 point). In addition, MRJ is slightly less competitive against regional jet segment (-3.0 points) and even less competitive against whole market in Japan (-15.0 points). Therefore, the conclusion of the analysis is likely to recommend “redesign” of the aircraft so as to acquire additional differentiation.

Furthermore, the CAM analysis can be used to simulate how the competitiveness of a new aircraft changes in a target market if MRJ would improve or add some of the differentiation factors to the current configuration of the aircraft design. In addition, the CAM analysis makes it possible to simulate the impact of additional competitors’ entry into the market as well. For example, other new regional jets such as Russian Sukhoi Superjet or Chinese ARJ 21 might challenge the Japanese market in the future (Figure 10). MRJ is able to further evaluate its competitiveness against such new competitors just by including these new foreign aircrafts in the CAM matrix. The point is that the tool can simulate potential actions and reactions of the competitors beforehand and thus enable to evaluate how competitors’ behavior affects competitiveness of your product in the market.



Figure 9 Aircraft Sales Agent Relationship in Japan



**Figure 10 Relations of Aircraft Manufacturing Companies in Japanese Market**

## Conclusion

Market oriented product differentiation is a critical issue for a business success today. Therefore, this paper discussed and proposed a matrix-based approach to evaluate competitive advantage of a new product in a market oriented context. The proposed Competitive Advantage Matrix (CAM) is a simple but effective tool to design a successful product differentiation. The author believes that the benefits of the CAM analysis are to;

- (1) Provide insights on whether a new product is likely to acquire competitive advantage against competing products, against segments and against markets at the same time, in a single matrix calculation, with enough differentiation in a target market, considering all aspects of technical, business and social factors.
- (2) Enable to simulate future state of competitiveness of a new product, considering conceivable actions and reactions from current and potential competitors such as new market entrants and further enhancement of the competitors.
- (3) Visualize decision making process of a product design in the process of development so that all the stakeholders can participate in the discussion.

The current CAM analysis represents only a simple decision making tool for designing a successful product differentiation. The tool is useful especially for a conceptualization phase of a new product development due to its simplicity and easiness of mastery. Future work must be done for enhancing rationality and objectivity of the scoring process in a matrix-based approach. It is also an important issue to evaluate the degree of “fit” between a target market and a new product as well.

## References

Asmild, M. Paradi, J. Reese, D. *Theoretical perspective of trade-off analysis using DEA*. The International Journal of Management Science, Omega 34, P337-343, 2006.

Aviation Statistics 2008. Ministry of Land, Transport and Infrastructure. Government of Japan.

Bleichrodt, H. Doctor, J. Stolk, E. *A nonparametric elicitation of the equity-efficiency trade-off in cost-utility analysis*. Journal of Health Economics 24, P655-678, 2005.

Boger, B. Fosgerau, M. *The Trade-off Between money and travel time: A test of the theory of reference-dependent preferences*. Journal of Urban Economics 64, P101-115, 2008.

Engel A and Browning R.T. *Designing Systems for Adaptability by Means of Architecture Options*. INCOSE 2006. 16th Annual International Symposium Proceedings. 2006.

Fuji Dream Airline Website. <http://www.fujidreamairlines.com/>. Nov. 27th, 2009.

INCOSE SE Handbook Version 3.1, Appendix L-7 of 14, 2007.

Kim, C. W. and Mauborgne, R. *Blue Ocean Strategy*. Harvard Business School Press in Boston.

Kotler, P. Wong, V. Saunders, J. and Armstrong G. *Principle of Marketing*. Forth European Edition. Pearson Prentice Hall. P421-425, P504. 2005.

Nakayama, H. *Trade-off analysis using parametric optimization techniques*. European Journal of Operational Research 60, P87-98, 1992.

Mitsubishi Aircraft Corporation Website. <http://www.mrj-japan.com/index.html>. Extracted on Nov. 27th, 2009.

Minato, N. Penetration strategy for ATR to Japanese regional air transport market, Toulouse Business School, France, 2007.

Morgan, J and Liker, J. *The Toyota Product Development System*, Productivity Press, N.Y., 2007.

Muhlbacher, Hans. Botschen, Gunther. *The Use of Trade-Off Analysis for the Design of Holiday Travel Package*. Journal of Business Research, 17, P117-131, 1988.

Porter, M. 1979. *How competitive force shape strategy*. Harvard Business Review March-April.

———. 1985. *Competitive Advantage*. Free Press.

The World Aircraft Annual 2008- 2009. Kantosha. 2009.

Walker, Gordon. *Modern Competitive Strategy*. International Edition 2007. McGraw Hill. P3-P19 and P329. 2007.

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