

An index of R&D productivity: To estimate R&D contribution for profit.



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1. Abstract

Some indexes of R&D productivity have existed such as sales vs. R&D expense, operating income vs. R&D expense, and they are used for relative evaluation among competitors etc.

Though top managements would like to know the contribution of R&D expense to sales and profit in a company, the above indexes are not satisfied for them.

It is a issue to how R&D expense contributes sales and profit by using appropriate indexes.

This paper presents an index of R&D productivity to use the R&D contribution for profit.

At first, contribution profit is calculated and then, the contribution profit is divided to two parts, one is R&D,M contribution and the other is Non-R&D,M contribution.

Finally, technology development/product development/research contribution becomes clear.

As a result, contribution of R&D for profit is represented as an index of R&D productivity.

It is important to compare current index with the past index of R&D productivity.

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2. Consideration of Indexes of R&D productivity

2-1. Issues and a structure of indexes

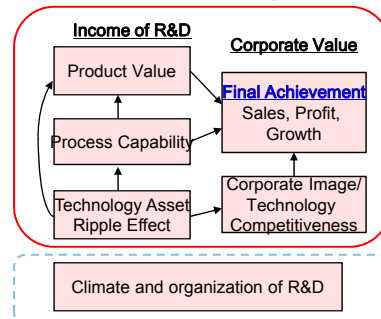
To analysis income of R&D activities and investigate indexes of evaluation for it.

As improvable activity of productivity is maintained, it is important to define indexes of R&D productivity and continue to measure whether it meets target value of indexes of R&D productivity .

Issues

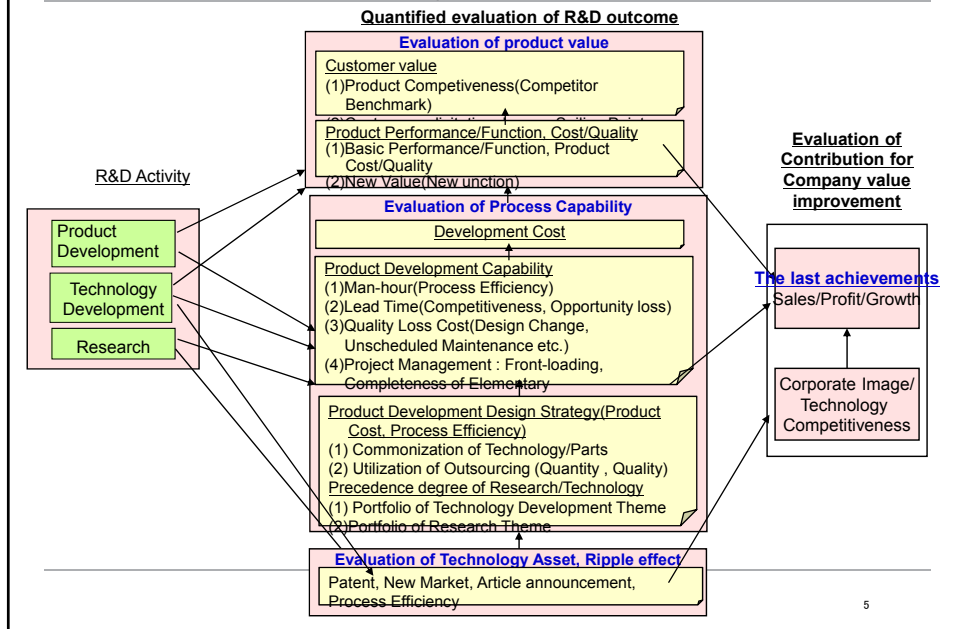
- (1) Is R&D contribution for sales quantified?
- (2) Can R&D productivity measure by indexes of Sales vs. R&D expense, operating income vs. R&D expense ?
- (3) Contribution of research and technology for sales is not clear .

Structure of indexes of R&D productivity



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2-2. View point of analysis and evaluation for R&D



2-3 General Indexes of R&D productivity

2-3-1 Summary

As an index of R&D productivity, R&D expenses rate and R&D efficiency are well-known.

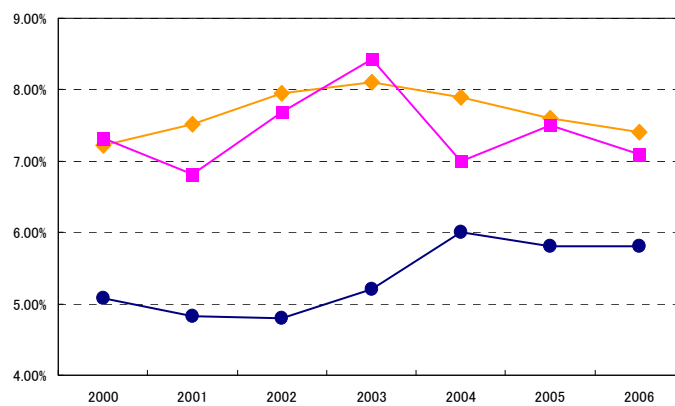
$$(1) \text{R\&D expense rate} = \frac{\text{R\&D expenses}}{\text{Total Sales}}$$

$$(2) \text{R\&D efficiency} = \frac{\text{Operating Income}}{\text{R\&D expenses}}$$

2-3 General Indexes of R&D productivity

2-3-2 R&D expense rate

$$\text{R\&D expense rate} = \frac{\text{R\&D expenses}}{\text{Total Sales}} \quad (\text{Ratio among the total sales of R\&D expenses})$$



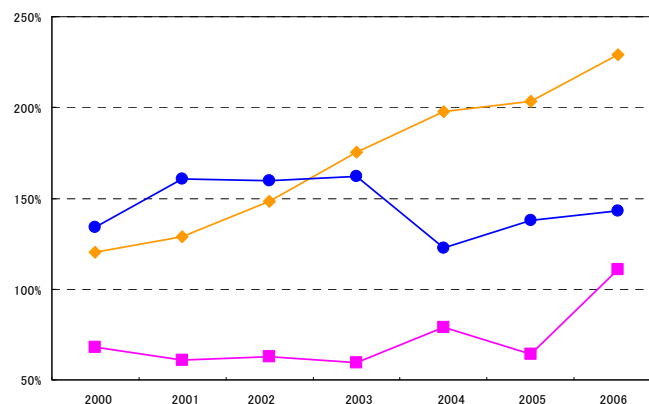
The source : securities report

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2-3 General Indexes of R&D productivity

2-3- 3 R&D efficiency

$$\text{R\&D efficiency} = \frac{\text{Operating Income}}{\text{R\&D expenses}} \quad \begin{array}{l} \text{The action to R\&D and the} \\ \text{consequent operating income is an} \\ \text{index.} \end{array}$$



The source : securities report

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3. Definition of Indexes of R&D productivity

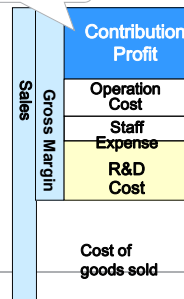
R&D productivity is defined by the ratio of "R&D property as a share of an inheritance to produce product value of the profit" (contribution profit*) and each present worth of "the R&D costs that I spent".

*Contribution profit = marginal income - Direct fixed cost

Definition of Indexes of R&D productivity

R&D productivity (ROI) = R&D contribution profit ** ÷ R&D costs

The profit that a product, business got



R&D contribution profit

** R&D contribution profit = Contribution Profit × Contribution by R&D(%)

Implication of the number of the R&D productivity

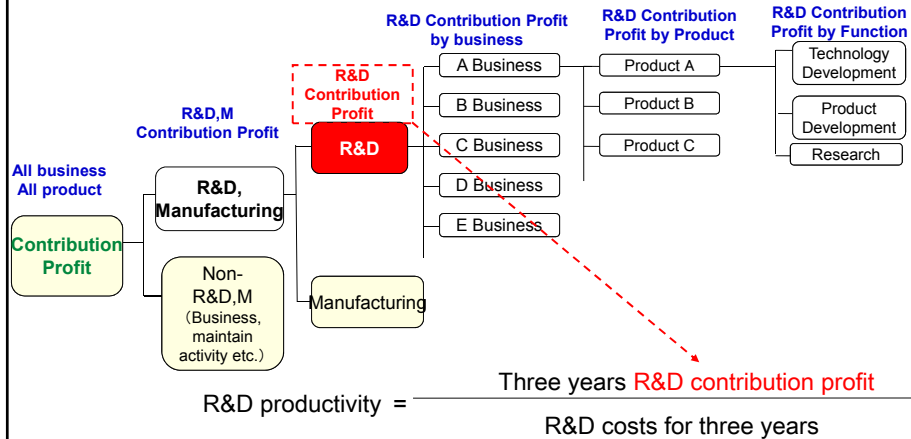
R&D Productivity =0 : The R&D investment collects it, but profit is in state that there is not it

R&D Productivity =1 : The state that realizes profits of the sum same as R&D investment

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4. The analysis of the R&D contribution profit

To get the value of R&D contribution profit, Contribution profit is analyzed and divided into R&D,M contribution profit, and then it is divided into R&D contribution profit.

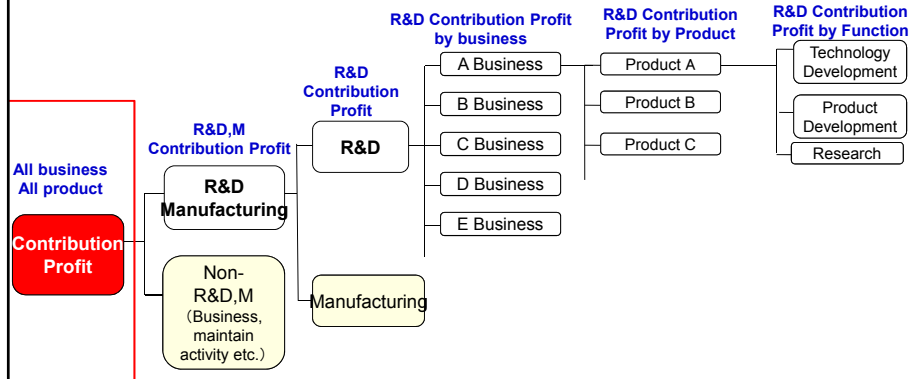


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5. Detailed of the R&D contribution profit structure

5-1. Calculation of the R&D contribution profit

Step1: **Contribution profit** is calculated by value of sales, gross margin, SGA, R&D expense etc..

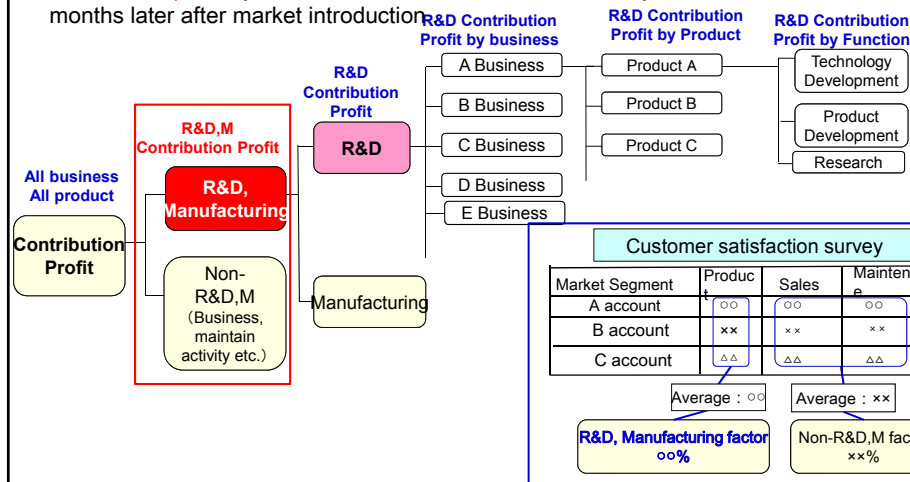


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5. Details of the R&D contribution profit structure

5-2 Technology and non-technology contribution profit

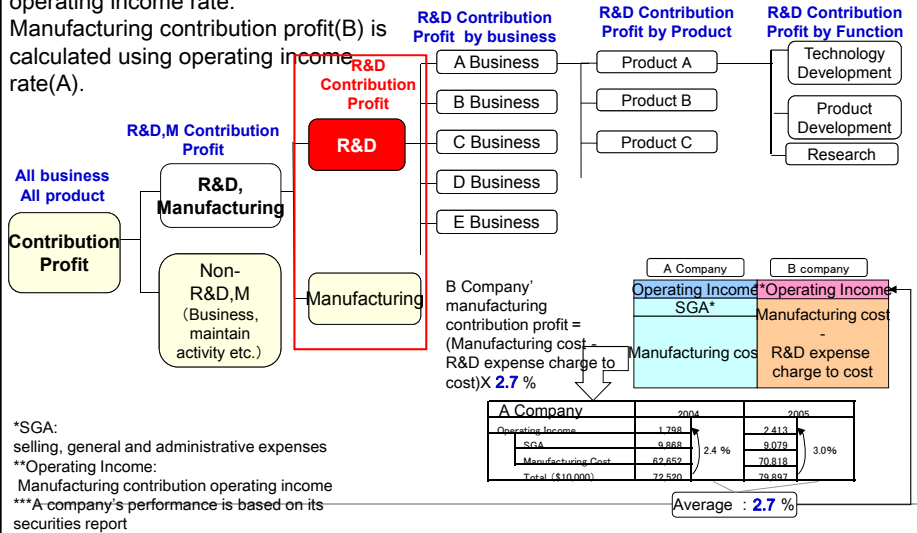
Step2: Contribution profit is divided into **R&D/Manufacturing** and non-R&D,M **contribution profit** by a result of customer satisfaction survey which is done six months later after market introduction.



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5-3 Manufacturing

Step3: R&D,M contribution profit is divided into R&D and Manufacturing contribution profit.
B company's manufacturing contribution operating income is calculated by A company's operating income rate.
Manufacturing contribution profit(B) is calculated using operating income rate(A).



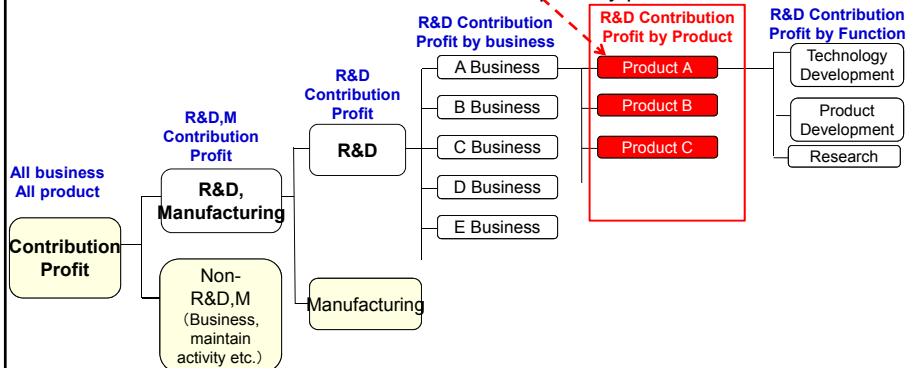
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5-4 Product

Step4: R&D contribution profit by product is calculated in the following expression.

Product A's R&D contribution profit by product =

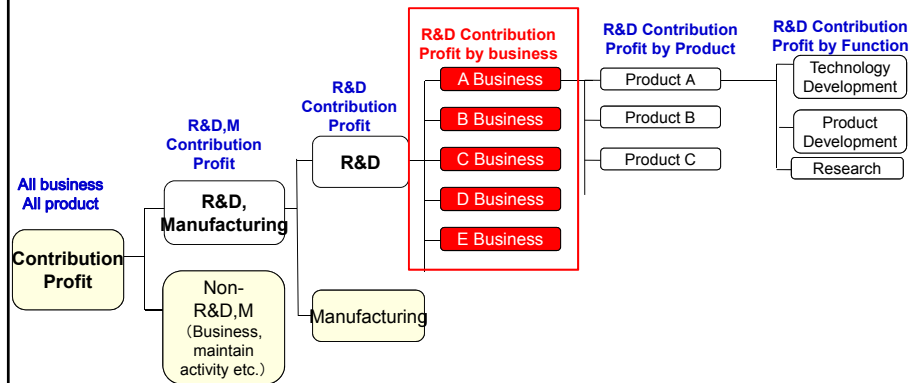
R&D contribution Profit x $\frac{\text{Product A's contribution profit by product}}{\text{The total of contribution profit by product}}$



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5-5 Business

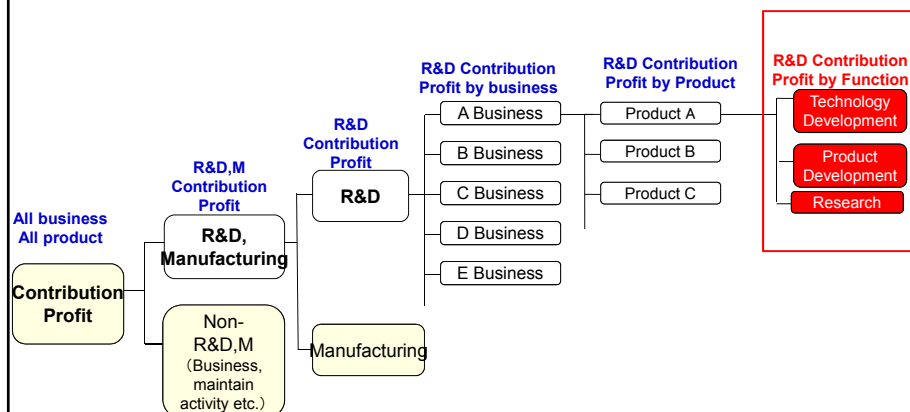
Step5: **R&D contribution profit by business** is added up product A/B/C/others R&D contribution profit by product.



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5-6-1 Function

Step6: **R&D contribution profit by function** is described following page.



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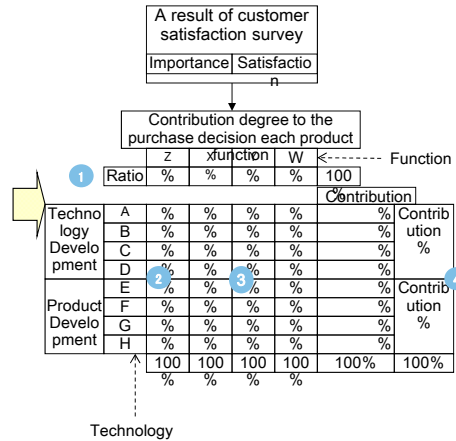
5-6-2 Function

Step7: R&D contribution profit by function is calculated into following steps of calculation.

Step of calculation

Using a result of customer satisfaction survey by product.

- ① A quality function item is replaced with a purchase decision contribution degree.
(Does a customer evaluate which item and purchase it?)
- ② In technology and product development, it is disintegrated by the main technology of the product.
(What kind of technical characteristic and competitiveness is to the product?)
- ③ A technology contribution degree of quality function item in each product is estimated for technology/product development phase.
(For the evaluation of a customer, which/How technology contributed?)
- ④ As a result, it is calculated how technology/product development phase (or technology) is contributed.



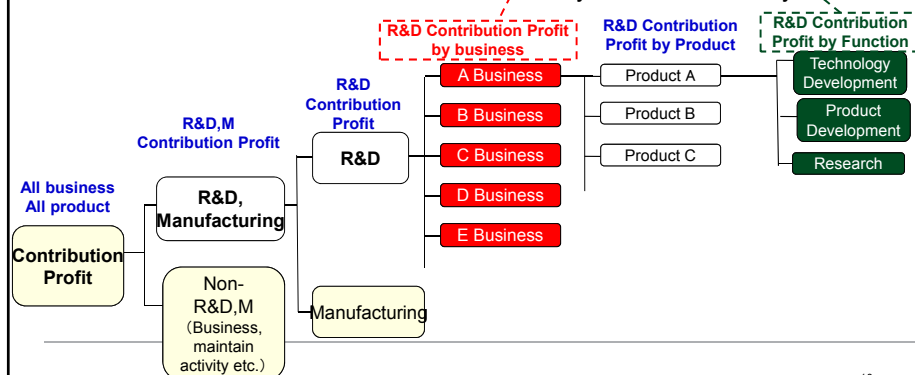
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5-7. The analysis of the R&D contribution profit

Final Step: R&D productivity and R&D productivity by function are calculated into following expressions.

$$\text{R\&D productivity by business} = \frac{\text{Three years R\&D contribution profit by business}}{\text{R\&D costs by business for three years}}$$

$$\text{R\&D productivity by function} = \frac{\text{Three years R\&D contribution profit by function}}{\text{R\&D costs by function for three years}}$$

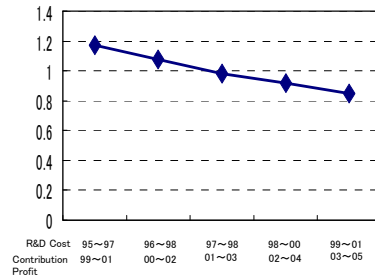


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6. R&D productivity example(1)

✓ R&D productivity by A business is a trend of decreasing continuously

R&D productivity by A business



$$\text{R\&D productivity by business} = \frac{\text{Three years R\&D contribution profit by business}}{\text{R\&D costs by business for three years}}$$

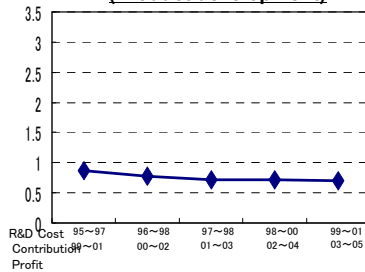
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6. R&D productivity example(2)

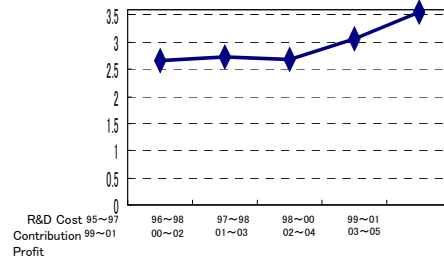
✓ R&D productivity by function(Technology development) is a trend of increasing.

✓ R&D productivity by function(Product development) is a trend of decreasing.

**R&D productivity by function
(Product development)**



**R&D productivity by function
(Technology development)**



$$\text{R\&D productivity by business} = \frac{\text{Three years R\&D contribution profit by business}}{\text{R\&D costs by business for three years}}$$

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7. Conclusion

- (1) Top managements understand the contribution of R&D expense for sales and profit in a company.
- (2) It is important to compare current index with the past index of R&D productivity.

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Appendix. References

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