A Structured Approach for Integrating Technology and Business Strategies

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Abstract

This paper presents a framework for processing a structured approach of R&D investment. It presents nine steps to operate R&D investment from analysis of environment situation to review and feedback its activity. Also fundamental questions for effective R&D management in business are discussed and after that critical eight success factors for R&D investment are discussed.

Key words: R&D, Technology, Strategy, Structured Approach, Investment

1. Introduction

A structured Research and Development (R&D) management had been considered difficult. The standard management and control of technologies used in other parts of organization were therefore considered inappropriate for R&D (Roussel et at., 1991). However, recent changes in the business environment such as opened market, shortened product life cycle, intensified competition, and advanced information and technology, etc. have focused company-wide attention on R&D's contribution to competitive advantage (Kumpe and Bolwijn, 1994; Drongelen and Cook, 1997). Today, R&D in company is no longer considered to have a mere supportive role to the company, but to be a vital part of company (Weed-Nederhof et al., 1997).

R&D investment system, as illustrated in figure 1, is a continuous process, starting from the strategic necessity of R&D, strategic planning, and research implementation, then to product realization and technology development. R&D can be defined as for transforming technology into new product designs and/or process designs based on customer needs, internal and external environment, and company strategy for satisfying stakeholder expectations and improving competitiveness of company (Park, 2002). Management of R&D can be considered as PDCA-based quality management or PDCA-based integration of management systems (Jianxin and Xuemei,

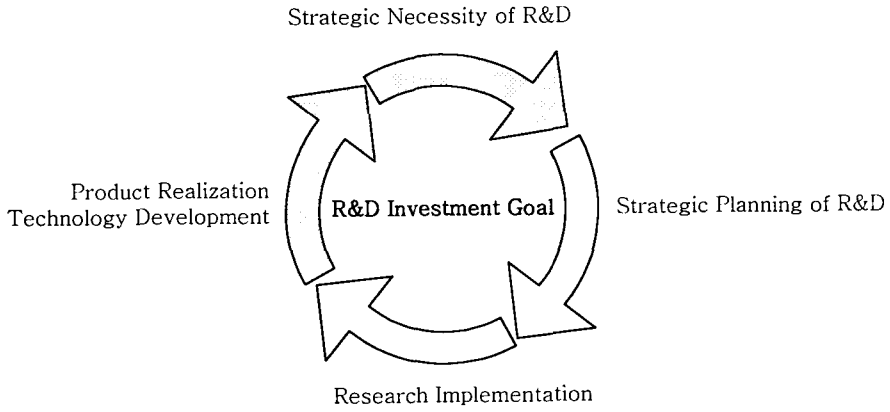

Figure 1. R&D Investment System

2002). Therefore, R&D management system is roughly consist of four steps based on strategic necessary of R&D investment, namely P(strategic and tactical plan how to establish R&D investment), D (do R&D what has been planned), C(check and assess what has been done) and A (product/process realization and act according to the results of check and assess) for satisfying stakeholders as well as competitiveness strengthening of company and product realization (see Figure 2). Successful companies manage technology as an integral part of their business processes.

R&D investment is embodied in the company through top managers, employees, business goal and processes, equipment, and plant. In this paper, a structure approach for integrating technology and business strategies will be described to illustrate an efficient and effective R&D management system in a company.

2. Structured R&D Process

The competitiveness of a product supplied

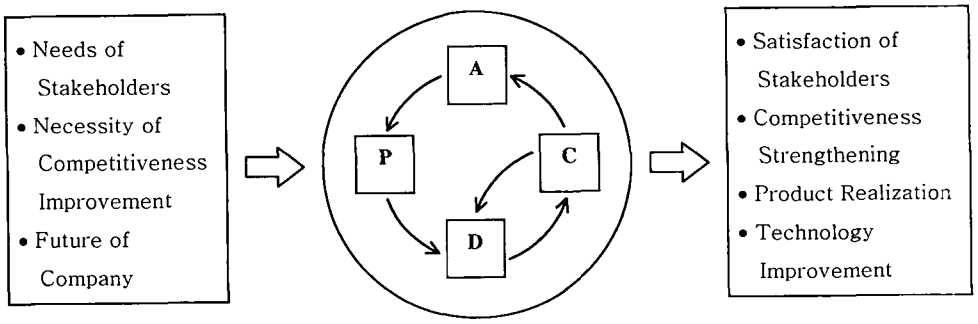

Figure 2. R&D Management System

by company is to a high extent determined by its R&D investment design (see Figure 3); consequently, management in upstream process such as analysis of environment situation, strategic consideration and in particular assess current technology situation needs considerable attention. The followings are a proposed nine steps for processing R&D investments in a company.

Step 1. Formation of Teams

Two different types of R&D promotion team would be necessary to run R&D investment project efficiently. The first would be the R&D research team. An ineffective team will never succeed R&D at the right time and right product. Individual's ability and experience to function effectively as part of a team are just as important as the investment of money for R&D. The second would be R&D cross-functional team for running R&D project management in cooperation with the R&D research team. The R&D cross-functional team must dedicate substantial time and effort to communicate with the R&D research team, assess the validity of current R&D project, and make the research results to be product realization. Easy and open communication between R&D research team and R&D cross-functional team, including periodic meetings, will be a key role for minimizing a development time, failure rate of commercialization and investment money.

- who are the members of R&D research team and what are the main jobs of them?
- who are the members of R&D cross-functional team and what are the main jobs of them?

Step 2. Analysis of environment situation.

The background analysis for R&D investment decision regarding the future of a firm can conveniently be divided into two main categories. There are both internal and external aspects to technology investment decisions. The internal background relates marketing, purchasing, manufacturing, human resources, facilities, distribution, service, sales, finance, and other performances. External background relates competitors, suppliers, politics, legislation, economic conditions, customers and other business environment. Also understanding its current technologies, searching its existing technologies, identifying new emerging technologies, and identifying technologies for future investment should be included at this step.

Step 3. Analysis of technological strengths and weaknesses of company

Successful strategy formation in R&D investment depends on creating a match between the resources available to a firm and the opportunities presented in its environment. Identification of the internal factors of strengths and weaknesses and the external factors of opportunities and threats

is an important step in the R&D investment strategy formation process. Use of a SWOT matrix and/or Strategic Gaps Analysis(Karol, Loeser and Tait, 2002) would be a very helpful tool for this purpose. The following questions would be answered;

- what are the technical strengths and weaknesses of the company in current situation?
- what are the strengths and weaknesses that will determine its future prospects?
- what are the opportunities and threats of the company that will meet in its future?
- what are the gaps (i.e., technology, market, process, and etc) between company's current position and the target?

Step 4. Consideration of business strategy and technology strategy

Most formal business strategy planning processes start with studies of the external and internal environments as discussed at the step 2. If not preempted by competitors or necessary, these may form the basis of future strategies for the business. To the extent that consideration of existing, key and emerging technologies are critical elements to setup business strategy and technology strategy in this step. The following questions might be answered in this step;

- to what extent technology relevant to the business
- where will we get the required technology
- what are core technologies for the business
- who are the stakeholders and how to satisfy the stakeholders
- what are the main purpose due to the R&D investment in a future profit, margin, quality, and etc?
- what are the important market-place needs and opportunities for technology in products or services that the company should target?
- how can R&D strategy be integrated with the business strategy?

Step 5. Assess current technology situation and select R&D investment

First, a full understanding of the company's current technology position is intended. Before selecting R&D investment, it is necessary to identify suitable candidates. And then based on a series of potential candidates for future R&D investment, a process of evaluation and selection of R&D is processed. Situations of finance, human resources, and facilities of the company should be considered. It would be better to setup technology roadmap for determining the desired technology option, including internal R&D programs, acquisition and/or technology transfer (Bone and Saxon, 2000). The main result of this step is a prioritized list of attractive R&D investment projects. The following questions would be answered in this step;

- what specific criteria should be used to assess current technology situation?

- what specific criteria should be used to select R&D investment?

Step 6. Develop tactical project plan and execute technology investments

Team should develop a detailed project tactical plan that identifies activities critical to achieving project goals based on the company situation. Tactical planning for R&D involves developing clear goals and milestone measurements before laying out tasks. The emphasis should be on addressing unknowns and validating assumptions, as early as possible (Lester, 1998). Effective project management requires the development and implementation of a detailed project tactical plan that leads to a successful new product as fast as possible. If a selected project is not valuable to the company, knockout of project should be performed sooner, allowing reallocation of resources to other project. If necessary, move to step 5 for selecting other technology portfolio.

- how will both financial and non-financial resources be allocated and prioritized in R&D investment?

Step 7. Monitor and assess technology investments performance

In order to evaluate R&D investment performance, reduce uncertainty as early as possible by moving from unknown factors, and identify possible areas for future research, appropriate monitoring and assessment system should be used. It should be noted that great care has to be taken when determining and using indicators for performance measurement in R&D investment. The most comprehensive measure of R&D performance may be a measure of the success such as market share, quality, productivity, and profits that the company eventually achieves in the market due to the R&D investment in a future. The information accumulated at this step shall be used at the step 9. If necessary, move to step 6 for adjusting the tactical plan. The following questions shall be answered in this step;

- how can performance of R&D investment be measured and evaluated in terms of operational effectiveness?
- how can a company continuously monitor R&D process in an efficient way?
- how can a company reduce uncertainty as early as possible by moving from unknown and assumptions to factors?
- how can a company handle time lag between R&D and product realization?
- how can a company handle the difficulty in isolating the contribution of R&D to company success?
- how can a company handle differences of performance measurement results between assessor and researchers?

Step 8. Transfer technology results to its production

The efforts of R&D investment must have a pay-off. The utilization of the results in products would be the ultimate goals. The

following four steps would be good for product development (Lester 1998). (1) concept development : compelling new product concept that appears viable from technical and business perspectives. (2) feasibility assessment : completed lab scale assessment that technology is feasible and business opportunity is viable. (3) field demonstration : completed field demonstration of pilot-scale product performance and confirmed viability of business opportunity. (4) commercial scale-up : validated business plan, and initial manufacturing and product sales. R&D research team and R&D cross-functional team have to reduce unknowns and assumptions as early as possible for shorting product-realization time and identifying knockout projects. The questions shell be answered in this step 7;

- how can results of R&D be used in the company of new products and/or other applications?
- how can a company improve the probability of success during R&D process?

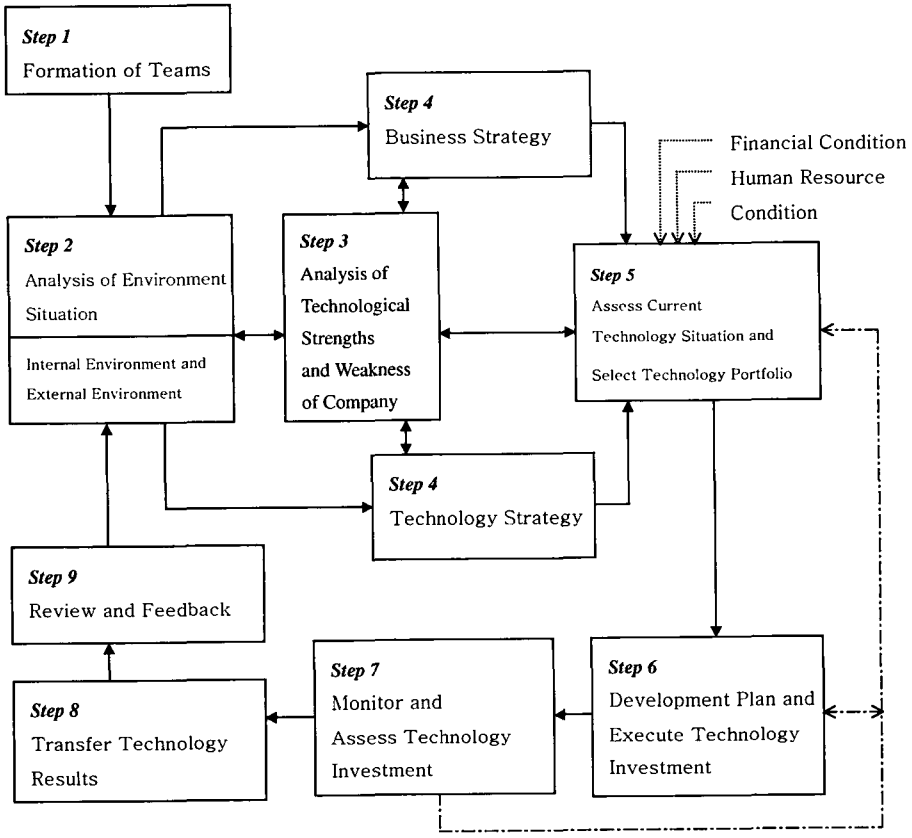

Figure 3. R&D Project Process

Step 9. Review and feedback its activity

The final step is a review and feedback activity. In managing technology in a rapidly changing environment it is vital to monitor continuously the activity. Also the information should be used as an assess process for the next R&D investment project. The following question should be considered at this step.

- how and what can a company review and feedback its activity in R&D management and business management in a effective way?
- how do internal customers see R&D project process and it's result?
- how do external customers see the output of R&D project?

3. Critical Success Factors for R&D

The success of R&D effort depends on 8 critical factors as the followings (see Figure 4);

(1) **Strategic leadership** : R&D is a continuous management process that is clearly mapped and communicated within the organization and to other business processes. Thus senior management commitment and support form an essential foundation of support for R&D to success. Major elements include vision, goal and objective, strategy, and sponsorship based on leadership. These provide a driving force for major initiatives and efforts.

(2) **CTO(Chief Technology Officer)** : His responsibility is managing the flow and direction of R&D activities (research, technology strategy, engineering and technology outsourcing) to meet the goals of the company and also controlling the resources that the R&D research team will need to reach product implementation and commercialization. CTO should have vision, leadership and business concept and also good communication channel with top managers of the company to run R&D project more efficiently and effectively.

(3) **Organizational support** : Firm must support and reward individuals who are engaged in R&D efficiently and effectively based on firm's R&D strategy and performance. Individuals who involved in R&D must believe that senior management will support innovative thinking and grant the time required for successful results.

(4) **Formation of ability R&D research team** : Individuals who have ability, skill and experience should be as part of a team.

(5) **Formation of R&D cross-functional team** : Team is formed early with the goal of staying together from concept development through full commercialization

and review step. Typically 4-9 members of team size will be good. The results of R&D must adequately address a number of questions such as how the product will be manufactured, how the product provides value to the customers, how the product will successfully compete with present and potential products, what the financial profits to the company might be, and what the product fit with the company's business and technology strategy. R&D team and cross-functional team should communicate and share information in a regular base time.

(6) **Project management** : Firm have to setup effective project management system and develop a detailed project tactical plan that identifies tasks critical to achieving R&D project goal.

(7) **Performance measurement** : There are two major purposes for performance measurement of R&D investment. First, performance measurement can serve to motivate people. The second purpose is associated with diagnosing project activities and organizational units. A diagnostic approach can be used to assess if problems can be expected. However, when trying to assess these, major problems are encountered. The first problem would be the time lag between R&D efforts and the potential financial rewards to the company. and the second problem may be the difficulty in isolating the contribution of R&D to company success (Drongelen, 1997). The last problem would be the acceptance of performance measurement by R&D staffs.

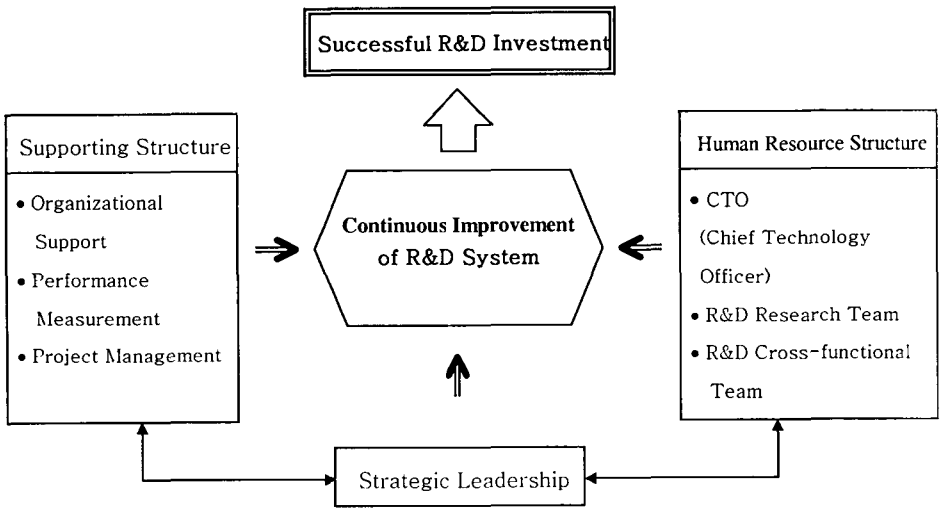

Figure 4. Success Factors of R&D

(8) Communications : R&D research team and R&D cross-functional team as well as top managers should share a common understanding of the process for the R&D projects. Easy and open communication between R&D teams and R&D Cross-Functional Team, including periodic meetings, will be a key role for minimizing a development time, failure rate of commercialization and investment money.

4. Concluding Remarks

In this paper a structured framework for processing R&D investment have been discussed. Starting from nine steps for determining R& D investment, fundamental questions for effective R&D management in business and eight critical success factors are discussed. From the literature overview it has become apparent that although quite a lot has already been written about structured approach of technology investment, there are still many areas that need future study.

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