Strategic Management for Sustainable Innovation
--- Effective Manner for Growing Japanese High-Tech Start-ups ---

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ABSTRUCT: Field Emission Lamp (FEL) technology is one of the hopeful new green light technologies to realize ecological social lives in the future. The paper describes two cases of commercializing the technology as a high-tech start-up business.

In general, start-up business is said to be an effective way for developing new business of commercializing advanced technologies which were developed in universities. Particularly in the USA, huge amount of money is invested to hopeful high-tech start-ups from the expectation for J-curve, rapid growth of sales of new products and high return to the investors. To get high return for investment and rapid growth of sales, most of start-up enterprises target huge market and focus on developing such drastic application field.

However, this kind of management manner would be effective only if they have some circumstance conditions as indicated below.

A) They have relevant supports on business strategy and human resource, such as “hands-on” by capitalists.

B) They have continuous, strong supports on finance and technology.

C) Good timing/matching on technology advancement and market growth

The paper analyzes two kinds of management manners on start-up businesses of developing FEL in Japan, and discusses about the effectiveness of them in respect to surrounding circumstance conditions. As a result, it was implicated that a management manner aiming for sustainable innovation and moderate growth in middle size market area by utilizing alliance with large enterprises is more effective for growing high-tech start-ups in current Japanese society than what we call J-curve, American-style venturing manner.

KEYWORKD: sustainable innovation, high-tech, start-up

1. INTRODUCTION AND BACKGROUND

Ever since the1990s, the period called as “the lost 10 years,” the manufacturing industries in Japan have not yet sufficiently recovered from long depression. One reason, as some people pointed out, would be that the manufacturing industries in Japan inclined toward what we call “process innovations” and was largely behind in “product innovations.” Since the 1990s, the industrial architecture has rapidly changed in globalization by the spread of Internet technology. That is, many manufacturing/production bases have moved from the developed countries to the developing countries including China, as theoretically pointed out by Vernon(1966). In such situations, many enterprises in developed countries should survive in severe

competition with the developing countries not only by process innovation but also by product innovation. To create new markets by developing new products beyond what we call “Death Valley,” is essentially needed for those enterprises. One of the reasons why the USA could reactivated the economy in 1990s was that they had established the social framework of supporting product innovations, in which small start-up enterprises commercialize seed technologies, developed by universities, and large enterprises expand their business by M&A of successful start-ups. In this framework, roles of high-tech start-ups are very important for industrial vitalization. In this context, growing high-tech start-ups is especially important also for Japan that has been still facing a serious economical depression. However, the reality is that most of the high-tech start-ups have not been grown enough to make a social role. One urgent issue is to clarify the reason of difficulty of growing high-tech start-ups in Japan and establish a social framework to guide us toward prosperity.

This paper focuses on one hopeful advanced technology, called Field Emission Lamp (FEL) to discuss the issue.

Because FEL would enable to reduce energy consumption more than conventional incandescent lamps and fluorescent lamps, FEL is expected to establish the huge markets as a new lighting device.

In this paper, two cases of start-up business on FEL’s technology are described to clarify the way to grow up high-tech start-ups in Japan. In both cases, the first author of this paper, Hiraki, played a significant role as a business founder and a principal engineer of FEL technology. Therefore, the authors can describe the details of these business cases and can analyze the deep factors of success/failure of them.

The first case is a first start-up enterprise founded by Hiraki and other members, which was intended to realize what is called an American style, J-curved venture. In spite of the aggressive effort on R&D by the staff engineers and investment of one billion yen by venture capitals, the enterprise went bankrupt after 6 years. The main reason of the bankrupt was thought to be un-fitting to Japanese business circumstance, as discussed later.

The second case is also a start-up enterprise on FEL business secondly founded by Hiraki, which was aimed to be what is called a Japanese style, sustainably growing, small enterprise. The management style and policy of the second enterprise was quite different from that of the first one. Japanese-style management manner for not dramatic but sustainable growing was adopted and collaboration with other enterprises and penetration into a small niche market were the basic strategy of the enterprise. So far in the period of one year after foundation, it has been still actively growing in the Japanese business circumstance.

Through comparative research of the two cases and two different management manners, the relevant manner to grow high-tech start-ups in the Japanese business circumstance will be analyzed. The analysis also will implicate the reason why so many high-tech start-ups in Japan were depressed and how to overcome the obstacles for them to grow their business.

2. FRAMEWORK OF RESEARCH

2.1 Research questions

For the questions what kind of roles high-tech start-ups should play in the industrial architecture mainly regarding “product innovation,” and how they should be managed to achieve a business success, earlier studies have pointed out the following situations.[1),2)]

1) In the commercialization of technology, the high-tech start-ups play important roles as mediators

between seed technologies developed by universities and commercialization by large enterprises.

2) From the viewpoint of R&D investments, the high-tech start-ups need much amount of investments from venture capitals, so the high-tech start-ups naturally have tendencies to select a business and a technology that will lead huge returns for investments. That is, the high-tech start-ups are needed to set about developments that should have great impacts on industrial architecture and should make large profits through large-scale business.

Based on these backgrounds, American-style industrial structure and social infrastructure are designed and established as indicated in the following items.

- R&D through universities
- Entrepreneurship of students and researchers
- Legal systems such as" Bayh・Dole" to support high-tech start-ups
- A large number of venture capitals and angels and huge amount of investments
- Management direction of large enterprises to utilize cooperated venturing and M&A.
- Office organization and personnel systems of enterprises based on working mobility and job transfers

These factors have a tight linkage and close relationship with American-style management manners of J-curve growing high-tech start-ups in the USA.

In contrast, Japanese society has different situations and different backgrounds, so that the relevant management manners of high-tech start-ups in Japanese business circumstance may be somewhat different from that in the USA.

Our research questions are summarized in the following two points.

1) Is American-style management manner for high-tech start-ups effective at the business circumstance in Japan?
2) If it is not effective, what kind of management manner is effective for high-tech start-ups in Japan?

2.2 Research methodology

The research is based on case studies. Two different styles of management on high-tech start-ups are compared. In order to focus on the difference of management, two object cases have many similarities of technology (FEL), human resource (the same founder, Hiraki) and business circumstance. In this scheme, the cases will be compared taking account of the following standpoints.

1) effectiveness of American-style management manner aiming J-curve dramatic growth in major, mass market in respect to outside business circumstance factors
2) effectiveness of Japanese-style management manner aiming sustainable growth in small niche market in respect to outside business circumstance factors

The final purpose of the research is to get some implications to find out a relevant management manner of high-tech start-ups in Japan for encouraging Japanese production industries.

2.3 Analysis framework

To clarify the differences and the similarities of two cases and characterize them, the object two cases are described for the following three items.

1) Technological development
2) Business management
3) Analysis on the factors of success/failure

After describing two cases on the above-mentioned scheme, two cases will be compared to discuss the adoptability of management style/manner and business circumstance.

The framework of analysis is schematically shown in the figure 1.

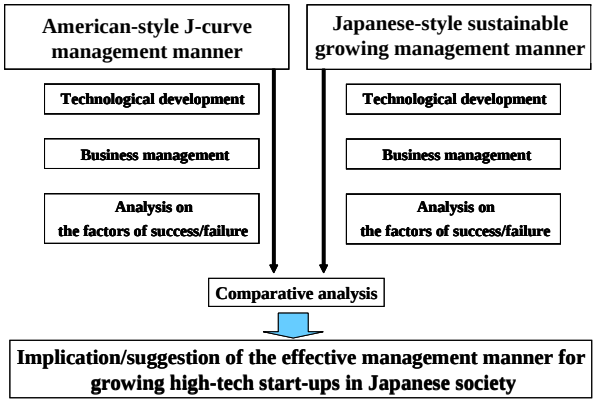

Fig.1 Analysis framework

3. CASE 1: AMERICAN-STYLE J-CURVE VENTURING MANNER

3.1. Technological development

Basic technology

To achieve a business success by a high-tech start-up aiming J-curve growth, they should focus on making great impacts on major, mass market in industries. That is why the case enterprise was targeting large new green lighting device market by FEL, which is using nano-carbon electron emitter of low power consumption than conventional fluorescent lamps.

The origin of this basic technology (Electron emission from nano-carbon materials) came from research results of Prof. Hiraki who was an emeritus professor of Osaka University and Kochi University of Technology. So this high-tech start-up fell into a category of the start-ups from universities. Before their launching the high-tech start-up, electron emission property of the nano-carbon emitter had already been reported with one of the world's most eminent properties. Three researchers including Hiraki transferred the technology to the high-tech start-up from the national project (R&D on nano-carbon emitters) and they continued the engineering research on FEL. They believed that if the technological superiority can be realized in the practical market scene, this high-tech start-up will be the No.1 enterprise in lighting industry.

Target fields

According to the initial strategy, it was planned to expand the business into the field of general lighting. However, the target field of their business was changed from general lighting to backlight for LCD-TV later. There were two reasons for such a strategy change.

1) General lighting market has a high barrier for entry/penetration by new lighting technologies by the following reasons.
   - Special distribution channels
   - Small profits
   - Need to pass a lot of standards

2) Backlight for LCD-TV was a remarkable technology at that timing, and their market was expected to be very hopeful by the following reasons.
   - Flat-type backlights were hopeful.
   - Low cost and low power consumption were strongly desirable.
   - FEL could satisfy both of the above-mentioned requests.
   - The position of FEL was also indicated hopeful in terms of this application as shown in the figure 2.

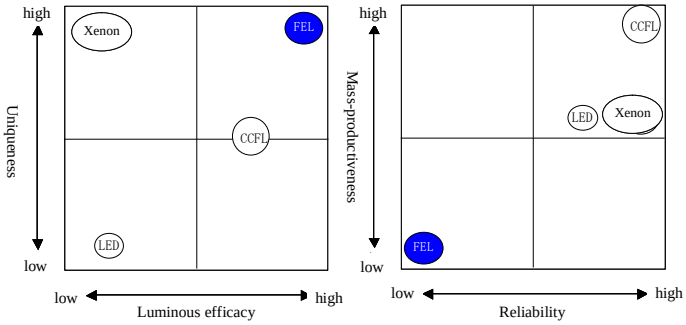

Fig.2 Technological positioning of FEL

The left side of Fig 2 shows comparison for uniqueness and luminous efficacy, the right side of Fig 2 shows comparison for reliability and mass-productiveness. As can be seen, FEL is positioned in the best part on the left side, but in the worst part on the right side. As for the worst position, staffs of this high-tech start-up were lack of the experience of practical utilization, product reliability technology, and mass-production itself. It was implicated that FEL can be a superior technology comparing to any other light source technologies, if the reliability issue and mass-production technology is completely established in the near future.

Items of development

In summary, the main items of development in the case were below.

1) R&D for nano-carbon materials and manufacturing methods of them.
2) Search for applications of using electron emission properties such as FEL.
3) Provision of license such as above technologies, know-how and patents.

3.2. Business management

Organization

Dialight Japan Corp., aiming American-style J-cuve growth, was established at Osaka in May,2004.

The members of the enterprise organization consisted of the below four categories.

1) Chairperson: The professor who invented this technology.
2) President: An engineer, a friend of the chairperson.
3) A specialist of finance and sales.
4) Three excellent engineers

The board members consisted not only of a professor from university but also of persons from other enterprises in order to build up the strength of the management. However, the president was an engineer from a large enterprise and two engineers were doctors from China, so it seemed that Dialight Japan had not a strong power in management. In such a sense, it was a very technology-oriented enterprise.

It was almost impossible for the high-tech start-up to challenge and act without any assistance by large enterprises at the huge and rapid growth market like backlights for LCD-TV. So the board members, including Hiraki, had focused to develop nano-carbon emitter that was their core technology, taking into account of the technology transfer to large enterprises in the future.

In such situation, the business tactics of the enterprise was formed as follows.

1) No investment in large fixed cost such as product equipments.
2) Intellectual properties are their main products.
3) The license fees by R&D will be the main profits.
4) Especially initial royalties will be important in order to recover a loss early.

The transition of business management

There were three business phases in management of the enterprise. The three phases strongly depended on the technological situations as indicated in followings.

1) Prototype stage for flat FEL devices
2) Development/business stage of flat FEL backlights for LCD-TVs
3) Development/business stage of common light devices by FEL technology

The figure 3 indicates the whole flow of development/business during the whole history of the enterprise.

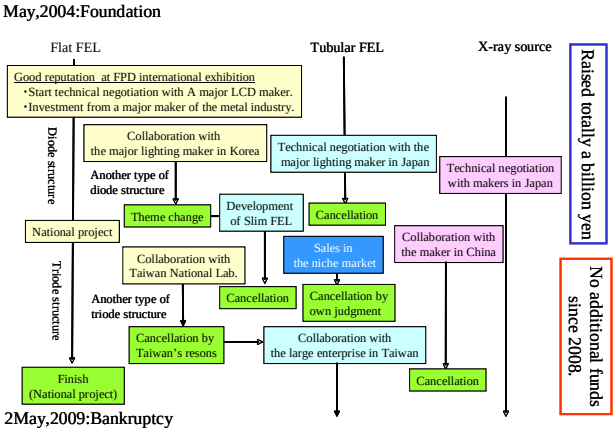

Fig.3 Business flow of the start-up enterprise

As shown in the figure, many varieties of technological subjects were researched in the short period. The main reason for such changing and waving of research subjects is a lack of budget. They could not continue the stable development by the shortage of budget, but this waving of development manner caused larger shortage of budget by excess investment of additional equipments and also caused a bad relationship with collaborating partner enterprises. As a result, the inconsistent R&D tactics and failure of financial management led the enterprise to bankrupt.

3.3. Analysis on success/failure of business

1) Immature management manner on technology/finance tactics and lack of capability of producing return for investment
2) Immature management manner on organization operation, collaboration with outside partners and communication between staff members and top managers.

Of course, the main reason of the failure should attribute to themselves, however if the enterprise was handed on by mature venture capitalists and instructed on management manner in addition to the sufficient financial support as in the USA, they could further advance and might avoid the failure. In that aspect, another reason of the failure is insufficient Japanese business infrastructure to support high-tech start-ups as follows.

1) Insufficient financial support by venture capitalists
2) Effective hand on by capitalists for management manner on organization operation, technology tactics, and financial tactics
3) Lack of business experience of growing start-ups for engineers and top managers

Taking account of many other cases of the failure of high-tech start-ups in Japan, the insufficient business infrastructure is a serious social issue. And in this reality, it is implicated that American-style management manner for J-curve growing start-up enterprises may be irrelevant or ineffective in Japanese business circumstance.

4. CASE2: JAPANESE-STYLE SUSTAINABLE GROWING MANAGEMENT

4.1. Technology Strategy

It may take time to establish business infrastructure to support start-ups in Japan, so that the realistic solution for Japanese start-ups is to change their management manner to adopt to the social circumstance in Japan.

The second case is also a start-up enterprise on the same FEL technology by the same founder, Hiraki. The difference is the new management manner changed from the previous case. Instead of aiming American style J-curve dramatic growth in major, mass market, the new enterprise is aiming moderate but sustainable growth in small niche market. By this change of strategy, they don't need so much amount of investment by venture capitalists. Thus, they don't need to make much return for investment, and the requirement for their financial operation can be reduced. Management of start-up enterprises becomes easier for engineers and top managers, even when they don't have

sufficient support of handing on by venture capitalists.

By this kind of discussion, the relevant management style in Japan can be summarized as follows.

1) Business tactics to operate a business in small niche market with small amount of production and make a sustainable relationship with special stable customers
2) The long-time continuous collaboration with many large partner enterprises may be more important in such a situation
3) Do not aim a dramatic growth but aim to accumulate many stable small transactions with patience
4) Manage the enterprise organization in Japanese style by respecting mutual collaboration, exchanging information, and cooperation

By the above-mentioned business tactics, the target application of FEL technology was changed. The figure 4 indicates many future applications for FEL.

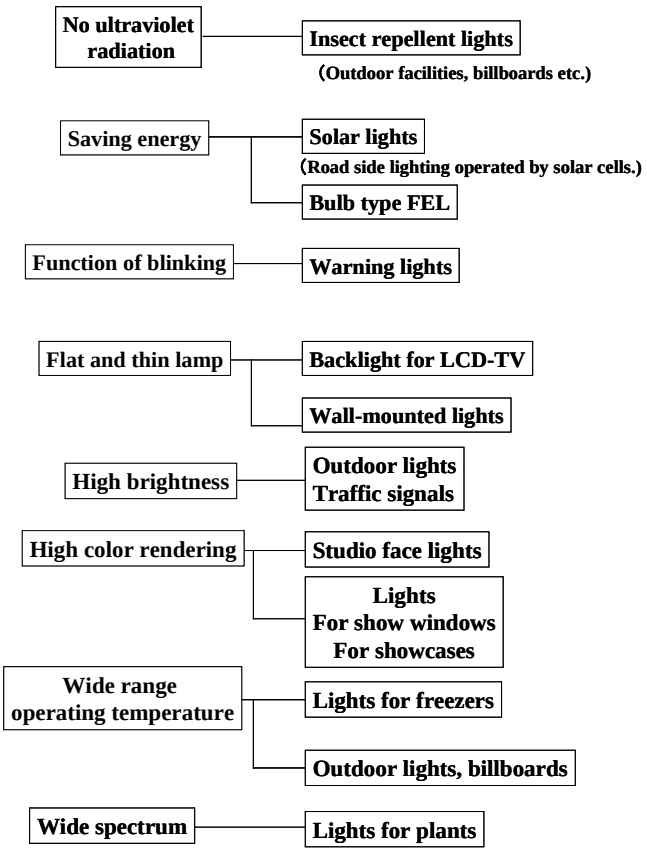

Fig.4 Application map of FEL

The target market area can be selected by the new management manner. In the case, many small markets can be selected by utilizing the competitive strength of FEL technology. The strength of FEL are summarized as follows.

1) Free from Hg use
2) Instant lighting: rapid attaining to 100% brightness
3) High color rendering
4) Easiness of controlling brightness
5) Broad temperature range of usage (-50℃～+80℃)
6) No emission of ultraviolet rays
7) High brightness radiation (Whereas, length of life time should be improved.)

On the contrary, the weakness of FEL technology is summarized as follows.

1) Insufficient efficiency of emission (40lm/W)
2) High driving voltage(over 5kV): difficulty in office usage as a general lighting device

Based on the new tactics of developing technology, target markets do not include a general lighting but many niche application areas based on their strength as follows.

1) Instant lighting: alarm lighting in tunnel, lighting for fishing
2) High color rendering : Face light for TV studio, light for art works
3) Easiness of controlling brightness: lighting in henhouse, lighting in plant farm
4) Broad temperature range of usage (-50℃～+80℃) : special light using in refrigerator storehouse, reach in case, sauna bath

Some other applications, such as lighting for evaluating solar panel, are on the way of development.

4.2. Business management

As mentioned before, the long-time continuous collaboration with many large partner enterprises

may be one important tactics for the enterprise. Particularly, in order to penetrate the major lighting market in the near future after establishing the basis of the business, to conclude a contract with a large enterprise that has a power of mass production and sales channel is realistic way for the small start-up enterprise.

In the case, the enterprise established a fairly good collaborative relationship with a certain Taiwanese large general electronics enterprise along this tactics. They decided to collaborate in the following two points.

1) Joint-development of FEL devices
2) Preparation for mass production and retail sales in the near future

These collaborations bring some merits for both sides.

For the large enterprise:

1) Absorbing FEL technology through the license contract.
2) Profit through mass production and sales of FEL devices in the near future

For the start-up enterprise:

1) Realizing business in the mainstream market
2) Accelerating the development speed
3) Getting reliability/credibility in the market
4) Getting financial support

On the other hand, the collaborations have also some problems. Although the start-up enterprise needs to penetrate the niche markets, the large enterprise directs to the mass market and they are not so collaborative for penetrating the niche markets. So that, to solve this contradiction is one urgent issue for the start-up enterprise.

They found the clue to solve this problem as schematically indicated in the figure 5.

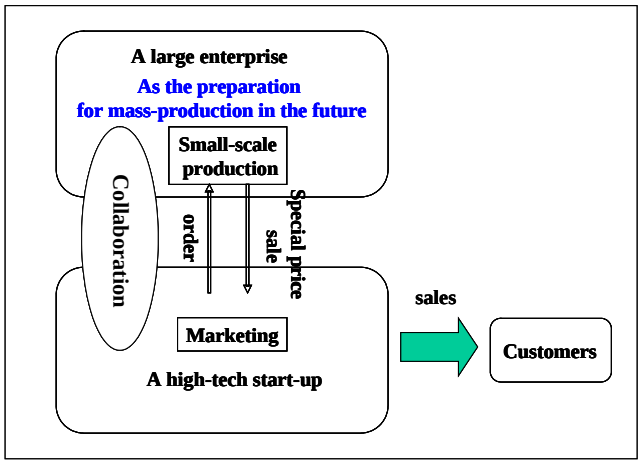

Fig.5 Collaboration scheme in the case 2

The idea is as follows. The large enterprise produces a small amount of FEL items for the niche market instead of the start-up and provides them to the start-up with low prices. This supports the start-up to penetrate the niche market, and also it is beneficial for the large enterprise to prepare the mass production in the near future by establishing production technology of FEL.

By utilizing these management tactics, the start-up enterprise secondly founded by the same engineering entrepreneur, Hiraki, has been carried on in good financial condition so far.

4.3. Analysis on success/failure of business

Looking at the previous history after the Second World War, Japan has been grown up by mass production and mass sales of industrial items. The social framework in Japan was formed to realize larger growth of economy in the specific situation and resulted many business culture indicated as follows; life-time-employment, seniority system, partnership between labor and management, sharing stocks system, Keiretsu relationship among small and medium enterprises, bid-rigging, family company, academic background-oriented society, authority orientation, conformity, government initiative, avoiding risk, and so forth. Even in the 21st century of globalization, in spite of the drastic

change of international business circumstance, Japanese society has been still maintaining some of their business culture and customs.

The business circumstance on supporting start-up enterprises is quite different in Japan and the USA because of their historical background. The reason why the second case of start-up business is more successful in Japan would attribute to the difference of social framework and background of business culture.

Although the first case American style management manner for J-curve high-tech start-up on FEL was not successful, the second case Japanese style management manner for sustainable growing start-up was relatively successful so far. The reason is that American style start-up needs social support as realized in Silicon Valley.

The case implicates that Japanese management manner is more effective and relevant for growing start-ups in Japan. Whereas, if the start-up is thinking about penetrate to the major market finally, they need to utilize both manners in balance and strong partnership/collaboration with a large enterprise is much important for their advance.

5. CONCLUSION AND THE FUTURE ISSUES

Two cases of high-tech start-ups on FEL(Field Emission Lamp) technology were described and analyzed. The cases were founded and managed by the same engineer, Hiraki as first author of this paper. Because the author himself was a top manager of both cases, the details of technology and business were deeply analyzed to find out the clues to grow high-tech start-up enterprises in Japanese business circumstance.

The obtained implications are summarized as follows.

1) There are difficulties to grow high-tech start-ups by American style J-curve venturing manner in Japanese business circumstance. The difficulties are caused by three main reasons, such as insufficient financial support to start-ups by venture capitalists, lack of capitalists' handing on for managing technology, organization and business strategy, and lack of maturity and experience of growing start-up business for engineers and top managers.
2) Japanese style sustainable growing manner for start-ups may be more relevant in Japan, because social business infrastructure for supporting start-ups is not sufficiently established in Japan. In that reality, the management manner of focusing on the niche markets by collaborating with partner, large enterprises with long time relationship were effective. Not only the collaboration with outside partners, the collaboration among inside organization employees is also very important.

The background of the relevancy of these two kinds of management manners is related with social infrastructure, business culture, industrial architecture, and so forth.

To grow up American style J-curve start-up enterprises in Japan, financial support and effective handing on by venture capitalists and accumulation of experience of managing start-up for engineers and top managers are essential.

To pursue precise analysis on social background and analyze the conditions of start-ups' success, the further research on many other cases and some statistical approach for inducing universal implications is needed.

APPRECIATION

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