Part II

Financing Support Promotion

Chapter 5. Financing Policy for Innovative SMEs

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Innovative SMEs in an economy suffer from financial constraints in the market due to information asymmetry problems, lack of collaterals and difficulties to collateralize technology and IPRs. These financial problems are critically associated with each development stage of innovative SMEs and with successful commercialization of SMEs' new technologies. Moreover, due to inefficient financial market institutions in most of developing economies, governments in developing economies have every reason to intervene in providing direct and indirect financial supports, in the form of loans or capitals. The financing policy course can be a channel to acquire the essential parts of implementing government financing policies in the developing economies through lectures on the theoretical backgrounds, practical case studies, and in-depth roundtable discussions. Through the course, the trainees can be equipped with capability to develop more articulated and customized financing policies in a developing economy context.

1. Introduction

1.1. General Description

Innovative SMEs suffer from financial constraints in market due to information asymmetry problems, lack of collaterals and difficulties to collateralize their own technology and IPRs. These financial constraints can be raised up in each development stage of innovative SMEs and also in the procedure of commercialization of SMEs' new technologies. Due to inefficient financial market institutions in the most of developing economies, developing economies' governments have every reason to intervene in providing direct and indirect financial supports, both in loans and capitals. This 'financing policy' course can be a channel to acquire several essential parts of implementing financing policies in the developing economies by learning theoretical backgrounds, practical case studies, and in-depth roundtable discussions. Through this course, the trainees can be equipped with capability to develop more articulated and customized financing policies in a developing economy context.

The theme of the workshop is "Linkage of technology development to marketing." The theme of the workshop indicates the final goals of this workshop are to learn how to transfer the technological achievements of SMEs to market success. In order to achieve successful transfer and commercialization of new technologies, financing is an essential ingredient. Innovative SMEs encounter different financial requirements for stepping up each stage of

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growth. For the start-up stage, personal savings of entrepreneurs, their relatives and friends are the common sources of setting up a firm. However, almost all the firms in this start-up stage experience years of negative earnings before entering into breakeven point. Thus, soon after depleting entrepreneurs' own sources of finance, outside funding is indispensable for on-going technological development and commercialization. In this early stage of growth, start-up companies, in general, suffer from low profitability and short business record. Start-up companies are also difficult to obtain loans in commercial banking system without solid collaterals due to information asymmetry and uncertainty problems. Venture capitals and equity investments should be indispensable capital for these young start-up companies before IPOs.

Small start-up companies have to face this funding gap between necessary financial needs of start-up companies and financial provisions of financial institutions. There exists a financial rationing to these start-up companies due to substantial asymmetric information problems. Given this funding-gap in financial life-cycle of start-up companies, governmental interventions are necessary to solve the problems, which are originated from market failures, such as information asymmetries and uncertainties. Government can intervene in market by providing direct finance to start-up companies in early stages of growth or by solving information asymmetry problems with better information communication in market such as technology information, technology evaluations, venture certification, technology guarantee programs, or technology transfer intermediaries.

These rationales are more demanding in the context of developing economies because of inefficient financial markets and financial intermediaries in their developing economies. Developing economies' governments are required to play more important roles in providing adequate finance to SMEs and innovative start-up companies. Indonesia proposed the requirement of financing policies: "In general, SMEs are having difficulties in accessing banking credit, due to asymmetric information (scale, formalization, information), lack of collateral and, thus, they are unable to make business plan. Innovative SMEs with high risk need special Financial Institutions for their supports. In order to help SMEs access to financing, the followings are required: 1) Providing Productive Financial Program to micro and small enterprises through saving and loan cooperatives, and revolving mechanism; 2) Central Bank measures to promote small and medium enterprises access to banking finance, which are a) a Linkage Program between Commercial Banks and Rural Banks, b) Increasing the role of Credit Insurance, c) Adjustments in banking regulations, d) Capacity Building, e) Promoting Venture Capital for innovative SME's development. In order to develop Innovative SMEs, especially related with financial support, Indonesia needs some measures, such as promoting venture capital development.

1.2. Objective and Expected Benefits

The target trainees for this course will be middle-management policy makers in charge of SME financing policy, managers of supporting organizations, and researchers in APEC developing member economies, especially in the area of public financing for SMEs. The course requires 3 hours time period, which consists of 1 hour of lectures, 1 hour of case studies, and 1 hour of discussions.

The objective of this course is to support policy-making capabilities of developing economies' government officials by learning an effective policy instrument in the area of public financing programs. More specifically, the trainees are expected to 1) apprehend comprehensive instruments for financing policies, 2) understand characteristics, diversities and differences of advanced and developing economies' financing policies through international comparison, 3) develop a capacity to apply equity-based financing programs in practice, and 4) develop a capacity to apply loan-based financing programs in practice.

The trainees will be benefited from this financing policy course in such aspects that: 1) the trainees will have a better understanding of financing policy instruments, and their differential aspects and effects in promoting SMEs' innovation, 2) the trainees will have a better understanding of what are the other APEC member economies' financing programs, and their status, and their operational aspects of financing programs, and 3) the trainees will have an in-depth practical understanding about good practices of the loan-based technology financing and the equity-based financing programs, which may possibly be implemented in their economies' own financing policy programs.

1.3. Methodology and Assessment

The subject of "Financing Policies" course will be divided into three steps of implementation. During the first 1 hour of the lecture time, the trainees will be provided the theoretical backgrounds of SMEs' diverse financial demands, financial market failures and government' financing policy instruments, which are effective in promoting SMEs' innovations in developing economies. The diverse examples of financing policies among APEC member economies are examined to compare the differences of diversified financing instruments. Through the 1 hour-lecture on this subject, the trainees will have a clear understanding of what would be the differential effects of diverse financing policies in promoting SMEs' innovation.

During the second 1 hour of best practice case studies, trainees are expected to learn practical operation aspects of financing policies. Through Australia's COMMET program, the trainees will have an in-depth understanding of the equity-based programs. Through Korean technology financing case study, the trainees will have an in-depth understanding of loan-based programs' practical management in promoting SMEs' innovation. Through these case studies, the trainees are expected to be able to utilize loan-based program and equity-based program for implementing their own effective financing policy programs.

In the last step of the 1 hour roundtable discussions, the trainees will discuss about the status of their economies' financing policies: what would be the implications of the advanced economies' financing programs to their economies' innovative SMEs; how to implement these programs into their economies' public financial support structures; and what would be obstacles and expected problems in incorporating financing policies for innovative SMEs.

The success of the financing policy course can be assessed by examining several aspects of the course outcomes: 1) what extent the trainees apprehend comprehensive instruments for financing policies, 2) what extent the trainees understand the characteristics, diversities and differences of financing policies through the comparisons of APEC economies' financing policies, 3) in the medium term, whether they develop a capability to apply equity-based financing programs in practice, and 4) whether they develop a capacity to apply loan-based financing programs in practice.

1.4. Scope and Structure

The structure and scope of this course can be divided into five differentiated contents as follows: 1) government intervention rationales, financing lifecycles of SMEs and diverse death valleys, 2) instruments of financing policies and their theoretical background, 3) comparisons of financing policies among APEC member economies and European countries, 4) equity-based financing programs, and 5) loan-based financing programs.

In the first section of "government intervention rationales, financing lifecycles of SMEs and diverse death valleys," the diverse financial needs of SMEs from the stage of R&D to the stage of mass-production and the market failure in providing adequate finances to SMEs in each stage will be discussed. In the section of "instruments of financing policy: theoretical background", diverse financial instruments, which can be utilized for government intervention in death valleys, their differences and their own strengths/weakness will be discussed. In the section of "comparisons of financing policies among APEC member economies and European countries," diversity of financing policies among APEC economies, Germany and EU will be discussed and the reasons behind these apparent diversities in intervening in financial market failures will be also discussed.

In explaining “equity-based financing programs,” diverse examples of equity-based programs in APEC and EU will be discussed in details. Australia provides Innovation Investment Funds (358mil$) in order to promote commercialization of R&D results. Canada operates indirect tax incentives to VCs, which covers 10% of total VCs in 2005(BDC, FCC Ventures, EDC VC Funds). Japan has a long history of operating ‘SME Business Investment & Consultation Companies’ to provide capitals to innovative SMEs. Korea also recently established ‘Funds of Funds’ in order to inject government capital investments. In explaining “loan-based financing programs,” diverse examples of loan-based programs in APEC, Germany and EU will be discussed. The Japanese government sponsored financial intermediaries, providing 10.3% of total loans to SMES in 2003. JASME, which was established in 1953, provides long-term capital with fixed low rates to medium-sized companies. NFLC, which was established in 1949, provides seed loans to small companies. Shoko Chukin Bank provides loans to member companies. Moreover, government- sponsored credit guarantee corporations, which operates 52 offices throughout the country, was established in 1953. The Korean government offered the public debt financing, which amounted to 2,75 trillion won in 2006. The SME Credit Guarantee Fund established in 1976, and the Technology Guarantee Fund established in 1989, also provides guarantee and credit/technology evaluations services to SMEs.

2. Theoretical Background of Financial Subsidy Policies

Why needed financial subsidization to small but highly innovative technology firms? Theoretically, economic literature suggests two explanations: 1) spillover effects of technology development, and 2) solving information asymmetries in market. The subsidization to technology development of small and medium firms would lead to R&D spillovers to overall industries. Because of this external spillover-effect of technology development, the actual R&D level in market will be below the socially optimal level of R&D investment. Number of studies have identified these spillover effects of technology development and concluded that social returns of R&D investments will be higher than private returns of R&D investment in general (Griliches 1992). In this regard, government should involve in subsidizing technology development of firms. And why are SMEs? Several studies suggest that “spillover problems are particularly severe among small firms, which are often unable to effectively defend their intellectual property or to extract most of the rents in the product market” (Gompers and Lerner, 2004).

The other rational for government financial policy programs is based on the certification effect. Between high-technology SMEs and potential investors, there exist informational asymmetry problems. High-technology SMEs, which are usually without high profile of past performances and experience difficulties in raising external capitals, in most cases, are even

precluded from financial market's investment consideration. This is originated from the argument that financial intermediaries such as venture capital funds, technology evaluation institutions may provide adequate monitoring and screening effects, eliminating informational asymmetry problems. However, total new start-up companies far more outnumber handful recipients of venture capital investments. Since venture capital funds cannot provide adequate monitoring for the 'whole range' of new start-up companies, governmental awards of financial assistances and subsidization to certain promising high-technology SMEs can effectively certify firms to external investors.

However, there could be political distortions in financing programs. Government involvement in financial assistances could be distorted by active interest groups to maximize their own private benefits instead of maximizing public spillover effects. The theory of regulatory capture, which were originated from Peltzman(1976) and Becker (1983) with explicit modeling, explains that "direct and indirect subsidies will be captured by groups who stand to gain substantial benefits and whose collective political activity is not too difficult to arrange (i.e. when free-riding by coalition members is not too large a problem). As Stigler (1971) points out, even very small firms (which have historically dominate industries such as trucking and the licensed professors) can organize to benefit from public largesse" (Gompers and Lerner, 2004). These problems could be more manifest where government corruption is prevalent and the efficiency of public service cannot be guaranteed.

2.1. Financing Life Cycles and Government Financing Policy[2]

Innovative SMEs encounter different financial requirements for stepping up each stage of growth. For the innovative start-ups, R&D funds are needed for further deepening of technology development. However, the high risks are associated with investments in this stage of firms' growth, and only seed capital by government or business angels, who are wealthy individuals providing not only sufficient funding but also consultation and their expertise, can intervene in this first and second valley of death for R&D investments and technology commercialization funds. After successfully developing engineering model and production model, start-up companies need to in-source further injection of capital for building up manufacturing production lines and further R&D investments, which are the third valley of death. However, in this early stages of start-up companies with low profitability and short record of business, if without solid collaterals, debt financing are difficult to obtain in commercial banking system. Venture capitalists can provide indispensable capital for this young stage of firms before IPOs. Unlike commercial banks, venture capitalists intensively

[2] The section 2.1, 2.2, 2.3 and 2.4 are drawn from APEC report "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)", which were conducted by the APEC SME Innovation Center of TIPA(Korea Technology and Information Promotion Agency for SMEs).

examine and evaluate growth potential of these young start-up companies and the values of their technologies before providing capital. The venture capitalists closely monitor firms' management even after capital injection, alleviating the problem of information asymmetry and uncertainty. When these start-up companies are successful in IPO or M&A deals, venture capitalists can exit the investments, reaping huge profits. The facilitation of exit mechanism in the market is a necessary condition for viable venture capital markets.

Governments' roles are two folds: 1) facilitation of efficient financial market through establishing better regulations and rules, and 2) provisions of direct financial supports to SMEs either by direct financing or by infrastructures and public services. Since this course only focuses on the direct intervention roles of government SMEs innovation policies, the second role of SMEs financing policy is only considered. There exist two venues for direct financing to SMEs and start-ups: 1) equity financing and 2) debt financing.

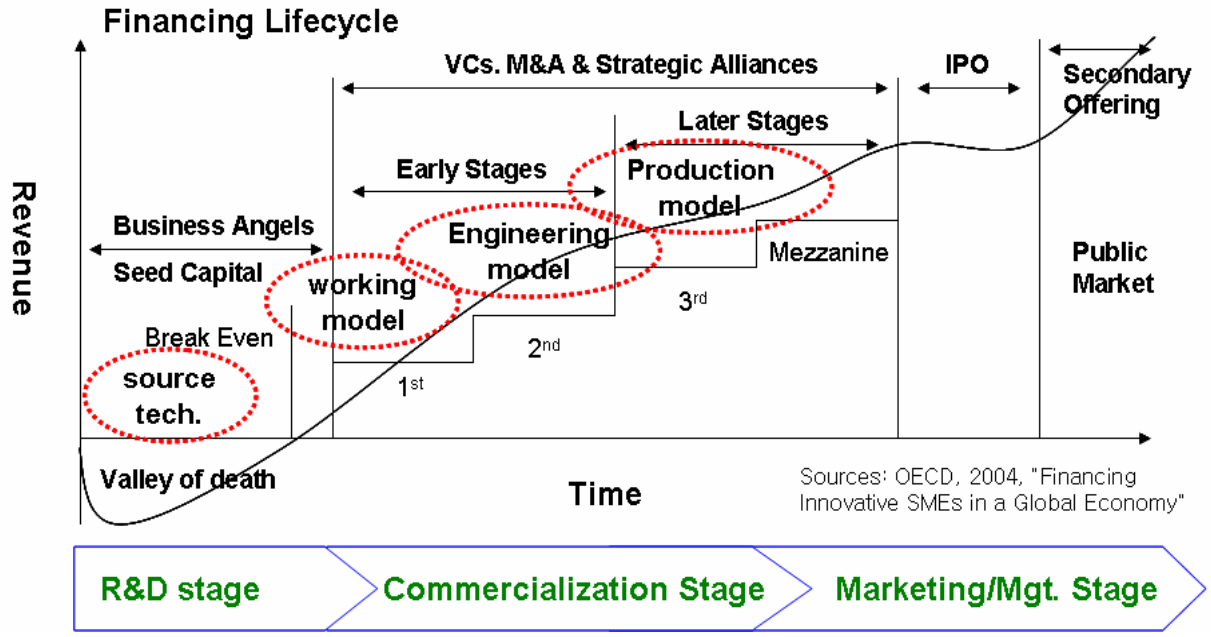

Fig 1 Financing Lifecycle and the Stages of SMEs growth

Sources: OECD, 2004, "Financing Innovative SMEs in a Global Economy"

2.2. Equity Financing

Government equity programs

For the first stage of a valley of death, governmental R&D investment financing can be provided to emerging new technology developments. Furthering technology development,

commercialization R&D and establishing manufacturing capacity can be supported by government direct equity program. Government can participate in direct equity investment through establishing direct funds for innovative SMEs with technological capabilities. These special-purpose funds obtain equity shares of innovative start-ups mostly below the entrepreneurs' shares proportion. Some APEC member economies has established governmental venture capital investment organizations with the purpose of direct investment in venture firms or participating as a limited partner.

However, the experiences of governments' direct equity programs were relatively negative in their effectiveness promoting innovative venture firms and start-ups. Since the government equity programs have unexceptionally ill-equipped with the suitable incentive structures for fund managers, they tend to lack in proper monitoring and due diligence of selection of potential leapfrogging venture firms. Government officials, who operate governments' equity programs, often lack the essential expertise in financial markets and fund management. Inefficiencies in dealing with venture firms naturally lead to increases of venture firms' failures and investments loss. Often hybrid-funds, which are venture capital firms with injections of public equity investments, are established in order to allocate public financial supports for venture firms, using professional fund managers to act upon equity investment. However, even in this case, establishing proper incentive structures for fund managers are essential in successful equity investments on venture firms.

Networks of venture capitalists: Business Angel Networks (BANs)

Angel financing plays the pivotal roles for the first-stage of financing death valleys for innovative SMEs. Business angels mostly face the lack of investment opportunities while entrepreneurs complain about the lack of opportunities receiving technology assessment and financing. These can be identified as one of the market failures, which are originated from lack of information flows in the financial market. The information asymmetry and separated marketplace between business angels and early stage entrepreneurs call for the government intervention in this area of inefficient financial market.

Business Angel Networks (BANs) are highlighted among policy makers as an alternative to direct equity financing for innovative SMEs. BANs bring together business angels, venture capitalists, investors and entrepreneurs, who, being equipped with highly innovative technology, look for financial sources. BANs provide communication channels among potential demanders and suppliers of capital for technology development and commercialization. These policy initiatives are cost effective without substantial deadweight sunk cost on the part of government, and are estimated to have been successful in promoting venture capital market, compared to any other government financial schemes. However, this policy can not reap the fruits of venture firms' success. Government only participates in

BANs as sponsorship for maintaining overall business angel networking. Moreover, international BANs can be further to in-sourcing international venture capitals and to sharing with advanced knowledge and expertise.

2.3. Debt Financing:

Direct loan programs

Government can establish direct loan programs for innovative SMEs and technology-based venture firms. Most governments provide these loan programs for SMEs with relatively favorable interest rates and low commission rates in order to support innovation activities of SMEs. These programs are operated by government-owned and special-purposed commercial banks or are operated in cooperation with private banks. When cooperating with private banks, loan guarantee programs should be provided for the compensation of possible defaults loss of loans to SMEs. However, the most of direct loan programs are not viable solutions for financing innovative SMEs and technology-based venture firms in the long-term perspective. Government lending' interest rates are fixed at low rates while the defaults risks are very high with young venture firms and SMEs. Since these loans are provided without collaterals, the financial losses of direct loan programs are clearly inevitable. Since these direct loan programs are established to share the downside risk of SMEs and venture firms while 'abstaining' from high returns of successful investments, the financial losses are inevitably expected. In long term perspective, this continuous and rather-purposeful loss in direct loan programs is not viable and is not cost-effective in promoting SMEs innovation, but rather create the problems of moral hazards among loan recipients.

Loan guarantee programs

Loan guarantee programs are mostly combined with governmental direct loan programs. Governmental loan guarantee programs provide guarantee to SMEs either by collecting guarantee insurance fees from SMEs or by executing technology-evaluations. With these governmental guarantees, private commercial banks provide loans for innovative SMEs and venture firms. Since governments assume the downside risks of venture firms and SMEs through government direct loan programs, proper guarantee insurance fees and authentic technology evaluations are indispensable for efficient operations of government loan guarantee programs. Especially technology evaluations are important because these evaluations reduce the problems of information asymmetries about the possibilities of venture firms' technology success. Technology evaluations mean the evaluations of net present values of technology with the analysis of technology development, possibility of commercialization and market demands. These technology evaluations can be utilized for venture capital investments, debt financing, M&A and technology transfers.

2.4. Certification of SMEs

Needs for certification programs for venture firms or SMEs

SMEs typically face the information asymmetry problems in financial market. Since SMEs are mostly in the early stages of development with little credits and financial market reputation, and sometimes even without market sales records or manufacturing facilities, SMEs can not easily earn outside credibility for their growth potential or business attractiveness. Because outside investors possess insufficient knowledge about SMEs or venture firms, entrepreneurs could have incentives to pursue private benefits or to show opportunistic behaviors. Because of this market failure in the form of information asymmetry between the insiders of SMEs and financial market participants, there exist needs for the government's intervention to solve this problem. Besides the problem of information asymmetry, venture firms and SMEs possess high uncertainty and risk regarding their future business. Moreover, SMEs typically lack in physical and tangible assets, which can be used as collateral for bank loans. However, most of commercial banks strictly require physical collateral for their lending. Even in the US financial market, especially in the venture capital market, which is the most developed one, investments or loans to the early stages of venture firms are also rare and overall too low to provide adequate financial supports to venture firms' technology development and commercialization (Lee, K. et al., 2003).

These market failures, which are faced by the early stages of SMEs and venture firms, especially in the areas of financial markets, call for government intervention in certifications. Government certification programs can provide adequate information and credibility about SMEs and venture firms' technology and business growth potential, which can solve the problems of information asymmetry to outsider investors, mostly venture capitalists.

Certification hypothesis and government failures

Lerner (2002) proposed a certification hypothesis about government's certification effects. If a promising start-up venture firm does not finance adequate funds for their technology development, it means that there exists market failure even though the NPV (Net Present Value) of their technology project shows positive. Then, through the government certification of venture firms or SMEs' technology projects, the government can signal to financial market about the significance and success potential of SMEs' technology projects. Outside investors can provide sufficient funds to the venture firms or SMEs, trusting the government certifications. Lerner (1999, 2002), and Gompers and Lerner (2001) provided the empirical evidences about the positive effects of government certification on SMEs and venture firms' performances.

However, there could be possibly government failures in these certification programs. De Meza (1992) questioned the government's abilities to discern promising venture firms or SMEs with high growth potentials and innovative technologies. The certification programs could be more inefficient than private financial markets. Moreover, government certification programs can face severe political pressures and lobbying from various interest groups. The SBIR programs of the US are evaluated to be successful because of the decentralization of decision making procedures (Lerner 1999). Venture capitalists or private market players should play the role of screening and monitoring SMEs' technology projects. Since venture capitalists mostly invest in the early stages of venture firms before IPO, these venture capitalists are the most demanding groups for the certification programs of venture firms' technology projects. The venture capitalists should possess industry expertise, which can discern and screen successful technology projects, and should follow up close monitoring after investment to venture firms or SMEs.

Table 1 Elements of Financing Policy

Element	Sub-element	Contents	Notes
Equity Financing	Government equity programs	- Establishing governmental sponsored special-purpose funds, which provide direct equity financing to innovative SMEs or venture firms - Participating in private hybrid funds specialized for investment in innovative SMEs or venture firms	
	Networks of venture capitalists: Business Angel Networks (BANs)	- Providing communication channels to business angels, venture capitalists, investors and entrepreneurs looking for financial sources with high potential innovative technology	
Debt Financing	Direct loan programs	- Providing direct loans to innovative SMEs or venture firms with favourable interest rates or often with long-term fixed rates	
	Loan guarantee programs	- Providing official guarantee about SMEs to financial institutions with which loan guarantee institutions compensates the loans loss in the case of the SMEs' default	
	Certification of SMEs	- Providing adequate information and credibility about SMEs and venture firms' technology and business growth potential - Solving the problems of information asymmetry to outside investors or financial institutions	

Source: APEC, "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)," 2006

3. Financing Policies: Country Studies and Comparison[3]

3.1. US's Financing Policy[4]

The US has operated dozens of financing programs over the past several decades and, during some period of times, the amount of government financing programs were so huge even comparable to venture capitals' financial provisions. Table 2 shows the lists of these financing programs in US. It has been evaluated that a number of public programs had strong influences on technology development and industrial growth in several sectors. Among the global companies, which has been rapidly grown up with IT revolution, were there the ones which received these public financial assistances for their early technology development and commercialization, which are, for example, Apple Computer, Chiron, Compaq, Federal Express and Intel. Especially, publicly sponsored funds during the 1960s provided an environment of early experiences of venture capital management, with which many fund managers could result in managing independent venture organizations.

Table 2 US Public Venture Capital Initiatives 1958-1997

Sponsoring Organization	Program Name	Brief Description	Span
Small Business Administration	Small Business Investment Company Program	Provides capital to federally sponsored funds that make debt and equity investments in growth firms	1958-1997
Department of Commerce	State Technical Services Program	Supported various government programs to help high-technology companies (especially new firms)	1965-1969
Department of Housing and Urban Development Model Cities Administration	Venture Capital Development Assistance	Demonstration projects in selected cities financed business begun by residents of targeted neighborhoods	1967-1971
At least 30 states	At least 43 state venture funds or SBIC programs	Make investments into funds supporting new enterprises, which often focus on high-technology firms	1970-1997
Department of State Agency for International Development	At least 13 developing country venture funds	Provided loans to financial intermediaries that made equity and debt investments in new enterprises in over 30 countries	1971-1993

[3] The Australian case, Canadian case, Japanese case and Chinese Taipei case are drawn from APEC report "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)", which were conducted by the APEC SME Innovation Center of TIPA(Korea Technology and Information Promotion Agency for SMEs).

[4] The US case, Germany case, Korean case and EU case are based on the STEPI(2006) research "A comprehensive appraisal of policy instruments for studying firm's technological innovation".

Small Business Administration	Specialized Small Business Investment Company Program	Provides capital to federally sponsored funds that make debt and equity investment in growth firms owned by disadvantage individuals	1972-1997
Department of Commerce National Bureau of Standards	Experimental Technology Incentives Program	Catalyzed new public programs(across agencies) to encourage industrial research and venture capital	1972-1979
National Science Foundation	Federal Laboratories Validation Assistance Experiment	Funded assessments by national laboratory personnel of prototype products and processes developed by entrepreneurs	1972-1975
National Science Foundation and Small Business Administration	Innovation Centers Experiment	Provided assistance to high-tech entrepreneurs through incubation centers, subsidies, and technical assistance	1973-1981
Department of Energy Office of Energy-Related Inventions	Energy Related inventions Program	Provides financing to individual inventors and small firms to commercialize energy-conserving discoveries	1975-1997
Small Business Administration	Small Business Development Centers Program	Funds university-based centers to assist small businesses and encourage technology transfer	1976-1997
Department of Commerce	Corporations for Innovation Development Initiative	Designed to fund state and regional corporations to provide equity financing to new firms; only one such corporation funded	1979-1981
Department of Commerce Minority Business Development Agency	Technology Commercialization Program	Financed minority technology-oriented entrepreneurs, as well as centers to assist such entrepreneurs	1979-1982
At least 15 states	At least 107 business incubators	Provide office and manufacturing space, support services, and often financing to start=up businesses	1980-1996
11 federal agencies	Small Business Innovation Research Program	Provides awards to small technology -oriented businesses (also predecessor programs at 3 agencies, 1977-1982)	1982-1997
Department of Energy Office of Energy Research	At least 6 contractor-organized venture funds	Make equity investments in spinouts from national laboratories (funds organized by prime or subcontractors at laboratories with department's encouragement)	1985-1997
At least 30 states	State Small Business Innovation Research Programs	Makes SBIR-like grant, often in conjunction with federal SBIR awards	1987-1997
Department of Commerce National Institute of Standards and Technology	Advanced Technology Program	Awards grants to develop targeted technologies to firms and consortia; some emphasis on small business	1988-1997
Department of Defense Defense Advanced	Experimental venture capital investment program	Designed to make investments in private high-technology firms in exchange for equity or royalties;	1989-1991

Research projects Agency		program only made one investment	
Department of State Agency for International development	Enterprise Fund Program	Oversees 12 federally funded venture funds investing in Eastern Europe, the former Soviet Union, and Africa	1990-1997
Overseas Private Investment Corporation	Venture capital fund guarantees	Guarantees full or partial return of capital to investors in at least 16 private venture funds in developing countries	1990-1997
Department of Housing and Urban Development Community Relations and Involvement Office	Tenant Opportunity Program	Funds new businesses and other initiatives by public housing residents (other aspects of program had begun in 1987)	1993-1997
Department of Energy Office of the Under Secretary	Defense Programs Small Business Initiative	Provides funding, technological assistance, and national laboratory access to small high-technology businesses	1993-1997
11 federal agencies	Small Business Technology Transfer Program	Finances cooperative research projects between small high-technology firms and non-profit research institutions	1994-1997
Department of Defense Cooperative Threat Reduction Program	Defense Enterprise Fund	Finances and independent venture fund investing in defense conversion projects in the former Soviet Union	1994-1997
Department of the Treasury	Community Development Financial Institution Fund	Invests in and provides assistance to community development venture capital and loan funds	1995-1997
Department of Defense	"Fast Track" Program	Provides 4:1 matching funds for private financing raised by SBIR awardees	1995-1997
Department of Agriculture Rural Business and Cooperative Development Service	Intermediary Relending Program(as amended)	Permits program managers to guarantee returns of investors in rural venture funds	1997

Source: Gompers and Lerner (2004)

The loan financing policy instruments of US SBA (Small Business Agency) are composed of 1) direct loans, 2) indirect loans through commercial banks, and 3) loan guarantee programs, among which loan guarantee programs are most common. As US SBIR program is introduced since the early 1980s, the proportion of direct loan programs are substantially reduced meanwhile the proportion of loan guarantee programs are substantially increased. As the focus of governmental loan programs has been shifted from direct loans to loan guarantee, the role of SBA's financing policies transferred from loan 'service to' loan 'oversight'.

However, the characteristic of US loan guarantee programs lie on competition-based selection process of ‘certified lenders’ and ‘preferred lenders’. When US SBA provide loan guarantees, US SBA designates some banks as ‘certified lenders’, which have shown a good record of lending to SMEs with a low rate of guaranteed-loan default, and among these ‘certified lenders’ are selected ‘preferred lenders’ banks which have shown best performances. The ‘certified lenders’ can be delegated for a part of responsibilities for screening guaranteed-loans to SMEs, and the maximum 90% of loans can be guaranteed. The ‘preferred lenders’ are delegated for the whole procedure of evaluating guaranteed loans to SMEs while the maximum 75% of loans can be guaranteed. Because of these favorable treatments of ‘certified lenders’ and ‘preferred lenders’, banks are competitive to receive these certifications, and these competition significantly improve the performance of SBA’s loan guarantee programs in essence. With these certification programs, banks are partially responsible for the possibilities of guaranteed loans’ defaults. And with incentive systems for better lending to SMEs, the moral hazard problem ca be solved and at the same time the policy purpose of increases of lending to SMEs can be achieved.

The US ‘SBIC Program’ is an indirect equity-based program, which was established based on the ‘Small Business Investment Act’ in 1958. Currently, the 20.1% of total US VCs funds in amount, 45.5% in numbers are covered by this SBIC program.

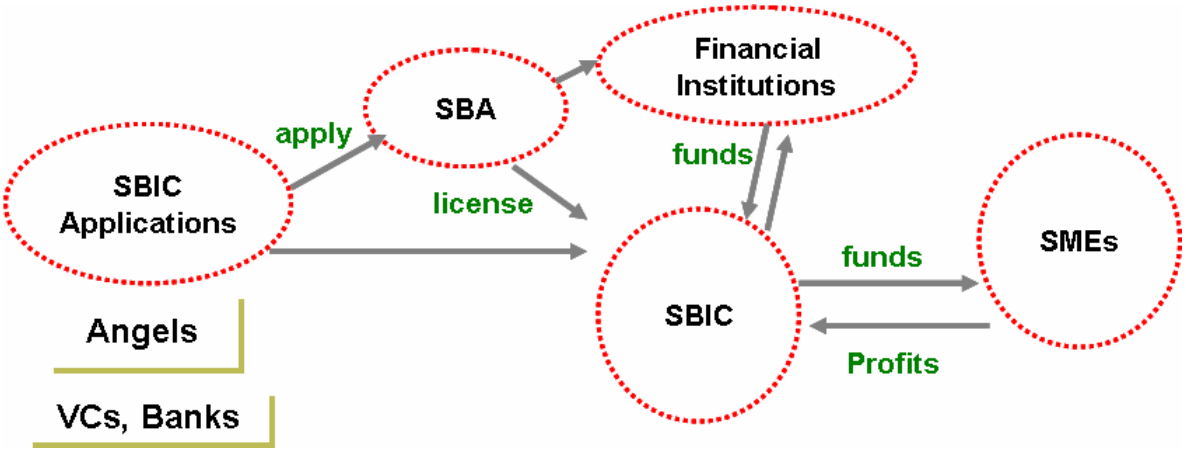

Fig 2 US SBIC Program Procedure

3.2. Australian Financing Policy

Government equity programs

Innovation Investment fund and Pre-Seed fund are available for SMEs in the early stage of development or for the purpose of commercializing innovative products. The Innovation

Investment Fund program is designed to promote the commercialization of Australian research and development, through the injection of venture capital into small, high-tech companies in their seed, start up or early expansion stage. The Australian Government is investing about $221 million, which will be matched by the private sector up to a maximum ratio of two to one. This means that total amounts of funds to support the commercialization of early-stage Australian R&D will total $358 million under both rounds of the Innovation Investment Fund program. Licensed private sector fund managers will administer this pool of investment capital. The fund managers make all investment decisions in relation to their Innovation Investment Fund money. However they are subject to the Commonwealth's license agreement and investor document requirements.

There are now nine Innovation Investment Funds with from $30 million to $50 million, and all states are now directly served by the Innovation Investment Fund -licensed funds. Two Innovation Investment funds, Allen & Buckeridge and Neo Technology Ventures, are specialized in information and communications technology (ICT). Two, GBS and Startup, are dedicated to a bioscience sector. One, CM Capital, has combined information technology and life science expertise. The remaining four, AMWIN, Foundation, Momentum and Nanyang, have a general investment focus.

The government is committing $200 million for a further round of the IIF program to be drawn down over the period 2007-08 to 2018-19. Each fund will be operated over a 10 year period. The Pooled Development Funds (PDF) program, which was started from 1992, provides predominantly new equity investment to eligible Australian SMEs. PDF program provides tax incentives, such as capital gains tax exemption and concessionary taxation treatment on dividends. The PDF program is designed to increase the supply of equity capital for promoting Australian SMEs. The PDFs are private sector investment companies established under the PDF Act which raises investors' capital and use it to invest in Australian companies. The government announced in the May 2006 Budget that the PDF program will close new registrations after 31 December 2006. It will be progressively replaced by the Early Stage Venture Capital Limited Partnerships (ESVCLP) program announced in the Budget, which is expected to become operational in 2006-07.

3.3. Canadian Financing Policy

Canada is considered as one of the leading economies in equity financing. The government acts as an investor to venture capital companies and supports the venture capital market directly through the 'Business Development Bank of Canada'. In addition, the government provides tax incentives to those investing in venture capital and provides SMEs with specialized debt financing programs.

Debt financing

The major program designated for SME is the Canada Small Business Financing (CSBF) Program. The purpose of the Canada Small Business Financing (CSBF) Program is to help an important part of the economy — small and medium-sized businesses — get access to adequate financing. The CSBF Program helps fill a gap in the range of financing instruments available to these businesses, which might otherwise have difficulty qualifying for financing or finding financing that meets their needs. The CSBF Program works because the Government of Canada shares the burden of risk with private sector lenders. As a result, lenders are able to increase the amount of financing they extend to small business.

Lenders include some 1,380 chartered banks, credit unions, loan and insurance companies, and caisses populaires. They operate from more than 15,000 locations, providing service to Canadians in all provinces and territories. The Government of Canada shares the cost of losses with lenders and leasing companies by paying 85 percent of eligible losses on defaulted loans and leases.

The CSBF Program supports asset-based debt financing. The maximum loan or lease is C $250,000, and terms of loans and leases are 10 years or less. The program is limited to small and medium-sized businesses with revenues of up to C $5 million per year and is not targeted to any group or region. During the period 2004–05 the total value of loans that private sector lenders made under the CSBF Program surpassed C $1 billion. It should also be noted that there are a variety of other debt financing programs offered at the federal and provincial levels that compliment the offerings of the CSBF Program.

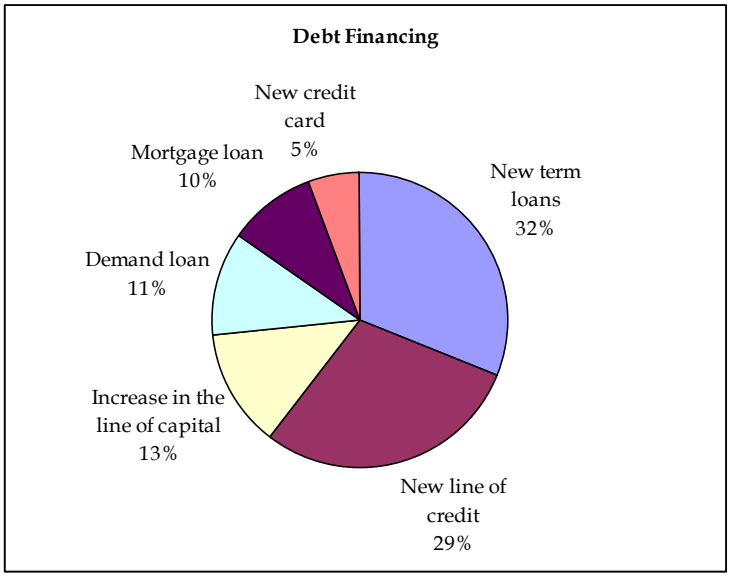

Fig 3 Debt Financing by the Kinds of Credit

Equity financing

Canada has a long history of venture capital. The first venture capital (VC) case is reported in 1945. The tradition of strong equity financing still prevails even though some downturn occurred after the collapse of the dot-com bubble. Between 2000 and 2003, Canada was ranked third among OECD economies for venture capital investment as a percentage GDP (OECD Science, Technology and Industry Scoreboard, 2005). In 2005, there was roughly C $56 billion in private equity capital under management in Canada, 37 percent (C $21 billion) of which was VC activity.

The government's role in encouraging VC is critical. The total VC funding placed in 2005 was C $1.8 billion, which was similar to that in 2004. The basic structure of equity financing initiated by the government is indirect. Government provides tax benefit to those investing in venture capital. Thanks to this benefit, labour sponsored venture capital corporations (LSVCC) have grown rapidly. In turn, the policy caused a high level of VC dependence on individual investors.

Besides LSVCC, the government supports VC through the Business Development Bank of Canada (BDC). The government also provides VC assistance through local non-for-profit organisations. For example, the Ottawa Centre for Research and Innovation (OCRI) receives funding from the government, the private sector, and universities. OCRI provides support to new and existing entrepreneurs and also promotes a venture capital network. In addition, a number of public pension funds invest some portion in VC, and they operate some VC funds directly.

Direct investment through government funds is also increasing the share in venture capital market. In terms of investment amount, this direct investment accounts for 10% of total VC in 2005. Government funds include BDC, FCC Ventures and EDC VC funds, as well as provincial government funds (e.g. SGF, Innovatech). These government funds play an important role in the early stages, as can be seen by BDC whom focuses on technology start-up SMEs. The Financing Policy Division of Industry Canada is working on ensuring that the role the federal government plays in the Canadian risk capital market is appropriate to the industry's state of development.

3.4. Japanese Financing Policy

Government equity programs

Small and Medium Business Investment and Consultation Companies, which were established since 1963, are private companies mostly owned by local governments or financial institutions. The companies provide equity investments to SMEs at the early stages by purchasing new stock issues, convertible bond issues, and warrant bond issues with the

capital of not more than 300 million yens in general. Promoting investment to venture business, SMRJ invests into limited partnership for venture capital investment. For the purpose of investing in domestic small and medium-sized venture businesses that are creating new business fields such as the development of new products and technologies, or in an early stage of growth, a Limited Partnership for Venture Capital Investment can be established with a private VC as an executive partner and SMRJ as a member of the Limited Partnership. With the aim of coordinating support in aspects of funding for new business of SMEs having an outstanding idea or skill, SMRJ and companies collectively build the 'Keep it up! SME Fund' with comprehensive support.

Government loan programs

Concerning public support for SMEs loans, there are three agencies involved. First, the Japan Finance Corporation for Small Business (JASME) established in 1953 provides long-term capital with long-term fixed and low interest rate. Second, founded in 1949, the National Life finance Corporation (NLFC) provides small and unsecured loans for very small firms. Third, the Shoko Chukin Bank established in 1936 is a private financial service bank. The JASME provides a high amount of finance for medium enterprises to purchase factories and collateral or guarantee is required. The NLFC provides small loans to small businesses such as stores, which do not require collateral or guarantee. The NLFC cooperates with Japan Chamber of Commerce and Industry (JCC) and the JCC provides teachings for small business managers on making accounting books as well as recommendation for finance for small businesses taught by JCC to NLFC. The finance for small businesses provided by NLFC has the maximum loan amount of 10 million yens with the interest rate of 1.8% per year. Shoko Chukin Bank provides finance for member companies only. The governmental banks, which provide about 10% of total SME finance amounts, complement private banking system.

Table 3 Shares of Government Supported Loans in SME Finance
(As of December 2003, Unit: trillion Yen)

Business Category	Financial Institution Name	Total Outstanding Loans to SMEs	% of Grand Total
Private Financial Institution	City Banks	79.2	39.4%
	Main Regional Banks	66.8	25.78%
	Secondary Regional Banks	23.7	9.1%
	Trust Banks and Long-Term Credit Banks	12.6	4.8%
	Shinkin Banks	41.8	16.1%
	Credit Cooperatives	9.2	3.5%
	Sub-total	233.3	89.7%
Governmental Financial Institution	JASME	7.6	2.9%
	NLFC	9.2	3.5%
	Shoko Chukin Bank	10.0	3.8%
	Sub-total	26.8	10.3%
Grand Total		**260.1**	**100.0%**

Source: APEC, “A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006),” 2006

Besides the governmental banks’ loan programs, SMRJ and prefecture governments invest support fund, which is called as Business Upgrading Loan, for local government and local industries partnership projects for local SMEs such as building Industry Park, Wholesale Park or Shopping Centers and improving Shopping Mall. The loan interest rate is limited to 0.8% or no interest (for projects approved under special laws or disaster restorations). The loan limit shall not be over 80% of applicable project costs and the repayment period shall not exceed 20 years (period of deferment is not more than 3 years).

Government loan guarantee programs

Supplementing credit capability of SMEs with the credit insurance system and credit guarantee system, the credit guarantee facilities, such as the Credit Guarantee Association and the Japan Small and Medium Enterprise Corporation, assist SMEs without sufficient credit and collateral. The systems aim to contribute to facilitate funding for SMEs through guarantee by the Credit Guarantee Corporations for their loans from financial institutions. Moreover, JASME supplements the risk in Credit Guarantee Corporations throughout Japan through reinsurance.

Credit Guarantee Corporations, a total of 52 independent offices throughout Japan, have been established as certified corporations under the Credit Guarantee Association Law (1953) for the purpose of facilitating access to finance for SMEs by guaranteeing their borrowings from financial institutions. The outstanding guarantee of liability is estimated as 329,739.7 billion

yens as of the end of March 2005. Under the Small Business Credit Insurance Law, JASME provides reinsurance of the debt guarantee by Credit Guarantee Corporations and lending them the funds necessary for operations. The contracted amount for underwritten insurance from April 2003 to end of March 2004 is estimated at 14,278.6 billion yens.

3.5. German Financing Policy

The government loan programs for SMEs in German operate solely by loan guarantee programs and the sources of loans originate from the funds of ERP (European Recovery Program). The ERP funds has been utilized for the purpose of loan guarantees for SMEs since 1960s and extended to funding for technology-based innovative start-ups since 1990s. Total budgets of ERP reaches to 12.4 billion euros as of the end of 2003, which are spent for social and environmental infrastructures, financing for SMEs, equity investments for technology-based venture firms and etc. The ERP funds are under the supervision of German Reconstruction Bank (KfW, Kreditanstalt fur Wiederaufbau), which provides refinancing and guarantee funds to public SMEs loan programs. Commercial banks and saving institutions are responsible for operating these public SMEs loan programs. There exists a risk-sharing mechanism in these public SMEs loan programs. German Reconstruction Bank (KfW, Kreditanstalt fur Wiederaufbau) was merged with SMEs Banks (Mittelstandbank) into forming KfW-Mittelstandbank.

German banks that provide direct loans and evaluations of SMEs are called as ‘Hausbank’, which operates in close and long-term relationships with firms often by share-ownerships. There does not exist any direct government loan assistance program, which can be easily found in Japan, Korea and other Asian countries. All the public assistance loan programs in Germany should be administered and lent by ‘Hausbank’. SMEs which apply for public loan assistances for their technological development have to consult with ‘Hausbank’, and final loan-lending decision making accompanying loan evaluations, selection criteria, and the terms of agreements are all solely in the hand of ‘Hausbank’. Because Hausbanks in Germany has accumulated in-depth experiences and vast information about SMEs and large firms through close and long-term relationships, Hausbanks are better positioned to evaluate and screen the qualities and viabilities of firms’ loan applications from solely commercial perspective. With this endowment of screening and evaluation role upon Hausbanks, German public loan assistance programs can substantially reduce the default rates of these public SMEs loan programs, and can effectively provide loans to promising SMEs which have a real potential of commercial success in their technological development. Hausbanks should also take responsibility in providing technical and managerial consulting to these SMEs which received public loan assistances through them. These consulting service provisions after loan lending can nurture and bring up promising technological SMEs but weak in management and

commercialization. Hausbanks should take final responsibilities for loan defaults of SMEs but the 40-100% of default loss in these SMEs public lending are guaranteed by German Reconstruction Banks with ERP funds.

There are several other loan guarantee programs, which are operated by private sectors or by state governments. Private guarantee banks, called as “Buergschaftsbanken”, provide loan guarantees to SMEs which cannot receive loans from general lending institutions. There are 24 “Buergschaftsbankens” in Germany, and these are non-governmental institutions, which are established by equity investments and fund contributions from regional business associations of SMEs, regional banks, “Sparkassen” and regional state governments.

German loan guarantee system consists of two layers: the 1st loan guarantee provisions by private guarantee banks, ‘Buergschaftsbanken’ and the 2nd loan guarantee provisions by German Reconstruction Bank and State-Banks, “Landesbanken” under the jurisdiction of state government. Public government loan can be guaranteed up to 80% of total SMEs loans, and the default loss of public SMEs loan guarantee are distributed among these guarantee institutions with the proportion: German Reconstruction Bank, 36%, State-Banks 29% and private guarantee banks 35%. By enforcing private guarantee banks also to take partial responsibility of loan defaults in public SMEs lending, German loan guarantee system ensure the effectiveness of private sectors’ rigorous screening and evaluations of public SMEs lending without moral hazard behaviors.

3.6. Financing Policies of European Commission

The financing policies of European Commission for SMEs can be summarized as 1) loan guarantee programs, and 2) venture capital investment programs. Under MAP (Multi-annual Program for Enterprises and Entrepreneurship), EC support 1) financial assistance programs, 2) EIC network assistances, and 3) policy development programs. Among the financial assistance programs are loan guarantees and venture capital investments, which are ETF-SU, SMEG, SCA and JEV. These programs are operated not directly by EC itself, but by an intermediary financial institution called as “European Investment Fund”, EIF. The targets of EIF financial assistance programs are mostly confined to innovative and technology-intensive SMEs in European Union regions. EIF was established in 1994 with contributions by European Commissions, European Investment Bank, and 31 private financial institutions. In this early stage, the missions of EIF were diverse not only supports for SMEs but even including cultivation of underdeveloped regions in EU. European Commission has driven the strategy of “Growth and Employment Initiative” from the year of 1997 and empowered EIF to add the roles of venture capital investments as the “Funds of Funds”. And in 2000, EC

restructured EIF roles and functions to exclusively dedicate on financial assistances to promising and innovative, technology-intensive SMEs in EU regions.

The loan guarantee programs of EIF are furnished with four different types guarantee programs: EC loan guarantee mandate, credit insurance, credit enhancement and structured investment vehicles. EC loan guarantee mandate program is the loan guarantee program, which is commissioned by EC, and called as “SMEG” under MAP. EIF does not provide direct loans to SMEs but provide SMEG loan guarantee to public loans of SMEs, which are screened and evaluated exclusively by private banks. This SMEG loan-guarantee system is basically two tier guarantee system which is originated from German loan guarantee system. EIF select best-performing financial institutions in EU regions to provide public loan guarantees and collaboratively determine public loan programs’ portfolios with these selected financial institutions, meeting diverse loan-portfolio needs of SMEs. The guarantee ratios of these public loan programs are determined disparately according to these loan portfolios, but up to the limit of 50% of credit risks in the SME lending. EIF does not receive brokerage commission fees on these loan guarantee programs from private banks, but only in the case that private banks agreed upon in advance for non-performing public loans.

The other guarantee programs, such as credit insurance, credit enhancement and structured investment vehicles, are based on EIF’ own risks rather than EC’s commissioned programs, which are without any risks on the part of EIF. The basic scheme of these guarantee programs are to provide guarantee for SMEs’ bonds to facilitate securitization of SMEs’ loans. The securitization of SMEs’ bank-loans transfers the default risks of the SMEs’ loans to financial markets, to risk-preferred investors. Since, through facilitation of securitization activities, default risks are successfully transferred to risk-preferred investors, private banks’ lending to SMEs, which are ‘without default risks’, can be significantly promoted. EIF intervenes in this process of securitization to upgrade securitized bonds’ credit grades, thus making these bonds to be more attractive to outside investors. The targets for these credit insurances and credit enhancements are the SMEs-loans with bond grades, A and BBB, which are to be upgraded to Aaa and AAA with EIF’s guarantee programs. This program constructively utilizes financial markets to leverage EIF’s limited funds for facilitating loan lending to promising and innovative SMEs in EU region.

EIF also play the role of “Funds of Funds” to inject investments into EU regions’ venture capital funds for SMEs and start-up companies. These “Funds of Funds” programs are ETF-SU, which provide investments to venture capital funds for start-up companies. Seed Capital Action (SCA) intends to reimburse overall costs of hiring best-performing investment managers from advanced EU economies when establishing venture capital funds in

underdeveloped regions in EU. JEV program supports formations of joint-venture partnerships among European member economies.

3.7. Korean Financing Policy

Most of Korean financial support programs for private sector's technological innovation employ the instrument of loan financing combined with loan guarantee programs. As Korean equity financial markets had not been developed to effectively facilitate financial flows to innovative but small firms and start-ups, traditional policy measures of financial support programs had to concentrate on loan provision. In order to solve information asymmetry problems and low collaterals problems in most of SMEs, government established loan-guarantee institutions to promote private banks' lending to technological development of SMEs.

Direct loan program

Financial supports for private sectors' technological development started from the late 1970s by establishing government's special-purposed banks and funds. As the demands for indigenous technological development increased since 1980s, the financing supports for R&D investment and commercialization have been developed. Korean Development Bank (KDB) started the loan program for technology development in 1976, SMBA provided the loan program for SMEs' technology development in 1977. During 1980s, the SME Bank (now Corporate Bank), the Kookmin Bank has started loan programs for private sectors' technology developments. Besides banks' loan programs, diverse special-purposed funds are established to provide adequate loans to promote technology development. Funds for Industrial Developments since 1980 have, in part, been utilized as technology-loan-financing to lend for industrial technology development. In 1990s, the funds for science and technology development, the funds for ICT promotion are newly established for technology loan programs.

Loan guarantee program

The loan guarantee fund is managed by the SME Credit Guarantee Fund and the Technology Guarantee Fund, which were established respectively in 1976 and 1989. The Regional Credit Guarantee Foundation was established in 1999, which operate in 16 cities and provinces nationwide. Moreover, not just indirect bank lending promotion, the governmental agency, SMBA also provides direct loans to SMEs for the purpose of technology development. Loan guarantees are provided to SMEs, which have difficulty in financing, by easing capital shortage and supporting business stability. The purpose of the loan guarantee service is as follows: first, the service evaluates the possibilities of technological development, its

commercialization and marketability; second, it offers financial assistance; and third, it intends to foster and develop high-tech SMEs and to promote technology-financing. By combining technology-evaluation with guarantee function, SMBA finances start-up or venture businesses, which have excellent technologies but suffer from lack of collateral.

Equity financing program

With the aim of improving the role of venture capitalists in Korean national innovation system for high-risk, high-return innovative SMEs, Korean government developed a series of venture- fund-related programs in providing financial support for SMEs' technology innovation. In order to promote and secure necessary funds for high technology start-ups and venture firms, government also revised financial-market-related-laws and provided direct funds to inject into venture capital investment funds. The four venture capital corporates, which are Korean Technology Advancement Corporate (KTAC), Korea Technology Development Corporate (KTDC), Korea Development Investment Corpoate (KDIC) and Korea Technology Financing Corporate (KTFC) established during the 1970s and 1980s, are the beginnings of governmental technology financings. In 1986, the law of 'finance corporate' for new technology commercialization was enacted.

The Fund of Funds was created by government in 2005 to promote the establishment of investment funds for SMEs and venture businesses. And 'Korea Venture Investment Corp' was designated as the institution for operating the fund of funds. Until 2009, the total funds of 1 trillion won will be provided for this fund, including 170 billion won in 2005 and 215 billion won in 2006. The direct financial support programs, which targets private firms' S&T innovation, are currently numbered to be 13 programs, involving 9 government ministries, 9 public funds and 4 special accounts in national budgets, in total of 3,500billion won .

Table 4 Public Financial Support Programs for Private S&T Innovation (as of 2005)

Competent Ministry	Supporting Method	Technology Innovation Stage	Project Name	Expenditure in 2005
Small and Medium Business Administration (Small Business Corporation)	Loan	Development & Commercialization	Supporting Development and Intellectual Property Technology Commercialization	92,441
Small and Medium Business Administration (Small Business Corporation)	Loan	Development & Commercialization	Supporting Small and Medium Venture Establishment	428,340
Small and Medium	Joint	Development &	Financing	150,000

Business Administration (Small Business Corporation)	Investment	Commercialization	Establishment Investment Association	
Ministry of Commerce Industry and Energy	Loan	Development & Commercialization	Financing Industry Technology Development	100,000
Ministry of Commerce Industry and Energy	Joint Investment	Development & Commercialization	Financing Parts and Materials Investment Association	3,000
Ministry of Information and Communication	Loan	Development & Commercialization	Applied Technology Development Supporting Project	195,000
Ministry of Science and Technology	Loan	Development & Commercialization	Research Development Financing Project	88,000
Korean Intellectual Property Office	Loan	Development & Commercialization	International Application Promotion	1,173
Korean Intellectual Property Office	Loan	Development & Commercialization	Intellectual Property Transfer Promotion	914
Ministry of Culture and Tourism	Loan	Development & Commercialization	Financing Culture Product Development	21,546
Ministry of Environment	Loan	Development & Commercialization	Financing Fostering Recycling Industry	70,000
Ministry of Gender Equality and Family	Loan	Development & Commercialization	Supporting Women Technician Establishing Firms	10,000
Sum				1,160,414

Source: STEPI, “A comprehensive appraisal of policy instruments for studying firm's technological innovation,” 2006

3.8. Chinese Taipei Financing Policy

Before the 1980s, equity financing in Chinese Taipei was limited, and bank loan were mainly destined. Thus, financial dualism was prevalent in Chinese Taipei with informal financial markets as the major lender for SMEs (Chow 2005). However, since the 1990s equity financing has increased, especially since 1997, while bank loan financing has decreased incrementally. Therefore, the debt-equity ratio has been declining over time. In particular, equity financing rather than debt financing has become the main source of innovative SMEs thanks to the government’s preferential policy.

Nonetheless, debt financing still dominates in Chinese Taipei. The most important financing policy for SMEs in Chinese Taipei is SME Credit Guarantee Fund. SMEs often find it difficult to secure financing from financial institutions because of their small size, concerns about repayment ability, the lack of collateral, or their unsound accounting systems. To help overcome this problem, the government established the SME Credit Guarantee Fund in 1974. The main function of the SME Credit Guarantee Fund is to serve as a financing bridge between banks and SMEs. By providing credit guarantees for those SMEs that are unable to provide sufficient collateral of their own, the Fund helps these SMEs to secure financing.

In 2004, the government formulated a development plan for the SME Credit Guarantee Fund. This plan encompassed five main development and transformation strategies – (1) the expansion of the direct credit guarantee mechanism, (2) the promotion of new appraisal systems, (3) the development of innovative new credit guarantee services, (4) putting the SME Credit Guarantee Fund on a sound financial footing, and (5) enhancing the efficiency of service provision. It was anticipated that the implementation of these strategies would help to improve SMEs' ability to secure financing, open up new financing channels, facilitate the implementation of the government's industrial policy, bring about better coordination of guidance resources, leverage the power of centralized credit databases, and help to improve risk management techniques.

As a part of the transformation program, the SME Credit Guarantee Fund will also be setting up a new risk management department and introducing new performance appraisal systems, so as to gradually reduce the loss. Thus, it can continue to function as an important source of support for Chinese Taipei's SMEs.

3.9. Comparisons of 10 APEC Member Economies[5]

The 10 APEC countries have diverse financial systems and have the different stages of financial market development. The financing policies of each APEC country are in accordance with each country's financial market systems. Roughly speaking, Canada, Australia possess Anglo-Saxon type's financial-market-oriented system. On the contrary, Japan, Korea, and other Asian member economies, which are extensively influenced by German and Japanese financial system, possess banking-oriented loan-based system. However as the global trend has shifted to venture capital and high-tech start-up companies,

[5] This comparison of APEC member economies is based on the APEC report "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)", which were conducted by the APEC SME Innovation Center of TIPA(Korea Technology and Information Promotion Agency for SMEs). The ten member economies of APEC are Australia, Canada, China, Chinese Taipei, Japan, Korea, Malaysia, Mexico, Philippines, and Thailand.

the financial system and the financing policies of banking-oriented member economies is also adopting the elements of venture investments and equity financing policies.

The elements of comparisons in financing policies of the 10 APEC member economies, as being suggested in the theoretical part of financing policy, are 1) Equity program: either direct equity financing program or hybrid-funds with private venture capitals, 2) BANs(Business Angel Networks) policy to promote networks of venture capitalists, 3) Direct loan program, and 4) Loan guarantee program.

Equity investment for high-tech start-ups

The ten APEC member economies share common characteristics in some aspects, and sometimes reflect different governmental philosophies with regard to SME innovation policies. The commonality of financing policies in the ten APEC member economies can be attributed to the recent establishment of governmental equity investment program, especially in strategic high-tech industries. Turning from the 21st century, IT and BT are booming as new technological frontiers with leapfrogging opportunities for innovative SMEs to become global competitors. During this period of pioneering new technological frontiers, SMEs, which experiment diverse technological paths with high risk and high returns, are indispensable. Financial market with venture capital and business angels, which can handle the investment opportunities with high risk and high returns, could be appropriate forms of SMEs' financing instead of traditional banking system.

The ten member economies are generally involved in equity financing program for innovative SMEs in high-tech new industry either directly or indirectly, observing the market failures of immature financial markets especially for the early high-tech start-ups with no sufficient collaterals. However, some economies with active financial venture capital markets, such as Canada, China and Mexico, did not operate direct equity financing programs but indirectly take the roles of connecting venture capitals and new high-tech firms such as BANs. On the other hand, some economies, in which high tech industries are not mature enough to finance innovative SMEs, such as Philippines, direct or indirect equity programs were not yet implemented.

Republic of Korea has established the fund of funds program in 2005, under the guidance of the Act on Special Measures for the Promotion of Venture Businesses. The program designated the private financial company, Korea Venture Investment Corp. to manage the fund for the purpose of providing the seed money to innovative SMEs and venture firms. The program resources are to be created to 1 trillion won until 2009, and so far 385 billion won are created in 2005 and 2006. Chinese Taipei initiated the 'SME Incubation Investment Trust Accounts' in 2003 in order to provide the secured working capital to newly established SMEs

less than five years with strong growth potentials. The program is scheduled to be allocated NT$2 billion during 4 years of operations. Malaysia established two venture capital funds of RM 150 million in 2000 in order to encourage the development of new technology industries such as information technology, communications, advanced manufacturing and life science as the engine of economic growth. Thailand raised the OSMEP Venture Capital Fund of THB 5,000 million in 2003, in order to promote investment in innovative start-ups and technological SMEs with high potentials in target industries such as Software and IT, Automotive Parts, Fashion and Design and export oriented business.

Australia started the Innovation Investment Fund program in 1997, which was designed for the promotion of commercialization of R&D through the injection of venture capital to small and high tech start-ups or early expansion companies for the target industries such and IT and Bioscience. The Australian government invests AU$ 221 million in the funds matched by private investors. Japanese government, through SMRJ(Organization for Small & Medium Enterprises and Regional Innovation), also invest into limited partnership for venture capital investment in order to promote investment to venture business. Japan established the private investment company, Small and Medium Business Investment and Consultation Companies, which are owned by local governments or financial institutions, in order to invest in SMEs with less than 300 million Yen.

Canada, Mexico and China do not have explicit forms of direct equity financing programs, but mostly play the roles of investment networks through BANs. Canada does not have direct equity financing program for innovative SMEs, but, venture capital groups are closely linked with local incubators and clusters. For example, in Ottawa an ITA would participate in a local business organization which would review proposals seeking angel funding. Angel funding, which are more broadly based geographically, is estimated to be 1 to 3 times of venture capital funding in Canada. Mexico installed the ‘SMEs Investor Club’, which is a group of private or public businessman with financial resources, in order to promote syndicated investment into productive early-stage SMEs during the courses of the Program of Entrepreneurial Development 2001-2006. China also does not have specific equity financing programs or BANs in central governmental programs. However, as Chinese government pursued the cluster and incubator development strategy for promotion of high-tech start-ups and venture firms, the local incubators have close networks with angel investors and venture capitalists, who can provide investment into highly-promising high tech SMEs and start-up companies in the incubators.

Direct loan programs and credit guarantee

Direct loan programs are traditional tools of providing funds for SMEs, which lack in collaterals and enough credit and thus unable to finance from banking system. Thus, mostly

developing member economies and banking-system-based member economies utilize direct loans programs often with credit guarantee schemes. While Japan and Korea are most extensive in their direct loan programs for SMEs, most of Asian member economies such as Malaysia, Philippines and China, and Mexico operate diverse direct loan programs. However, Chinese Taipei only provides extensive credit-guarantee schemes. Australia and Canada, which have market-oriented financial systems, do not operate direct loan programs nor credit guarantee schemes. Thailand also does not have direct loan programs to promote SMEs development unlike other developing member economies and most of Asian member economies.

Japan has three channels of providing direct loans to SMEs: 1) the Japan Finance Corporation for Small Business (JASME) established in 1953 for long-term capital, 2) National Life Finance Corporation (NLFC) established in 1949 for small loans to very small business, and 3) the Shoko Chukin bank established in 1936 for member companies' loans. These three governmental financial institutions have 26.8 trillion yen as total outstanding loans to SMEs, which is 10.3% of total financial loans to SMEs. Besides these direct loan programs, Japan has two institutions for credit guarantee schemes, which are Credit Guarantee Corporations, of which outstanding guarantee is 329,739 billion yen in 2005, and JASME, 14,278 billion yen.

Korean SMBA provides policy loans to SMEs for the purpose of promoting innovative SMEs. The policy fund amounted to 2.75 trillion won in 2006. For credit guarantee schemes, Credit Guarantee Fund and Technology Credit Guarantee Fund were established respectively in 1976 and in 1989. With the budget for guarantee, as of June 2006, the government provided 300 billion won for credit guarantee funds, 600 billion won for technology credit guarantee fund, and 14.5 billion won for guarantee foundations.

Philippines established Small Business Corporation (SB Corp) in 1991, which provide credit financing and guarantees to Philippines SMEs. SB Corp provide wholesale funds with low interest rates to bankable SMEs, credit guarantees for near bankable SMEs and direct loans to non-bankable but promising SMEs. Beside, all lending institutions are required to provide at least 6% of total loans to SMEs.

Malaysian governments allocated a total of RM 555.6 million for direct lending to SMEs, of which RM 100 million was channeled through SMIDEC. And also in 2005 SME Bank was created through the merge of two banks, BITMP and BPIMS in order to provide financial, non-financial services (such as development of entrepreneurial community) and credit guarantee to SMEs. China provide direct loans or grants to innovative SMEs from the Innovation Fund for Small Technology-Based Firms, which was established in 1999, and also

from the Funds for SME Development, which was established in 2004, with annual budget of 3 billion yuan in 2006.

Mexico established the Seed Capital Program to operate in 2005 in order to direct financial resources to entrepreneurial projects, which are previously identified, developed and evaluated by business incubator centers. Direct loans are granted based on the technological level of the new business model. The Seed Capital Program had the budget of 100 million pesos in 2005. Besides, National SME Guarantee Program was established under the administration of Ministry of the Economy and two Development Banks, NAFIN and BANCOMEXT. Chinese Taipei does not provide direct loan programs but established the SME Credit Guarantee Fund in 1974 for facilitation of SMEs loan financing. The Fund provides credit guarantees for micro-enterprises start-up loans, for R&D loans of industrial upgrading, and for knowledge economy enterprise financing. In 2004, the Fund provided 265,139 credit guarantees with a combined value of NT$315,658 million, helping 126,457 enterprises to secure financing worth NT$517,037 million from financial institutions.

Typology of financing policies

The ten APEC member economies are diverse in their economic development stages and financial market systems, and thus the methods of financing policies are inevitably various. When comparing financial market sizes of the 10 APEC member economies, Japan, Canada possesses the stock market capitalization more than US$ 1,000 billions, while Philippines, Thailand, Mexico and Malaysia are far behind in terms of financial market size less than US$ 200 billions. Korea and Chinese Taipei shows relatively similar stock market capitalization, which are little above US$ 400 billions. Australia and China Mainland also showed relatively similar stock capitalization, which are around US$ 700 billions.

Even though China Mainland recorded the high volume of stock market capitalization, which is comparable to Australia, the efficiency of Chinese financial market in providing financial capital to companies is quite not satisfactory according to survey data. The average answer to the 1st question of “Stock markets provide adequate financing to companies” is the second lowest next to Mexico among 10 APEC survey. The 2nd question about “Venture Capitals: venture capital is easily available for business development” produces a relatively similar answer, which recorded the lowest among 10 APEC member economies, with the 1st question. Australia, Canada, Japan forms the highest country group in the 1st stock market adequacy and 2nd venture capital availability questions, while China, Mexico, Philippines forms the lowest country group. Thus from the perspective of financial market development stages, Australia, Canada, Japan are categorized as the high development group, and Chinese Taipei, South Korea, Malaysia and Thailand can be categorized into the Medium development group, and China, Mexico, Philippines can be categorized into the low development group.

Table 5 Stock Market Capitalization of 10 APEC member economies

(US$ billions)	2000	2001	2002	2003	2004
Australia	**372.79**	**375.13**	**378.85**	**585.48**	**776.40**
Canada	**841.39**	**700.75**	**575.32**	**893.95**	**1,177.52**
China	**580.99**	**523.95**	**463.08**	**681.20**	**639.77**
Japan	**3,157.22**	**2,251.81**	**2,126.08**	**3,040.67**	**3,678.26**
Korea	**148.65**	**220.05**	**249.64**	**329.62**	**428.65**
Malaysia	**116.94**	**120.01**	**123.87**	**168.38**	**190.01**
Mexico	**125.20**	**126.26**	**103.14**	**122.53**	**171.94**
Philippines	**25.96**	**21.22**	**18.55**	**23.57**	**28.95**
Chinese Taipei	**247.60**	**292.62**	**261.47**	**379.02**	**441.44**
Thailand	**29.49**	**36.35**	**46.17**	**119.05**	**115.40**

Sources: IMD WORLD COMPETITIVENESS YEARBOOK

Table 6 Survey: Stock markets provide adequate financing to companies?(10.0 scale)

(US$ billions)	2000	2001	2002	2003	2004
Australia	**7.71**	**7.79**	**8.18**	**7.64**	**7.98**
Canada	**7.75**	**7.09**	**8.14**	**7.44**	**7.81**
China	**5.05**	**4.82**	**4.94**	**4.17**	**4.53**
Japan	**4.96**	**4.37**	**5.90**	**5.85**	**7.04**
Korea	**6.11**	**5.06**	**5.79**	**5.48**	**5.69**
Malaysia	**6.51**	**6.36**	**7.00**	**6.06**	**6.33**
Mexico	**3.73**	**3.64**	**3.34**	**3.24**	**4.18**
Philippines	**4.22**	**3.60**	**4.14**	**4.76**	**4.78**
Chinese Taipei	**7.03**	**6.94**	**7.35**	**6.78**	**6.80**
Thailand	**5.16**	**5.76**	**7.01**	**6.55**	**6.61**

Sources: IMD WORLD COMPETITIVENESS YEARBOOK

Table 7 Survey: Venture capital easily available for business development? (10 scale)

(US$ billions)	2000	2001	2002	2003	2004
Australia	**5.64**	**5.75**	**5.95**	**5.93**	**6.25**
Canada	**6.42**	**6.10**	**6.59**	**6.26**	**6.52**
China	**2.99**	**2.95**	**3.37**	**2.98**	**2.92**
Japan	**3.20**	**3.33**	**4.08**	**4.68**	**5.53**
Korea	**5.67**	**4.29**	**4.50**	**5.10**	**4.40**
Malaysia	**5.30**	**5.70**	**6.29**	**4.78**	**6.56**

Mexico	**2.36**	**2.46**	**2.20**	**2.62**	**3.38**
Philippines	**3.23**	**3.52**	**3.00**	**3.38**	**3.57**
Chinese Taipei	**6.47**	**6.36**	**6.76**	**6.44**	**6.40**
Thailand	**4.35**	**4.81**	**5.23**	**5.17**	**5.00**

Sources: IMD WORLD COMPETITIVENESS YEARBOOK

The SME financing policies of ten APEC member economies can be divided into two broad groups, while still possessing diversities even within the groups: 1) investment-focused group and 2) loans-focused group. The investment-focused group consists of Canada, Australia, Thailand, China and Mexico. These economies all share the characteristic that government does not provide or provide only small proportion in recent years for systematic direct loan facilities. These economies do not have special banks or credit guarantee institutions for SMEs. But still the diversities remain within the group. First of all, Canada and Australia have most developed financial market system, while Mexico, China and Thailand lag behind. Moreover, while Australia and Thailand governments are directly involved in creating Venture Capital Funds to provide investments for innovative SMEs, Canada, China and Mexico only participates in the network formation of market venture capitalists with start-ups.

The loans-focused group consists of Japan, Korea, Chinese Taipei, Malaysia and Philippines. These economies all share the characteristic that governmental financing programs are centered about bank loans and possess special banks or guarantee institutions to operate for systematic loans and guarantee services to SMEs. However, these economies except Philippines have created equity investment programs in recent years especially targeting for high-tech innovative SMEs. But still the loans programs are the main channel of financing support to SMEs. Japan, Korea, and Chinese Taipei have the longest history of governmental loans programs while Malaysia and Philippines relatively newly established the public loan systems. Chinese Taipei has the uniqueness that it does not have direct loan programs but has extensive loan guarantee systems.

Financial System Stage					
	High	•Australia	•Canada		•Japan •Korea •Chinese Taipei
	Low	•Thailand	•Mexico •China	•Philippines	•Malaysia
		Government equity program	BANs-centered	Loan Only	Loan + VC
		Investment-focused		**Loan-focused**	

Fig 4 Typology of SME financing policies among 10 APEC member economies

Source: APEC, 2006, "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)"

4. Case Studies

4.1. Australia: Technology Commercializing - COMET[6]

The general focus of Australian federal government's SME policies is on improving the flow of finance into business innovation and on stimulating the growth of innovative firms by enhancing Australia's capacity to commercialize research and new technologies. The Australian government recognized that commercialization of technology is essential for an effective Australian innovation system. However, the government finds it difficult for early-staged technology companies with potential high risk to attract capital and to obtain management and business skills. The government has concluded that the good quality research has not been successfully commercialized due to this reason. The COMET (Commercializing Emerging Technologies) program, which provides a comprehensive support measure combining financial assistances and management consulting services to early stage companies, is the best measure to cope with these difficulties.

The COMET program is designed to support early-growth stage companies, spin-off companies and individuals to commercialize their innovation technology. COMET is a merit-based assistance program which provides business assistance through access to private sector consultant Business Advisers as well as access to merit-based financial assistance. It also

[6] This Australian case of COMET program is drawn from the APEC report "A Research on the Innovation Promoting Policy for SMEs in APEC: Survey and Case Studies (SME 01/2006)", which were conducted by the APEC SME Innovation Center of TIPA(Korea Technology and Information Promotion Agency for SMEs).

provides business assistance in the following areas: management development including participation in approved management skills development courses; engagement of mentors; strategic and business planning, including export strategy if appropriate; market research; market validity; Intellectual Property strategy; and Proven Technology (including finalizing Working Prototypes).

At 31 December 2004, outcomes include more than $313 million raised in equity capital by COMET customers, over 600 strategic alliances, licenses and agreements, and around 265 manufacturing commencements and products / services launched. COMET has been extended until June 2011 with additional funds of $100 million as part of the Australian Government's innovation statement, Backing Australia's Ability – Building Our Future through Science and Innovation. More than 1,000 companies will benefit from the extended program.

The eligibility for COMET assistance is for 1) early-growth stage companies commercializing their innovation, 2) spin-off companies formed by individuals from either public or private research institutes. The eligibility criteria for application of COMET grant require that 1) innovation has commercial potential, 2) the majority of the applicant's current business activities, employees or assets must be within Australia, and 3) the applicant must be prepared to become an incorporated entity under the Corporations Act 2001, 4) the applicant must have ownership of, or beneficial us of, any intellectual property necessary to commercialize innovation, 5) the applicant companies must be less than five years old, 6) the total turnover for the applicant companies over the previous two years must is less than $8 million, and 7) the applicant must be solvent, 8) the applicant must be prepared to enter into "a success fee agreement."

The merit criteria for assessment of applications are 1) actual or potential management capability to commercialize the innovation with appropriate COMET support, 2) market opportunity and strategy, 3) technical feasibility of the innovation, and 4) demonstrated need for COMET funding. Applications are considered on an ongoing basis, which is assessed by COMET business advisors, and applicants will receive the notification within 14 days of the program delegate's decision.

COMET offers two streams of business services assistance: Tailored Assistance for Commercialization (TAC), and Management Skills Development (MSD). Under TAC, eligible firms work with private-sector business advisers on strategies such as developing a proper business plan, and a product prototype and market analysis to attract and manage capital. TAC provides assistance of 80% of eligible costs incurred under the customer's TAC plan. Assistance averages $50,000 to $60,000 and is capped at $100,000 for exceptional applicants. MSD provides dollar-for-dollar assistance up to $5,000 to enable individuals to

undertake courses in relation to management of innovative practices and the financial management of commercialization. COMET assistance is available for up to two years.

The COMET financial assistance for companies is available through a two tier funding structure. In the tier 1 stage, grant value up to $64,000 can be provided. The rate of assistance is available at 80% of the eligible expenditure. In the tier 2 stage, grant value up to an additional $56,000 can be provided. The rate of assistance is available at 50 % of the eligible expenditure. Assistance to individuals is available to develop management skills required to progress their innovation towards commercialization. Grants to individuals are limited to $5,000.

PageUp

PageUp is the computer software service provider specialized in HR management software. In 1997, Melbourne-based PageUp began when Simon and Karen Cariss started building web-browser-based software for various organizations. PageUp focused on providing world-class human resources technology for recruitment and recently became a service provider for Australia's largest employer, Coles Myer.

Since PageUp received an Australian Government Commercialising Emerging Technologies (COMET) grant in 2000, it has won a number of awards and made the BRW's Fast 100 list in 2004. Simon and Karen worked with their COMET business advisor Bob Beaunont to use their $80,000 funds for market research, developing intellectual property and strategic planning.

Over the last five years, PageUp has worked hard to become the clear market leader providing HR services to Australia's top 100 companies and PageUp has grown from six employees to 28 and tripled its turnover to $3 million per annum. In 2004, PageUp was listed by BRW as Australia's 33rd fastest growing small to medium enterprise. It also won the Telstra and Victorian Government Small Business Award for the 20-50 employees category.

Source: AusIndustry

The strength of the COMET program is the focus on the commercialization of scientific research results and on the high-tech start-up companies. The COMET program is the customized and comprehensive services combining financial grants and management consultation for newly established start-ups. Since the market failures in economic growth and job creations are mainly centered about the formation of new firms, the policy focuses on promoting commercialization and high-tech start-up companies is appropriate for Australian SME innovation and economic growth. In this regard, the COMET program played the major role in pursuing the innovation strategy in recent years.

The success of the COMET program is due to the combination of financial support and management advisory services. Often newly start-ups face difficulties in raising long-term stable capital and also difficulties in obtaining managerial talents to handle with business growth. Even if a start-up company can finance their R&D investment from outside capital, they often end up in failing commercialization of their scientific researches because of lack in managerial skills. Thus, with financial assistances to start-ups, managerial advisory and

consultation services should be accompanied for the successful commercialization and production of high-tech research results. In this approach, the Australian COMET program could achieve high success in assisting the commercial growths of Australian high-tech start-ups and spin-offs.

4.2. Korean Technology Financing[7]

Korean technology financing programs for SMEs, in which several Korean ministries are involved (MoCIE, MoST, SMBA), are managed mostly thorough establishments of special-purposed funds in the operations of technology-collateral, technology evaluations, credit guarantees and debt financing. Here are introduced two special-purposed funds, 'Science and Technology Promotion Fund' and 'Information and Communication Fund', which employ not only general collateral-based loan programs but also on technology-collateral-based loan programs.

STPF (Science and Technology Promotion Fund) was established in 1992 for the purpose of promoting science and technology investment under the Comprehensive Plan for S&T Innovation of 1991. STPF provides loan programs for private firms' R&D investments or commercialization of science and technology developments. The purpose of this loan program is to promote technology developments of small venture firms which has technological capabilities but are weak in material collaterals. The targets of this loan programs are confined to three different types of R&D investments and commercialization: 1) national R&D programs and consequent national R&D programs, 2) R&D investments in future promising technology areas, and 3) basic scientific research or high technology developments.

Table 8 The Assistance Conditions and Coverage of R&D Loan Programs

	General Collateral Loans	**Technology-Evaluation Based Loans**
Administrative Institution	Science Foundation	Science Foundation
Loan lending financial institution	Selected nine financial institutions	Technology Credit Guarantee Fund
Lending interest rates	Inter-bank interest rate in previous quarter – 0.75% (SMEs)	Inter-bank interest rate in previous quarter

[7] Korean Technology Financing cases are based on STEPI report(2006), "A comprehensive appraisal of policy instruments for studying firm's technological innovation".

Duration of lending	Maximum 7 years (maximum 3 years deferment)	Maximum 5 years (maximum 3 years deferment)
Amounts of lending per project	Max. 2 billion won per project Max. 6 billion won per firm	Max. 2 billion won per project Max. 6 billion won per firm
Coverage of guarantee	Max. 100% of total loans	Max. 100% of total loans
Technology evaluation institute	TCGF and other six technology evaluation institutes	TCGF

Source: STEPI, 2006, “A comprehensive appraisal of policy instruments for studying firm's technological innovation”

STPF employ not only general collateral-based loan programs, but also technology-collateral based loan programs. General collateral-based loan programs involve two stages of evaluation system. In the first stage, seven technology-evaluation institutes including TCGF (Technology Credit Guarantee Funds), KIST, KISTEP involve in loan evaluations. The selected loan applications after the 1st loan-evaluation are recommended to financial institutions which proceed to evaluate these loan applications on the aspect of material collaterals such as real estates, stocks and bonds. The financial institutions involving in this 2nd evaluation procedure are commissioned a brokerage fee, 1% of total loans. However, since this collateral-based loan program is unapproachable by technology-based innovative firms without material collaterals, the purpose of STPF could not be exactly achieved with this general collateral-based loan program. Thus the proportion of collateral-based loan program has been continuously reduced to be nullified completely in 2006. Only technology-collateral-based loan program is now in operation for STPF.

Technology-collateral-based loan program provide public loans to innovative and technology-based SMEs or venture firms, solely with the evaluation of SMEs’ technology values. This program is introduced in 1997. Technology evaluation is operated by TCGF (Technology Credit Guarantee Funds), which provide loan guarantees for selected loan applications. TCGF are commissioned a brokerage fee, 0.75% of total loan provisions. Because TCGF provides loan guarantees which might result in default loss, TCGF would have disincentive to provide these loan guarantees to high-risk SMEs and start-up companies. In order to alleviate this disincentive problems and to prevent the evasion of loan guarantee provisions to highly-innovative but highly-risky SMEs, STPF furnishes credit-default insurance fees, 2.03% of total technology-evaluation-based loan guarantees provided by TCGF. With this risk-sharing between STPF and TCGF, technology-evaluation-based loan programs can be successfully

promoted. SPTF provided 1.2 billion won to 3,848 projects of 3,043 firms during 1993-2005. The strength of this loan program is low interest rates with long-term duration of loan lending and the method of technology-evaluation-based selection procedure. However it is criticized that its loan coverage is overlapped with the loan programs of 'Information and Communication Fund'.

Similar loan program, which is called as "Applied Technology Development Supporting Loan Program", is managed by 'Information and Communication Fund'. This loan program started in 1993 with the title of "Technology Development Support Project for Information and Communication Industries" and changed the title of the program to current one in 2002. The targets of this program are the firms which are engaged in the industries of S/W, digital contents, computers and related equipments, information/communication services and IT-related products and services. Especially high-tech SMEs which have difficulties in raising investment funds for their technology developments are the major targets. The purpose of this loan program is promoting entrepreneurship and start-up companies' technology developments in ICT industries.

As like STPF, ICF employ not only general collateral-based loan programs but also technology-collateral based loan programs. The general collateral-based loan programs of ICF also involve two stages of evaluation system, in the first stage of which KISDI involve in loan-application evaluations for policy-conformity, technology values, and commercialization possibility. The selected loan applications after KISDI's evaluation are recommended to financial institutions which proceed to evaluate these loan applications based on material collaterals such as real estates, stocks and bonds. Technology-evaluation-based loan programs are introduced in 2002. The selection and evaluation procedure of this loan program involves the first stage of TCGF's technology evaluation and the second stage of in-depth evaluation. TCGF provides loan guarantees for evaluated technology values, and private banks provide public loans to SMEs or venture firms with this loan guarantees. Total amount of 1.9 billion won are provided for this loan program during the period of 1993-2005.

Table 9 Assistance Performance of ICF's Loan Programs (unit: Million Won)

Year		**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Total (a)	# of projects	470	575	510	404	503	n.a
	Loan Amount	149,552	179,142	181,665	128,579	218,222	n.a
	amount per project	318	312	356	318	434	n.a
General Collateral loans (b)	# of projects	470	575	317	47	93	n.a
	Loan Amount	149,552	179,142	113,608	11,656	84,812	n.a
	amount per project	318	312	358	248	912	n.a

Technology evaluation based loans (c)	# of projects	-	-	193	357	410	n.a
	Loan Amount	-	-	68,057	116,923	133,410	n.a
	amount per project	-	-	353	328	325	n.a
Ratio of technology-evaluation-based loans in # of projects (c/a)		0.0%	0.0%	37.8%	88.4%	81.5%	n.a
Ratio of technology-evaluation-based loans in loan amounts(c/a)		0.0%	0.0%	37.5%	90.9%	61.1%	41.4%

Source: STEPI, 2006, “A comprehensive appraisal of policy instruments for studying firm's technological innovation”

Figure 5 shows the whole procedure of this technology-evaluation-based loan programs in Korean technology financing. Financial institutions operate diverse portfolios of this loan programs to meet various financial needs of SMEs and venture firms. Among these programs, Korea Development Bank (KDB) technology financing can be a good example of providing adequate funds to SMEs. KDB provides: 1) ‘Early technology commercialization funds’ (amounts to 30bil.won), which aims at the promotion of commercialization of technology from public research institutions, 2) ‘Investment for Venture Firms’ (amounts to 70bil.won) for less-than-5-year venture firms’ working in R&D and commercialization, 3) ‘Credit loans to technology-based firms’ (100bil.won), which provide technology evaluations, business evaluations and IPR evaluations, 4) ‘KDB Venture Star’, and 5) ‘KDB Global Star’ programs.

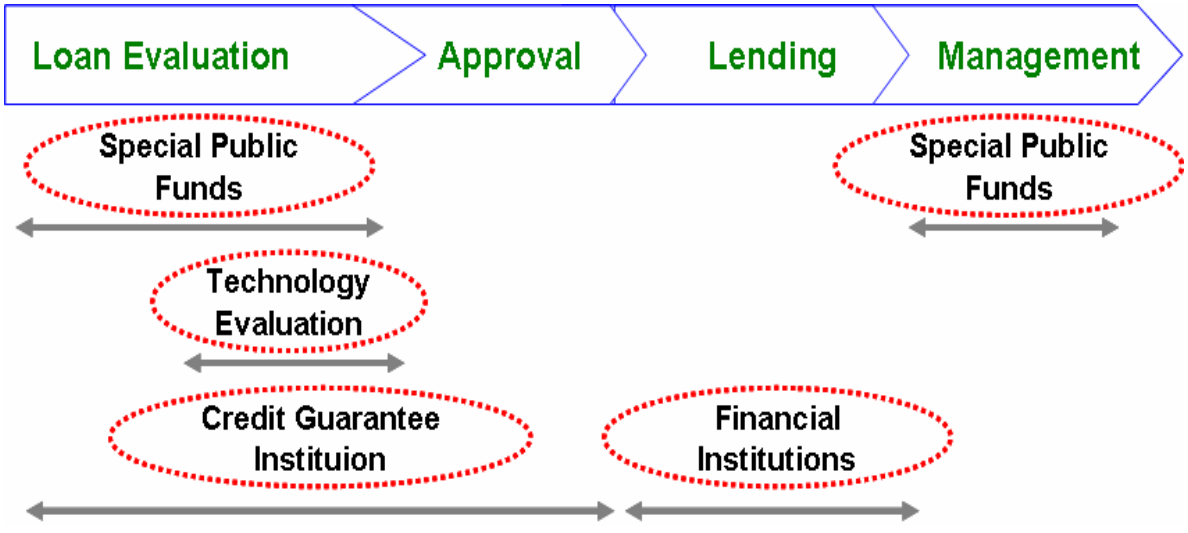

Fig 5 Korean Technology Financing Process

5. Conclusion

5.1. Discussion Agenda

There would be five topics for roundtable discussions among trainees and participants. First of all, all the trainees from developing economies are expected to make short presentations about financing programs of participants' economies. Secondly, roundtable participants will discuss what would be the differential effects between equity-based programs and loan-based programs, or between financial market developments and governmental direct interventions? Thirdly, the discussion agenda will be whether the country's industrial specificities matter for differentiation of financing programs or not. Fourthly, what are the practical problems, which might be faced by each economy's financing programs? And what would be possible solutions? Lastly, are there international cooperation agendas to enhance financial capacity for SMEs' innovation?

5.2. Suggestions for Policy Implementations

The financial support measures for innovative and technology-intensive SMEs have a long history in advanced economies, and even within the circle of developing countries such as Korea, Taiwan and other Asian countries. However differences could be found in the methodologies of providing financial assistances to innovative SMEs. Mostly Anglo-Saxon countries with the tradition of free market trade focuses on equity-investment tools of financial assistances while German and Japanese system in the tradition of common law are found to utilize loan guarantee provisions. Historically even within the tradition of Anglo-Saxon countries, direct loan provisions to SMEs were once employed to fill the financial gap problems faced by innovative-but-low-collateral SMEs. With the development of financial markets and sophistication of banking system in developed economies, Anglo-Saxon advanced economies mostly confined their public financial assistance programs to equity investments while the common-law-based advanced economies mostly restrain their public financial assistance programs to loan guarantees.

The common characteristics of advanced economies in operating financial assistance programs for innovative SMEs are 1) their rigorous preventive measures of moral hazard problems by financial institutions and venture firms, which might show rent-seeking behaviors with these public financial assistances, and 2) their profit maximizing measures while achieving public goals of promoting technology developments of innovative SMEs and entrepreneurship in market. These measures could be called as "market-friendly" measures to facilitate financial market or financial institutions' functions through the intermediary roles of public funds. The public funds provide necessary guarantees or equity investments which solve information asymmetry problems of innovative SMEs with rigorous technology evaluations. Thus if financial markets or financial institutions are developed enough to

distinguish these investment or loan lending opportunities, public financial assistance programs could be confined to intermediary functions of loan guarantee or equity investment with rigorous evaluation and screening. However since financial institutions or financial markets of developing countries are underdeveloped not enough to distinguish profitable investments or successful loan lending opportunities in innovative SMEs, the direct loan financing to SMEs are still prevalent in public financial assistance tools.

The developing countries' financial assistance programs, regardless of whether they pursues equity investment strategy or loan lending schemes in promoting innovative SMEs, have to deal seriously with moral hazard problems and with dwindling public funds due to high default loss in their lending or investments in risky start-up companies. While the public assistance programs in developing countries pursue the public goals of promoting innovative SMEs in their economies, if the public measures are not market-friendly in essence, the public financial assistance programs could be ended in with the results of even damaging long-term competitiveness of innovative SMEs and entrepreneurship formation. These are the reasons why, in recent years, Korean government and Japanese government change the general principals of SME innovation policies from helping 'weak and unprotected SMEs' to promoting competition among innovative SMEs.

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Chpater 6. Technology Financing

Sanghoon Kim[1]

This subject is designed to assist policy makers in developing APEC member countries in establishing policies for SME promotion by introducing concept and issues of "Technology Financing." The main purpose of this subject is to promote technology development and commercialization of SMEs, survey several case works previously practiced, and propose viable policies and/or following systems for the future.

1. Introduction

1.1. Technology (general term vs. as a candidate for commercialization)

Even though present life is intertwined with technology, there is yet no universal definition of the term for technology. Various definitions can be made by people with different professional backgrounds that are partial or narrowly focused. For examples, technology can be defined as means for performing industrial arts and infrastructure building from the typical viewpoint of engineer or it can be seen as the things that human create to alter their everyday life-styles from the viewpoint of journalist, whereas it can be defined as a capital good utilized as a production factor for economical growth from the economist viewpoint.

Apart from this type of partial definition, a comprehensive definition is available from graduate level academic textbook. According to the textbook, "Technology" refers to that theoretical and practical knowledge, skills and artifacts that can be used to develop products and services, as well as their production and delivery systems. Technologies can be embodied in people, materials, cognitive and physical processes, plant, equipment and tools. Key elements of technology may be implicit, existing only in an embedded form (like trade secrets based on know-how) and may have a large tacit component (Burgelman, R et al 2004).

All of the above definitions are correct for the special focus group. However, all of the partial as well as comprehensive definitions do not readily lend themselves to be actionable managerial definition for the purpose of performance assessment and resources allocation in an enterprise. Moreover, the definitions are neither universal nor measurable for sound managerial decision-making, which implies the above definitions are not readily useful for everyday decision-making purposes in the enterprises.

[1] Vice President of EBSI

It is, therefore, suggested that more actionable term of "technology" or "technology-system" needs to be introduced in order to facilitate technology related management in an enterprises. Fortunately, a generally accepted and actionable definition has been developed in terms of evolution of the economic and business factors of production through a series of attempts by several researchers (UN-ESCAP, 1984). According to these researches, "Technology" can be defined as simply human-made help-mate for all economic value addition activities, i.e., application being the essence, technology is a capital good utilized by all economic systems. Considering technology is a critical factor of production, it is possible to isolate the factors which comprise technology as we review the evolution of technology as a crucial factor of economic activities.

1.2. Supporting Tool for SMEs

For policy makers, the survival and growth of Small and Medium-sized Enterprises (SMEs) is a matter of primary concern. The dynamic disposition of SMEs is an interesting factor in the aspects that they invigorate the stagnant economy and are necessary as an infrastructure for large enterprises. Since SMEs are flexible in terms of organization and production structure in general, they are supposed to seize new business opportunities rapidly, thus overcome financial crisis at a lower cost. SMEs also contribute to the stability of society by accounting for a large share of total employment.

In addition, technology is recognized now to be the most sought after human made help-mate, which can be utilized effectively and efficiently as a capital-good for economic wealth generation, all over the world. There is also widespread agreement now that technology management is critically important for the survival and growth of all enterprises in the new world economy, which has become extremely competitive and increasingly interdependent (Sharif, N, 2006).

Technology change and the growing significance of R&D investment, are often cited as the primary driving force of economic growth, and it is widely accepted that social rate of return on R&D expenditure exceeds the private rate. In the absence of policy intervention, the latter may lead to low R&D activity in the society and to a sub-optimal rate of economic growth. The industrialized countries have all, to varying degree, publicly funded R&D projects that are believed to have particularly large social benefits. The total amount of public R&D support is considerable.

For examples, due to assumptions of market failures and the under-investment in R&D and innovation activities, all OECD countries are spending significant amounts of public funds on programmes intended to stimulate these activities. At the end of the 1990s, the share of government funding of the total R&D, in the respective economies, was approximately one

third in the US and Europe and one fifth in Japan (OECD 2000). Nearly 10% of commercial firms' R&D expenditures in the OECD are publicly funded.

In this regard, this article is focused on the understanding technology financing for the enterprises (especially SMEs) operating in the present day global economy. Detailed experience in Korea for designing and implementing such a program will be introduced with a focus on guarantee based loan financing with a close relation to technology evaluation.

The objectives of this subject can be summarized as follows: First of all, it is required to develop general definition of "technology" as a candidate for commercialization to lead trainees to have a unified understanding. Then, it is necessary to identify various factors and isolate key factors in commercializing technologies. Understanding the role and process of "technology financing" to promote technology commercialization can be achieved by attempting to understand various types of SMEs based upon growth stage and their technologies, and diverse financial needs of SMEs.

Finally, it is crucial to understand the required infrastructure or resources (i.e. policies, budget, manpower etc) to implement technology financing (through proper technology evaluation). Also, understanding "technology evaluation" as a key factor for "technology financing" is helpful to have macroscopic insight of technology financing system on the whole.

With this article, it is anticipated that this subject assist policy makers in APEC developing member countries in establishing policies for SME promotion by introducing concept and issues of "Technology Financing" as a key factor for SME support, surveying several case works previously practiced, and finally proposing viable policies and/or following systems for the future.

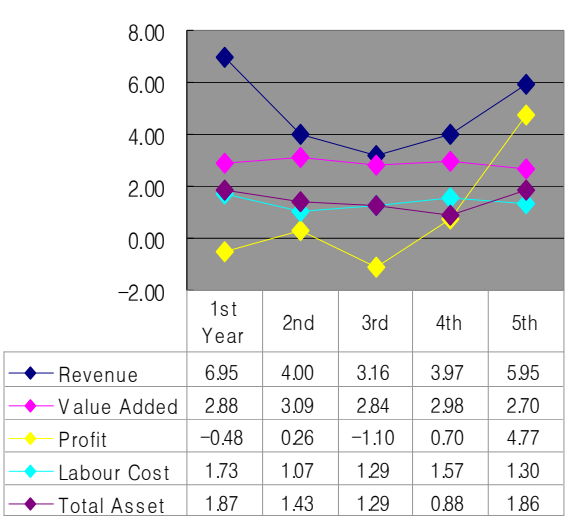
2. Technology Financing (TF) - Status of SMEs

2.1. The Importance and Hurdles of Technology Commercialization for SMEs

It appears that technology based SMEs tend to generate more "profits" and "value added" when compared to traditional SMEs. According to recent survey, the major hurdles which SMEs have been facing in technology commercialization are closely related to financing. However, especially SMEs have experienced great difficulty in attracting capital, especially due to characteristics of business risk. Innovation, which has attracted large attention today, also can represent a disproportionately large financial risk than before. In the next figure, the

"profits" and "value added" generated by technology based SMEs are compared with those generated by traditional SMEs.

Considering these circumstances, governmental intervention needs to be rationalized as well as to be required. It is apparent, however, that the fund supported by the government is usually smaller than that required by the SMEs. It is necessary, therefore, to introduce government-lead financing policies and/or systems, in order to achieve more efficient distribution of government aids. An effort to come up with an efficient system can be made by understanding the status of each member economy and caseworks attempted in other member economies.



	1st Year	2nd	3rd	4th	5th
Revenue	6.95	4.00	3.16	3.97	5.95
Value Added	2.88	3.09	2.84	2.98	2.70
Profit	-0.48	0.26	-1.10	0.70	4.77
Labour Cost	1.73	1.07	1.29	1.57	1.30
Total Asset	1.87	1.43	1.29	0.88	1.86

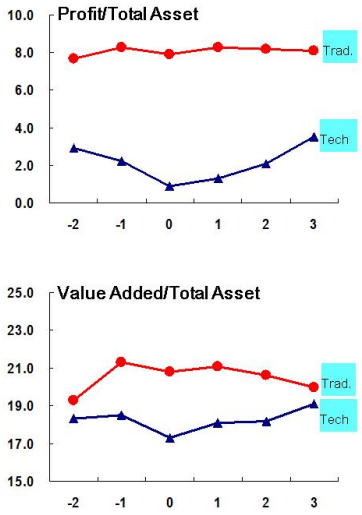


Fig 1 The "profits" and "value added" generated by technology based SMEs

The major justification for the importance of technology financing can also be found from the survey. According to KIBO (formerly KOTEC) in Korea, it was found that most commonly faced problem to SMEs was financing. This is shown in the figure.

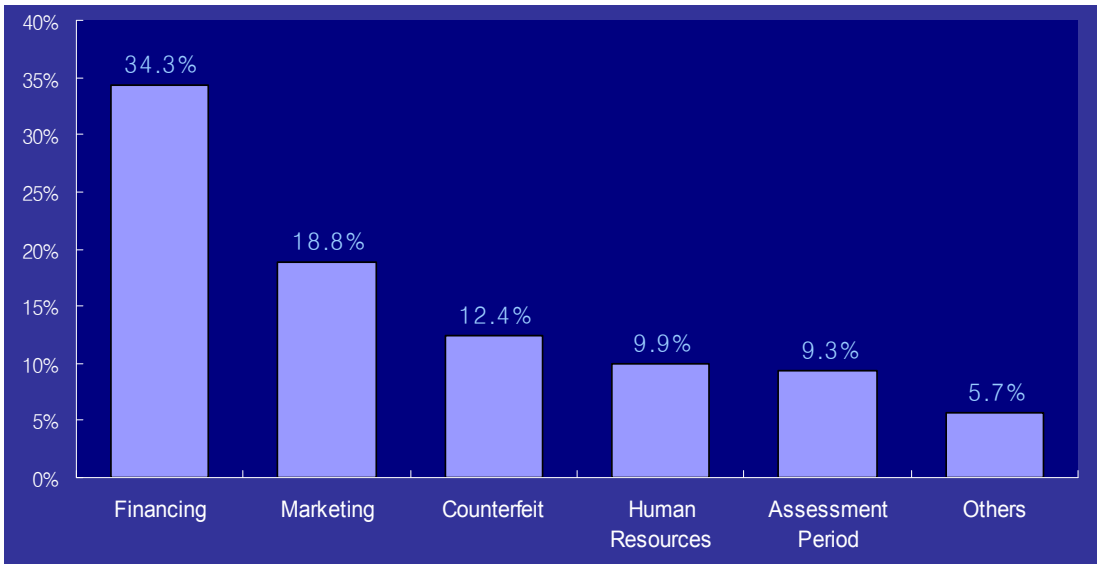


Fig 2 Major Hurdles for SMEs' Business (Questionnaires to SMEs) ('04. 5)

Conventionally, key criteria involved in technology evaluation for the purpose of technology financing composed of four items; the ones related technology, human, market and finance. From the detailed viewpoint of these criteria, it is possible to isolate the main reasons for finance problem and their relation to other reason for different criteria. Through the figure shown below, it is expected that identifying the major purpose of financing, the average financing size required etc can be plausible.

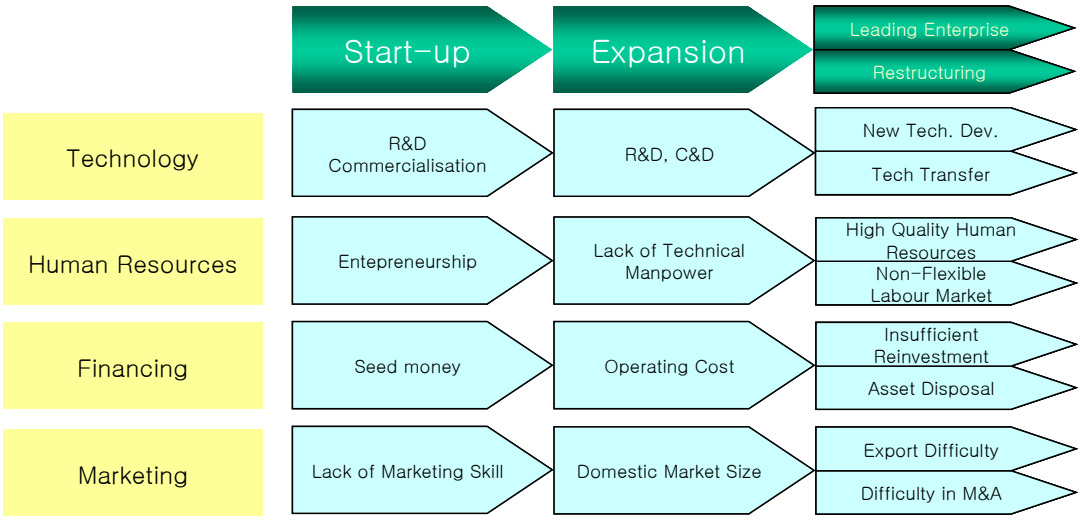


Fig 3 Main hurdles to be overcome for each growth stages of SMEs

In addition, the effort of identifying countermeasures for enhancing SMEs' competitiveness performed by SMBA in Korea shows that financing is critical factor. According to the figure

shown below, this factor is more critical in the initial stage from the business start-up. It also appears that the innovative (technology based) firms and small firms are more susceptible to the financing issue.

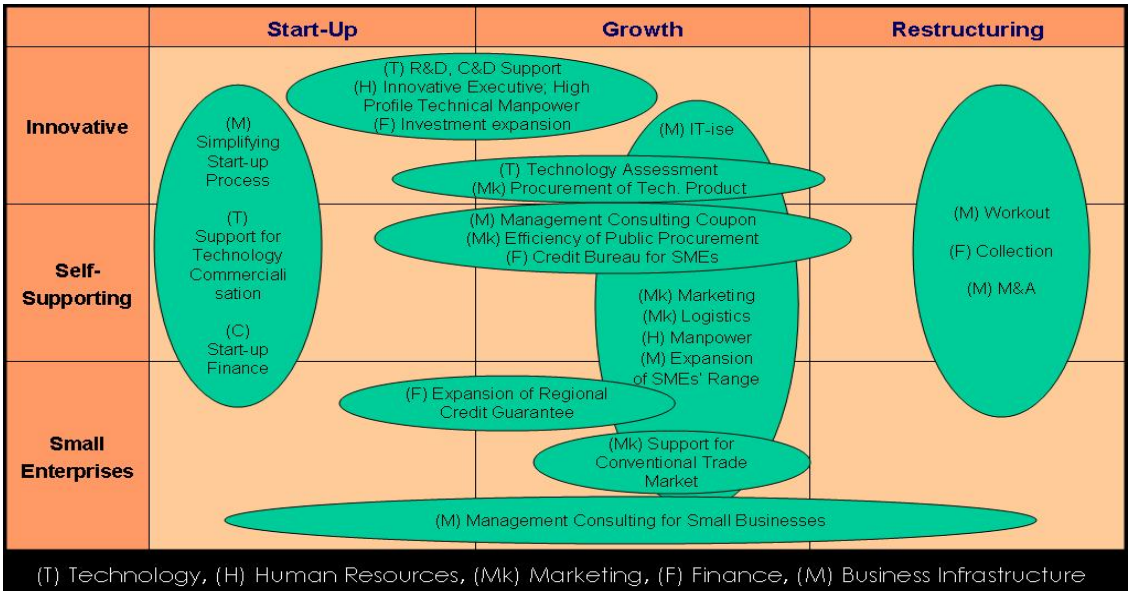


Fig 4 Comprehensive countermeasure for enhancing SMEs' competitiveness

Based upon the consideration described above, it is possible for policy makers to make to classify which types of technologies and SMEs are eligible for government support and financing. During this process, it should be pointed out that potential conflicts of interest between individual objects (such as between the parties of budgeting, policy making, administration, banking institution (government or civilian), investment firms and SMEs themselves) which comprises financial transaction chains may be caused, which requires careful consideration.

2.2. Factors affecting Technology Commercialization

Recent research in strategy suggests that the creation of new technology is an important driver of firm success (Eisenhardt and Martin, 2001). However, not all firms can create technology within their boundaries (Teece, 1982), and even firms that can do so sometimes make use of externally generated technical knowledge (Tripsas, 1997; Cohen and Levinthal, 1990; Chesebrough and Teece, 1995). Such sourcing helps firms to obtain access to new technologies that are valuable to their performance in the market place but unavailable within organizational boundaries. Many observers have commented on the problems that firms experience commercializing new technology created outside of the organization (Teece, 1986; Nevens, Summe and Uttal, 1990), but little empirical research has identified factors that make for the successful commercialization of imported technology (Porter and Stern, 2001).

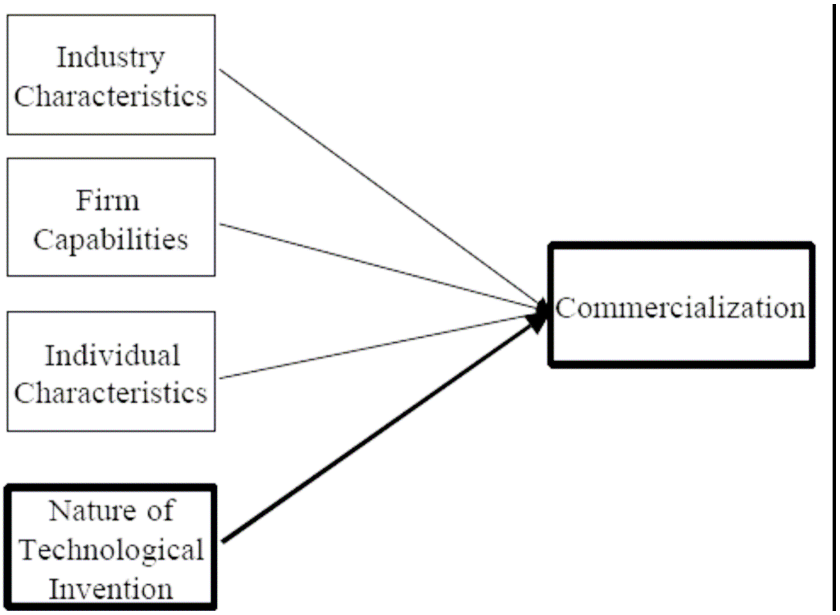


Fig 5 Drivers of Technology Commercialization

The body of literature that documents the importance of new technology commercialization for economic as well as firm growth is extensive (Schumpeter, 1934; Solow, 1956; Penrose, 1959; Nelson and Winter, 1977). Three streams of research are relevant for understanding the determinants of commercialization of technologies sourced from outside of organizational boundaries (Drazin and Schoonhoven, 1996; Schilling, 1998). The first one focuses on the role of communities, populations and the broader environment. Examples of research in this stream include Wade (1996), who examines the effects of new entrants to the industry on the sources and rates of technological innovation in the microprocessor industry; Abrahamson and Rosenkopf (1997) who focus on social networks and their impact on innovation diffusion; and David (1988), who offers network externalities and increasing returns as an explanation for emergence of standards. The primary explanation for successful commercialization is embedded in the environment and manifests itself via social networks, bandwagon effects or network externalities.

The second stream focuses on understanding the capabilities of individual firms in commercializing new technologies, with particular focus on dynamic capabilities that allow repeated success at commercialization (Teece, Pisano and Shuen, 1997). Examples of research in this stream include Dougherty and Hardy (1996), who examine firm resources and processes and their role in sustained product innovation; McGrath, Tsai, Venkataraman and MacMillan (1995), who show that firm competence is a necessary antecedent for innovation

success; and Pennings and Harianto (1992) who present evidence that firms with technological networking capabilities are the most successful.

The third stream of research examines the role of the individual in technological commercialization. Scott and Bruce (1996) suggest that leadership, individual problem solving style, and work group relations affect innovative behavior directly, while Howell and Higgins (1990) examine the importance of individual champions in the innovation process. Other research has examined the context of the teams or groups that innovators belong to within the firm. Bantel and Jackson (1989) show that educated top management teams are positively associated with successful innovative activity in the banking industry while Nerkar, McGrath and MacMillan (1996) demonstrate that team satisfaction mediates the relationship between effort and innovative success.

The prior research streams have generally not focused on the nature of the technology itself (Henderson and Clark, 1990 and Anderson and Tushman, 1986 are notable exceptions). Moreover, even when researchers have examined the nature of the technology itself, they have not examined the determinants of commercialization of externally sourced knowledge. While the role of the environment, the culture, the firm and the individual are important factors in explaining the commercialization of new technology, the nature of the new technology needs to be explored in greater detail for researchers to develop a fuller understanding of the commercialization of new technology.

It should be noted that the isolation of more crucial factor is necessary sometimes, although various factors mentioned above interact each other, which makes the factor isolation more complex. In addition, it needs to be reminded that which factor is more crucial is dependent upon each nation’s circumstances (such as education, population, economy and environment atc), and this consequently affect the unique characteristics of policy directions for each country as shown in the figure.

Fig 6 SME policy directions for different countries

2.3. The Classification of SMEs (as a target for TF)

Although it is natural to define SMEs as a beneficiary of "technology financing" in the context of this subject, the general definition of SME is too obscure to be applied to the technology financing. Since the source for funding is limited compared to the SME's demand, certain criteria as an eligible applicant need to be set first. For example, financing seems to be more critical for start-ups as mentioned earlier. Therefore, it might be logical to set criteria for funding to start-ups rather than grown-ups in terms of effectiveness. Similar approach can be made to innovative firms and the others.

The effort to define SMEs, as a target subject for financing, needs to be done. At first, in the aspect of SME classification, required attempts would be to establish definition and classification of SMEs according to the activity and technology type (see table below). It is then possible to identify the potential impact of financing on sustainability of these SMEs and national economy.

Table 1 Example of SME classification setup, eligible for funding

Firm Type	Technology Type	
	Emerging	Mature
Start-ups	Type I (venture)	Type II (differentiated or brave entrant)
Established	Type III (revitalising, or diversifying)	Type IV (incumbent innovator)

The setup of definition and classification of SMEs according to growth stage (see figure below) may also be necessary based upon circumstances (This is the case for many countries including Korea). Since spontaneous income of funding from the market may not be available to start-up and early-stage SMEs, it is sometimes appropriate to set-up target SMEs for government support, to improve promotion efficiency.

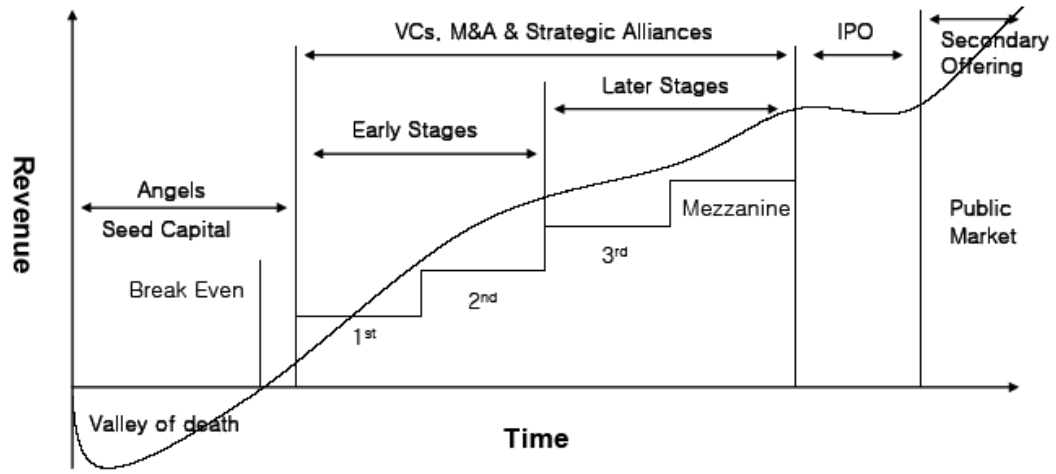


Fig 7 Typical example of revenue vs. growth stage of SMEs

3. Technology Financing (TF) Systems and Policies

3.1. Concept of Technology Financing (Definition and purpose)

Conventionally, technology financing can be defined as all kinds of financial activities including guarantees, investments and loan-lending which are accompanied by a series of technology innovation processes like R&D and commercialization.

There is no doubt that technology based SMEs are crucial for national economies especially nowadays. However, it is often observed that market itself appears to be indifferent to the

SMEs' promotion, especially for start-ups and early stage ones, partly because of the lack of patience to wait for their outcome. Therefore, efficient government-driven technology financing system may be required, in order to achieve the goal of efficient SME promotion.

3.2. Theoretical Background

The theoretical literature on the economic benefits of innovative activities is vast. There is also a steadily growing empirical econometric literature and case studies verifying the importance of R&D and innovation at various levels of aggregation.

The economic-theoretic support for state intervention in R&D activities begins from 1940s, with the researches by Schumpeter (1942), Nelson (1959) and Arrow (1962). The recent endogenous growth model by Davidsson and Segerstrom (1998) differentiate between innovative R&D and imitative R&D. The former produces higher quality products, while the latter imitates other firms' products. Although both types of R&D activities create new knowledge, they find that only innovative R&D subsidies lead to faster economic growth.

A governmental grant regime, stimulating a faster rate of imitation, makes the monopoly profits earned from successful innovation more short-lived. The consequence is a decrease in the rate of technical change, resulting in slower economic growth. Based on data from a typical OECD country, they empirically show that all R&D expenditure increase the level of GDP, but only investment associated with new products for the market, new processes and development of knowledge have a positive impact on the GDP growth rate.

Most industrialized countries have publicly funded research-grant programmes that attempt to funnel public resources directly into R&D projects that are anticipated to have particularly large social benefits. Such research-grant programmes include those that support basic scientific research; R&D aimed at particular technical priorities to the state (eg. Defence, health and environment); 'pre-competitive' R&D intended to generate large spill-over, often with a collaborative component; subsidies especially targeting the new technology based firms and early-stage financing to firms, particularly those in the high technology field. Most of these grant programmes can be assumed to target innovative R&D along the Davidsson-Segerstrom definition.

The assessment of various governmental grant programmes is afflicted with fundamental measurement problems such as: (1) how to measure research output of supported research entities, (2) how to measure the spill-over benefits of funded research enjoyed by entities other than those that are directly supported, and (3) how to measure transformational impacts, whereby public support changes the nature of the research infrastructure, with possible long-lasting effects.

In evaluation studies several different measures of R&D output can be distinguished. First, if the R&D expenditure is aimed at early-stage technology development then the output can be technical and the activities that transform commercially promising innovation into a business plan can attract sufficient investment such that output enters a market successfully (Branscomb et al 1999). Second, when the objective of the R&D efforts is to develop a new science or technology that is protectable, then the best measure of output is patents or copyrights. Third, R&D investment intended to result in the successful entry of a new or significantly improved product into a particular market can best be measured as innovation sales.

A more recent discussion on the impact of state funding considers whether the public funding decision represents an endorsement of a project as being of high quality. The screening of proposals by the likelihood of success is a costly and uncertain process. Non-public sources of funding may piggyback on the public review process, or even if they make their own assessment, they acknowledge that their assessment is uncertain and can be influenced by that of the government experts. This ‘certification’ or ‘halo’ effect is believed by research grants agencies in the USA to be an important factor in increasing to total spending of grant recipients (Diamond 1998, Jaffe 2002).

It is also well documented in the literature that firms funded by the government are likely to be among those with best ideas. Thus, they have more incentive to spend their own resources, and are more likely to receive support from third parties than firms not funded. As emphasized by Jaffe (2002), any regression analysis that compares the research expenditure of government supported firms to those that are not supported has to take into account the selectivity problem. A closely related assessment issue concerns additivity versus crowding out phenomenon. While the selectivity problem arises because public funding goes to proposals judged in advance as likely to succeed; the additivity and crowding phenomenon out refers as to whether public funding increases the total spending on research or merely displaces funding from other sources (Busom 2000).

In order to measure the impact of public funded R&D and to reduce the problem of selection bias, many recent assessment studies rely on one or more of the following methods: (1) regression with controls, (2) fixed effects or difference-in-difference models, (3) sample selection models, (4) instrument variable estimators, or (5) matched samples of treated and untreated firms. The treated firms are firms receiving public funds.

In recent years, there has been a surge in econometric works focusing on the effectiveness of public R&D policy at various levels of aggregation in many OECD countries. The following

table depicts the common methods used and the main results from selected recent related studies.

The heterogeneous results from different assessment studies, shown in above table, confirm previous findings in the literature. Reviewing the body of available econometric evidence accumulated over 35 years, David, Hall and Toole (1999) conclude that conflicting answers are given as to whether public R&D spending increases or replaces private R&D expenditure. According to recent research by Lööf et al., it was found that there are additive effects of public R&D financing on private research expenditures, but the only beneficiaries are small firms (Loof et al, 2006). It is suggested that a possible explanation to this ambivalent finding in the existing literature would be different and sometimes inadequate research methodologies applied to the data.

It is widely accepted that, in the absence of policy intervention, the social rate of return on R&D expenditure exceeds the private rate, leading to a socially sub-optimal rate of investment in R&D (Guellec and Pottlesberge 1997). The main channels of public support for individual firms are tax incentives, direct government funding, co-operation arrangements between firms, research institutes and universities, and loan guarantees (Lööf and Heshmati, 2006).

Considerable effort has been devoted to the evaluation of the efficiency of public subsidies for R&D. Despite the prevalence of such programmes, there is little consensus about their effectiveness (Jaffe 2002 and Hall 2002), and there remain serious methodological issues about their findings, which are yet to be investigated.

Klette, Möen and Griliches (2000) report that most evaluation studies on governmental subsidies utilizing microeconometric methods are based on the assumption that R&D subsidies, to a large extent, are allocated randomly to firms and projects. If the allocation process is haphazard then the challenging issue is to find sufficient comparative data for firms receiving R&D subsidies as for similar non-supported firms. The difference in performance between the two groups of firms could then be estimated, with public funds as a determinant.

Table 2 Recent studies on the impact of R&D subsidies

Year	Data (Period)	Author	Method	Result
1998	Finish (1985-93)	Toivanen, Niininen	Regression with controls	R&D subsidies have no effect of private R&D for large firms but increase private funding by 5% for small firms.

1999	Spanish (1998)	Busom	Regression with controls	For 2 firms out of three the subsidies increase private funding of R&D by 20%. For the remaining third firms, there would be complete crowding out.
2000	US SBIR (1990-92)	Wallsten	Instrumental variables	The R&D investment would have been made even without subsidies because governmental agencies tend to favour projects with the highest private return.
2000	Israel (1990-95)	Lach	Matched samples & Regression with controls	Using matching methods and a subsidy dummy variable suggest that subsidies add to private funding of R&D. Regression methods suggest that one additional dollar in R&D subsidy would increase private R&D by 41 cents.
2001	German (1994-98)	Czarnitzki, Fier	Regression with controls	On the average, one Euro of subsidy would increase private R&D by 1.3 to 1.4 Euros.
2002	German (1995, 97, 99)	Almus, Czarnitski	Matched samples	Firms in Eastern Germany that participated in governmental R&D schemes increased the private R&D investments with an amount corresponding to 4% of their turnover.
2003	French (1985-97)	Duguet	Matched samples	R&D subsidies add to the private R&D.
2005	Korean (1999-2004)	Sohn, Moon, Kim	Regression and Matched samples	R&D subsidies add to the private R&D.

There is overwhelming evidence that firms do not randomly participate in governmental R&D support programs. On the contrary many studies have concluded that public R&D policy attempts to cherry-pick the winners in programmes (Irwin and Klenow 1996; Lerner 1998). Furthermore, small firms participate less frequently than larger firms in various support

programmes and a larger proportion of beneficiaries and users of the support programmes are in the more technologically advanced sectors (Hanel 2003).

If the performance of the supported and non-supported firms ex ante differs systematically one difficulty in this type of evaluation is the potential selection bias. Jaffe (2002) describes a typical case, where firms funded by the government are liable to be those with the best ideas. This implies that these firms have more incentive to spend their own resources and are more likely to receive support from third parties. Hence, in a microeconometric analysis, public funding is an endogenous variable and its inclusion in the list of independent variables will result in inconsistencies.

4. Experience in Korea

4.1. Infrastructure related to SME

Case studies of best practices could be found in Korea for mainly debt financing and guarantee system. Although financing can be performed in the form of either equity financing or debt financing, equity financing is more popular in private sector. In Korea, the most of fund from government is supported usually through loan, more specifically through the provision of guarantee for loan. Most of these financing systems work under the frame of legal system of Korea as shown in the figure.

One of the key features of this structure is related to effort to enhance start-up environment, as backed by enactment of “Support for SME Establishment Act” (May 86). This act has continuously been followed by continuous attempts to ease off restrictions, which resulted in more than 25 times of start-ups so far. Establishing and supporting business incubator centre was another key feature, which resulted in approximately 290 centres nationwide within university and research institute. In this program, providing office, management/technology advice and business information for early stage companies with new idea and high technological potential have been actively introduced. In addition, policies for financial support and tax deduction benefits such as profit tax, corporation tax, acquisition tax etc have been implemented successfully. In general, the main aim of SME related law system can be summarized as follows:

Construction of a start-up and fostering base for SMEs and venture enterprises

Enhancement of a technology innovation system for SMEs

Creation of an environment conducive to viable enterprise management

Improvement of the information system for SMEs

Expansion of domestic and overseas markets for SME products

Fostering of the middle class & expansion of the industrial base

Establishment of an efficient support system for SMEs

Tax incentives toward SMEs and SME-related agencies

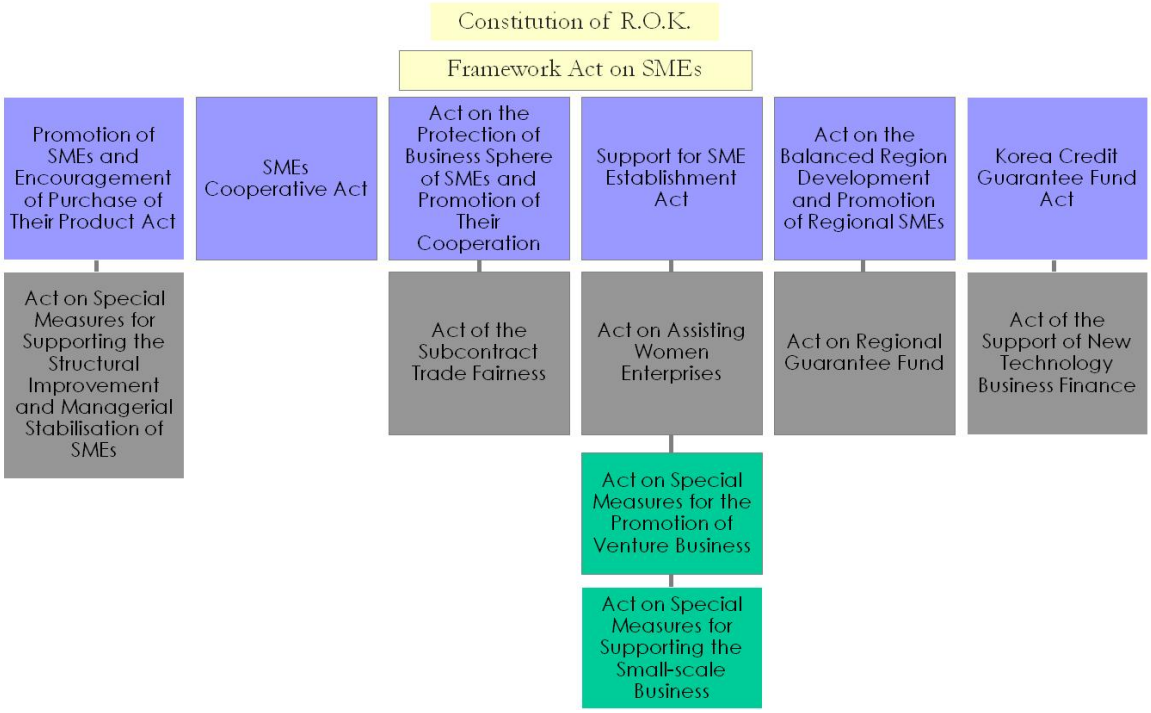


Fig 8 Structure of laws relevant to SMEs

In terms of SME promotion, Small and Medium Business Administration (SMBA) is key governmental organisation in Korea. The major activities and tasks of SMBA are described as follows:

- Look for and prioritize innovative companies

Greater resource needs to be applied to identifying start-up companies that are innovative and have the potential to grow. There needs to be greater emphasis on scanning and pro-active identification of growth companies. This will require a dedicated resource and a wider, more holistic interpretation of innovation, which encompasses product, process and marketing.

- Focus on growth enterprises

SME support should focus support in a more concentrated way, across all sectors, on those companies that have the best prospects for future growth. Other SME company segments should continue to have support relevant to their needs and stage of development, for example, website information, selected business development advice, information on quality standards and training.

- Adopt a more strategic approach in project selection and information dissemination

Priority setting in innovation infrastructure must be future oriented. The support services need a stronger reference to, partially already introduced, criteria like technological level, coherence with strategic core competences of the region, potential for value added, export orientation and, most importantly, global market potential. The impact of business creation and development activities on the local economy in a place and its surrounding region could be used for promotional campaigns.

- Promote business-to-business mentoring

Larger companies can play an important role in encouraging SME innovation and exporting by making available expert managers to SMEs for short advisory sessions. This can be very effective and valuable to many companies at the early stages of their development.

- Foster grass roots innovation

More should be done to encourage innovation in agricultural and food industries, basic industries and services and in smaller, less capital-intensive companies. There are good examples of grass roots interventions which should be considered for replication across a wider group of companies and industries.

- Promote high level innovation

Existing good practice initiatives should be sustained and lessons applied to other industries. Brokering relationships between larger regional companies with latent intellectual property and SMEs with the capacities to use it should be seen as another potential route for stimulating higher level innovation. The smaller company could buy, licence or pay a commission for the intellectual property. The approach requires a public sector agency with in-depth technology and business awareness to scan for such brokering opportunities and to initiate and facilitate dialogue.

- Pilot a high-growth start-up programme

A high-growth start-up programme could be piloted at local level. This would identify start-up companies with a minimum growth potential (based on employee numbers and/or turn-over), co-ordinate public support, provide bespoke mentoring and advice, and assist with the raising of private investment. Such a programme would only focus on a small cohort of start-ups over a two year period (given the size of the economies, perhaps only twenty companies a year would be recruited). This could be particularly valuable in districts where the entrepreneurial climate is close to Federal average but quality issues are evident.

- Narrow the current specialization of innovation infrastructure

The current areas of core innovation competence seem to be too broad in their definition and are followed by many other regions. In order to enable the crystallization of a locally specific global competitive advantage, the development of a more sophisticated cluster approach in activities where the locality and its surrounding region already have demonstrated international success is recommended.

- Identify complementary strategic assets

Although physical infrastructure for innovations seems to be in a good shape, in some locations there are missing or underrepresented components in the broader innovation support infrastructure, like specialist equipment providers and research specialists. Efforts should be made to identify such assets in other locations within Germany or abroad and to create connections with them. A well functioning network including industry experts is needed to conduct a detailed inventory and assessment of local strategic complementary assets. It is important to develop and maintain mechanisms that allow for an acceleration of time-to-market and time-to-money procedures of locally generated innovation.

- Exploit innovation through a wider group of firms

The existing innovation infrastructure should be used more intensively to foster collaboration between HEIs and local companies of all sizes as well as with large companies located elsewhere but with relevance for the local value-chain. Multinational companies located locally or elsewhere represent an opportunity for local economies to accelerate and scale-up commercialization processes because of their strong access to markets. Such links could help to test innovative products and services in market-like conditions and positively influence time-to-market relations. However, attention must be paid to the protection of intellectual property when building value release strategies.

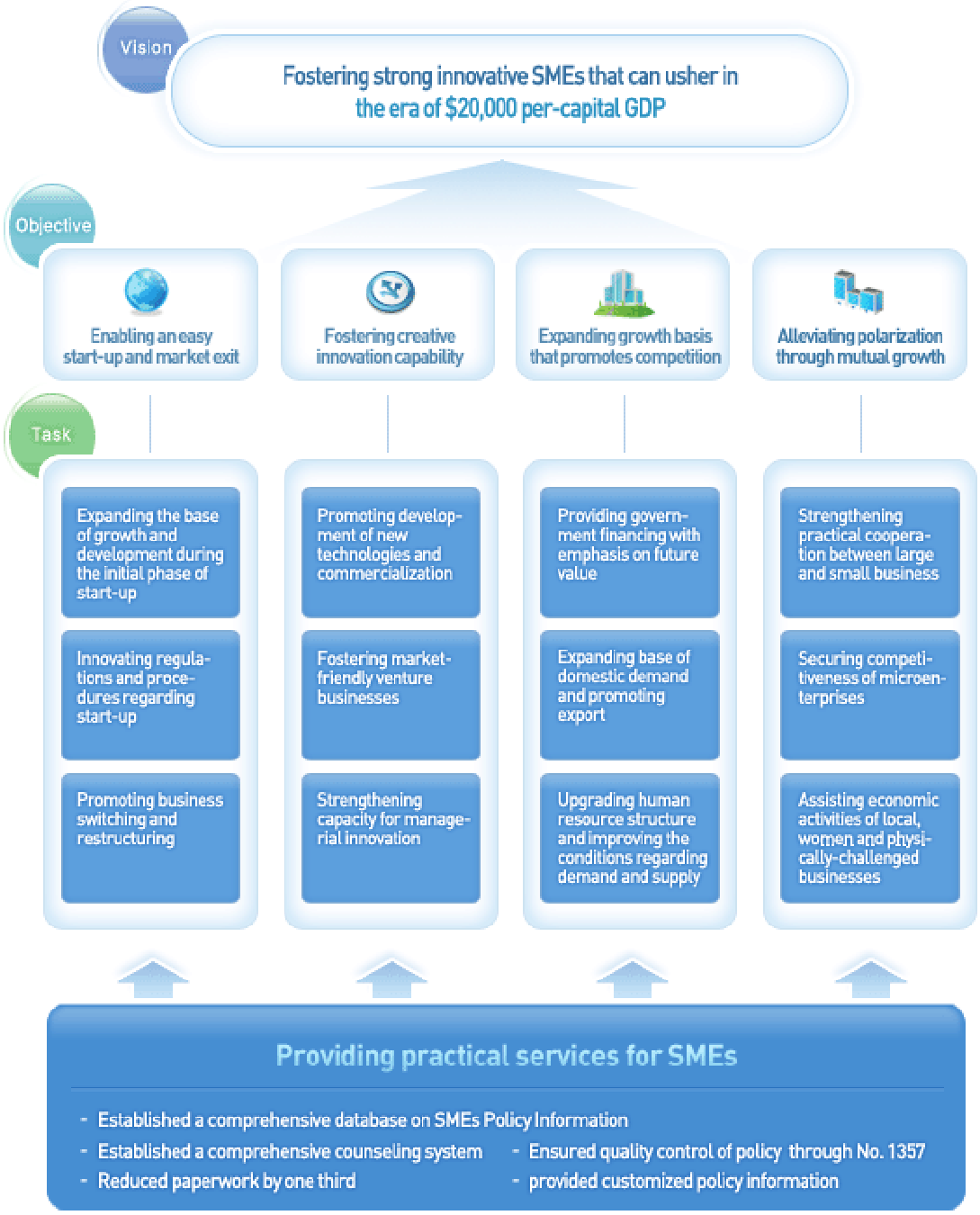


Fig 9 Vision and task of SME promotion policy in Korea

4.2. Status and role of SME

In general, an SME is defined to be an enterprise employing less than 300 personnel and of varying size, sector and type. As of 2004, the number of SMEs in Korea is approximately about 3 million, including 84,000 medium enterprises (with 50~300 employees), 230,000 small enterprises (with 10~50 employees) and 2.68 million micro-enterprises (with less than 10 employees).

As the main component of the Korean economy, SMEs represent 99.8% of the entire enterprises (3 million SMEs), and 86.5% of total employment (10.41 million employees). Moreover, exports by SMEs have continued to grow significantly every year, making up for sluggish domestic consumption and improving Korea's reputation around the world.

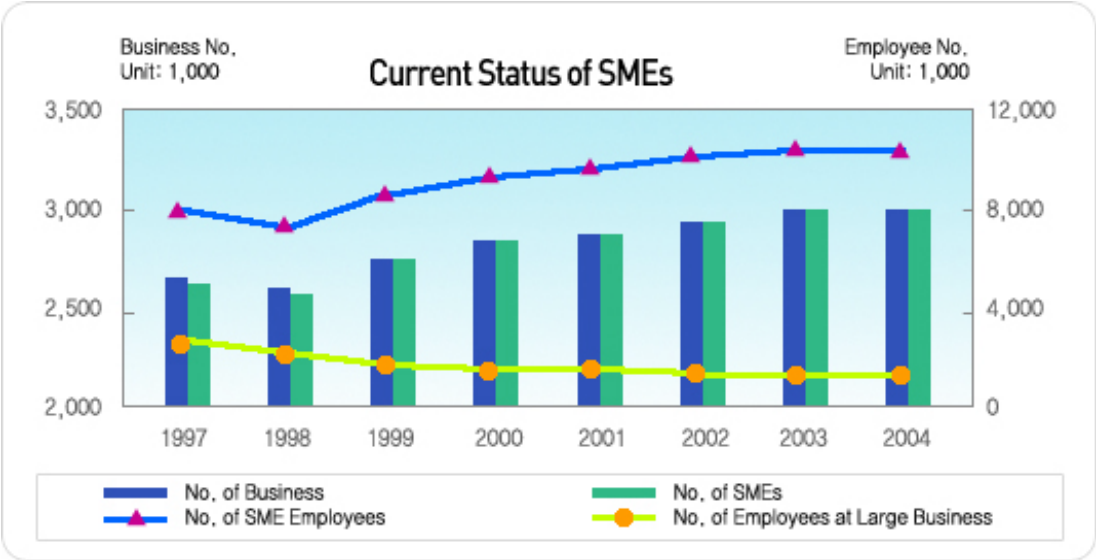


Fig 10 Current status of SMEs in Korea

SMEs in Korea have served as key solution to resolving unemployment. During the period from 1999 to 2004, the number of those employed by large enterprises was reduced by 1.2 million while that of SMEs increased by 1.54 million. As the source of innovation, competition and new ideas, SMEs create a large number of jobs, and are helping ease unemployment concerns.

Table 3 No. of SME employees - annual trend

(Unit : 10,000, %)

	1999	2000	2001	2002	2003	2004
Total employee(A)	1,083	1,153	1,165	1,198	1,204	1,203
No. of SME Employees(B)	887	968	997	1,039	1,047	1,041
Ratio(B/A)	81.9	83.9	85.6	86.7	87.0	86.5

According to the GEM(Global Entrepreneurship Monitor) report prepared jointly by the US Bapson College and London Business School to measure start-up activities of each nation, Korea ranked 6th out of 41 nations during 2000 to 2003, demonstrating Korea's high

enthusiasm for start-ups. Under this business climate, enthusiastic young people can help realize their dreams by starting up their own enterprises.

The current difficulties confronting SMEs are not easy to overcome. However, they provide SMEs with new challenges and opportunities as well as enable them to compete on the global stage. The Korean government directs its policy priority towards SMEs. Also, it will assist anyone possessing creative ideas and making strenuous efforts to start up a new enterprise and help an increasing number of the public to fulfill their dreams through SMEs.

4.3. Technology Financing (Credit guarantee)

It is widely recognized that knowledge is one of the most important factors in the era of knowledge revolution and globalization contributing to economic development as well as strengthening competitiveness of a nation. Great efforts have been made in many countries to create or absorb advanced technology from other countries in order to enhance their competitiveness in international markets. Korea along with some other countries such as Finland has proven to be very successful in responding to such changing environment.

Having successfully weathered the worst economic crisis since the 1950s, Korea nevertheless faces numerous structural problems in an increasingly competitive global environment. To manage the transition to a knowledge-based economy, Korea needs to increase overall productivity and open up to international trade and information exchange. This implies a fundamental renewal of government policies in favour of technology and knowledge innovation, entrepreneurship, education and deregulation of markets.

The challenges facing Korea as it draws up a strategy for economic development in the 21st century were described in the publication from OECD/World Bank (OECD 2000) , which warns that Korea's growth prospects may be seriously hampered unless changes are made to an excessively complex system of regulations and an outdated industrial framework, traditionally dominated by the chaebol, the family-controlled conglomerates.

Korea has been investing more in education, information infrastructure, R&D and technology commercialization as a percentage of GDP than most OECD countries. Yet the benefits that it reaps in economic terms are low due to inadequate protection of intellectual property rights, lack of flexibility and misallocation of investments, technology innovation and SME promotion.

Productive entrepreneurship is also crucial to local economic growth, employment creation and innovation. Entrepreneurial activity creates jobs, drives efficient resource use and accelerates the process of generating, diffusing and applying innovative ideas and concepts.

In line with those hurdles, the recent efforts in Korea are aimed at (1) identifying the major factors that have contributed to successes and failures in the process of innovating knowledge and technology as well as turning them into businesses in Korea; (2) creating an environment that will inspire knowledge innovation with regard to turning knowledge and technology into businesses.

From 2004, Korea gives strong emphasis on those efforts among various policies, which are easily noticed by a series of governmental countermeasures and plans where technology financing for technology commercialization is now regarded as the core for overall government policies. Establishment proper technology (or technology intensive corporate) evaluation system, therefore, attracts a strong attention as a pre-requisite for successful introduction of technology financing policy in Korea.

For policy makers and academic researchers, the survival and growth of Small and Medium-sized Enterprises (SMEs) is a matter of primary concern. The dynamic disposition of SMEs is an interesting topic in that they invigorate the stagnant economy and are necessary as an infrastructure for large corporations. Generally, SMEs are so flexible in organization and production structure that they can seize new business opportunities quickly and overcome financial crisis at a lower cost. In addition, SMEs contribute to the stability of society by accounting for large share of total employment.

However, SMEs in common face great difficulties to finance investment due to asymmetric information. The asymmetry in information arises from lack of financial information and standardized financial statements. That is the reason why government intervenes to establish and to enhance collaboration between financial institutes and SMEs through credit guarantee systems in many countries. If credit guarantee institutions are able to inform about the risks associated with the loans of the lenders properly or they manage the risk better then lenders, then credit guarantees can help to overcome SMEs collateral constraints. It will relieve the risks of lending to SMEs and micro enterprises, it compensates for low profit margins, and it produces additionality (Gudger, 1998). Riding and Haines (2001) indicated that loan guarantee programs could be an effective mean of supporting the start-up, growth, and survival of new and risky enterprises. In other words, credit guarantee warrants firms to private investors and settle informational asymmetries that might have otherwise precluded investments.

Korean government encouraged new businesses and support to SMEs to accelerate economic growth and to decrease unemployment rate in the aftermath of the economic crisis in late 1990's. Among many direct and indirect support measures, credit guarantee system is seen as one of the most important instruments to achieve the economic policy goals. The credit

guarantee system played an important role in assisting SMEs to raise necessary investment funds from the capital market throughout the economic crisis in the late 1990's and in particular after the collapse of bubble in venture business in early 2000's. Since banks were reluctant to lend to SMEs in the absence of exact risk measures, the amount of credit guarantee increased rapidly as a corrective measure. This was due to their inherent high risk such as high failure rate and lack of collateral, especially for venture business or new technology based firms. With credit guarantee, many SMEs overcame financial distress and achieved their transformation into a competitive constitution.

The roles of technology credit guarantee systems in economic development

Recent paradigm shift suggest the transformation from traditional industrial society into a knowledge-based society which requires the shifts of the source for the value-added from labor and capital to knowledge. Until the foreign exchange crisis, industrial sectors in Korea were stalled at a gridlock of high-cost low-efficiency structure.

The economic crisis, however, gave Korea a rare opportunity to take second look at the widespread problems in the economy such as the rigid production system, opaque corporate governance and inefficiency in business management. Awareness of these problems led to realize the necessity to transform the industry structure into one that fits into the new paradigm for a new take-off of the economy.

Realizing that technological capability is a key factor for securing competitive edge in new era, traditionally underrated contribution of small and medium sized enterprises (SMEs), and the lack of an efficient coordination system that connects conglomerates, SMEs and industries should be regarded as a "fixation solution for inefficiency of the economy".

It was, therefore, necessary to shift the focus of competition strategy from low cost into technology (1) to allocate more resources to the sectors that could lead technology innovations, and (2) to reduce overlapping investment. These measures were expected to help the Korean economy reshape its industries into more technology-driven and high value-added ones. It was also agreed upon that restructuring was needed in all spectrums of the nation to have a more competitive economy that could meet the global standards.

Nurturing SMEs and venture firms was also essential for the Korean economy to take a great stride forward. Given their creativity and dynamics, they could maximize the mechanism of the National Innovation System (NIS)2, and help the nation prepare a new industry structure.

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[2] National Innovation System (NIS) refers to a nationwide networking system that interrelates private sector, public sector and institutions. It facilitates a production, transfer and sharing of knowledge

Introduction of credit guarantee system

Since the early stage of economic growth, the Korean government tried to come up with various policy measures. Among other measures, the credit guarantee system turned out to be an effective policy tool not only to support SMEs, but to supplement other economic policies in weathering a difficult economic reality. It is still being used as an effective policy tool of the government.

The objective of the system was to bolster the financial sector that was not mature in various aspects and exposed many problematic factors including collateral-based loan practices, lopsided loan extensions toward large companies, and government-intervening financing. It was also aimed at sweeping away the chronic excessive demands in the loan market and ensuring an efficient distribution of financial resources.

In the 1980s when each economic player wanted more freedom in their activities and technological capability was widely recognized as the best alternative to secure the competitive advantage, a national consensus was reached upon setting up support system for technology-intensive companies. In line with this demand for nurturing technology-intensive SMEs for sustainable growth of national economy, Korean government launched "the Technology Credit Guarantee System" with the enactment of “The Financial Assistance to New Technology Businesses Act” to extend credit guarantee resources to new technology businesses in 1986. Under this legislation, KOTEC (changed to KIBO in 2005 due to CI project) was founded in 1989 as a non-profit guarantee institution for an efficient implementation of the Technology Credit Guarantee System.

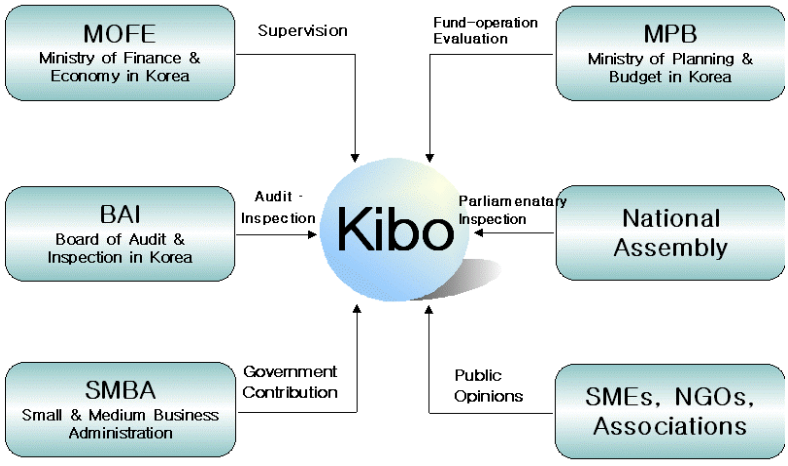

Fig 11 KIBO (KOTEC) as a non-profit guarantee institution

among the networked participants. It also plays as a core factor to enhance a nation’s collective competitiveness.

The technology credit guarantee system was introduced to offer financial assistance to SMEs that have difficulty accessing financing resources under the old-fashioned banking system. It was also aimed at enhancing the technological innovations of SMEs. the Technology Credit Guarantee System of KOTEC has contributed significantly to expanding financial support to the new technology businesses and strengthening technological innovation of SMEs. Since KOTEC's foundation, its history can be discussed in three distinct stages as shown in Table 4.

Table 4 Development of KOTEC (now KIBO)

	Stage 1: Taking Root (1989 ~ 1997)	Stage 2: Financial Crisis (1998 ~ 2000)	Stage 3: Transition (2001 ~ Present)
Changes in Economic Environment	Weakening competitiveness of SMEs under high cost & low efficiency structure	Worsening liquidity crunch & shrinking business opportunities for SMEs	Changing business environment & support policy for SMEs & venture businesses
Role of KOTEC	Expanded guarantee support & facilitated Technological development for SMEs	Significantly expanded guarantee support & technology appraisal capacity	Established better-quality custom-tailored support programs
Total Guarantees (Cumulative)	USD 18.2 Bil. (USD 18.2 Bil.)	USD 27.8 Bil. (USD 46 Bil.)	USD 35.3 Bil. (USD 81.3 Bil.)
Technology Credit Guarantee (Ratio)	USD 13.8 Bil. (76%)	USD 20.6 Bil. (74%)	USD 29.3 Bil. (83%)

Technology appraisal (see technology evaluation subject) refers to an activity or procedure that make scoring and/or valuation for the technology potentially aiming at commercialization. The appraisal result for the subject technology serves as a good reference in making decisions in connection with the technology transfer, bank lending, investment, M&A and so on. Especially, it helped create a new financial environment where high-tech SMEs can receive loans without secured mortgage through KOTEC's technology appraisal.

As is shown in the following table, KOTEC has offered credit guarantees totaling 67 trillion won, or about 55.7 billion USD equivalents, to around 290,000 SMEs and venture enterprises since its foundation 13 years ago. Of the total guarantee amount, over 80% were first given,

via “the Technology Credit Guarantee System”, to those engaged in developing new technologies or to those trying to commercialize their technological innovations. KOTEC also introduced the “Technology-Preferential Guarantee System” that features swift guarantee provision with its credit examination focused more on the technological capabilities of the applicants and extends preferential treatment to high-tech enterprises.

Table 5 Technology Appraisal Guarantee offered (No of Cases, USD)

(Million USD, Cases)

		2000	2001	2002	2003	2004
Total Guarantee		8,954	12,233	11,132	11,187	10,021
Technology Credit Guarantee		7,073	10,361	9,451	9,311	8,390
Technology Appraisal Guarantee	Amount	252	454	838	1,044	1,160
	Cases	1,320	1,822	1,835	2,063	3,189

According to a recent research (KBI 2005), KOTEC's macro-economic effects over the last 10 years are estimated at about 56 billion USD, which accounts for 1.5% of Korea's cumulative GDP for the same period estimated at 3,712 billion USD. This estimate proved to be 20 times larger than the government's capital contribution to KOTEC for the same period totaling 2.95 billion USD. It turned out that KOTEC's credit guarantee service contribute to the stability of macro-economic indices such as employment rate, interest rate and commodity prices

In response to the rapidly changing technology environment, KOTEC's technology credit guarantee system incorporating a combination of technology and credit guarantee continuously transforming itself. As shown in the following table, the technology credit guarantee system has evolved into new versions.

Table 6 Development of Technology Credit Guarantee System

	Technology Credit Guarantee Scheme	Technology Preferential Guarantee Scheme	Technology Appraisal Guarantee Scheme
Relative weight of technology factor in guarantee screening	30%	60%	90%
Time Focus	Past	Present	Future

Along with the system evolution, the weight of technology related factors in the guarantee screening gradually increased from 30% all the way up to 90% approximately. In the same context, the growth potential or future value of applicants, rather than sales records or financial standing of the past, gains more importance in connection with the guarantee screening.

In an effort to facilitate swift guarantee provision to high-tech SMEs in need of capital to finance the development or commercialization of their technologies, KOTEC has utilised its in-house technology appraisal capability in the course of guarantee screening procedure and designed the technology appraisal guarantee scheme.

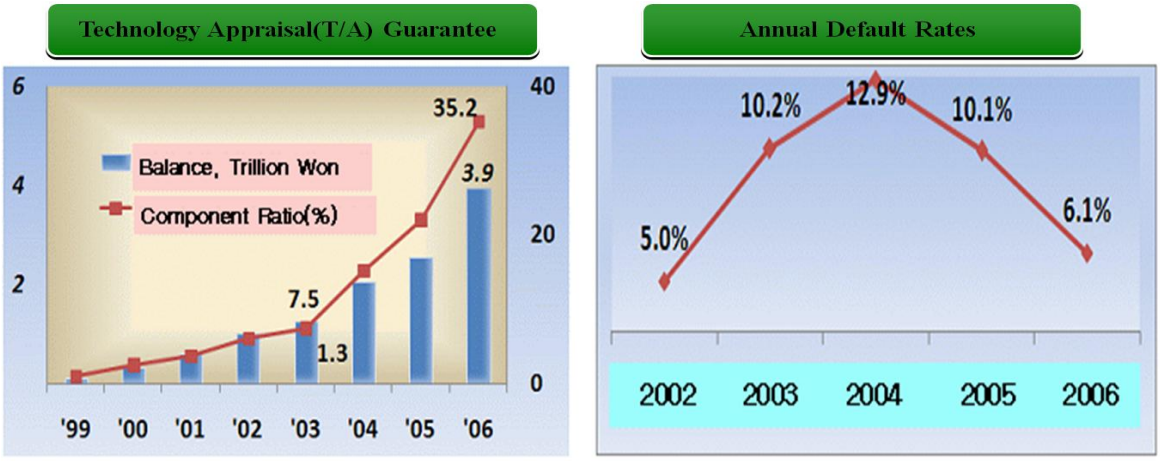

Fig 12 Technology based credit guarantee operated by KIBO (KOTEC)

To be accepted as a general practice in financing sectors in Korea, enhancing credibility and objectivity of the technology appraisal model, including valuation and scoring method, is crucial. KOTEC has been performing re-modelling processes on both valuation and scoring model for each industry/technology area. The details are described in the "Technology Evaluation" subject of this programme. In the figures shown above, the cumulative amount of guarantee and default rate are shown. It should be noted that the default rate has been drastically decreased due to reconstruction of technology evaluation system. This clearly shows the importance of proper technology evaluation system in implementing technology financing. Since then, its steady improvement of its Technology Appraisal systems and aggressive risk management enabled KIBO to strive to improve its managements like setting up its target rates to keep. The target default rate of 2007 is 7.3 %. The overall guarantee flow chart including technology based credit guarantee in the following figure as a reference

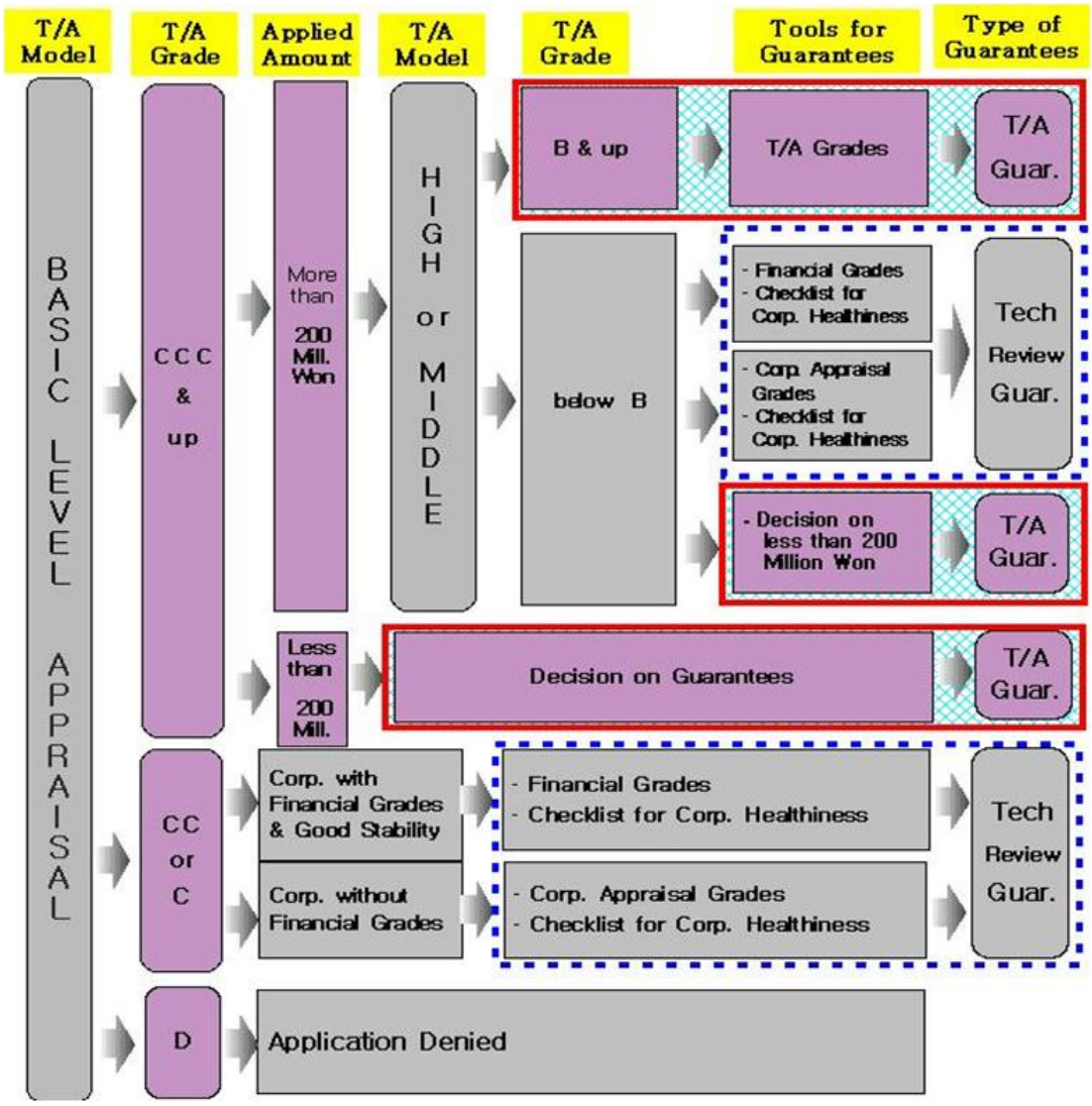

Fig 13 Overall guarantee flow chart including technology based credit guarantee operated by KIBO

5. Policy Matters

The matters concerning technology financing policy are closely linked with SME promotion policies. Since the status of SMEs in different countries can be said unique on its own, there would not be universal solution for the technology financing policy for all the countries in APEC. For example, depending on the direction of financing policies based upon each country's circumstance, the matching programme can be greatly differs.

In spite of this situation, the policy makers are supposed to have basic knowledge on followings to facilitate the technology financing setup process when it is necessary:

- Develop general definition of "technology" as a candidate for commercialization.
- Identify the various factors and isolate key factors in commercialising technologies.
- Understand diverse financial needs of SMEs
- Understand the required infrastructure or resources…
- Understand different methodologies to achieve "debt financing" and "equity financing" (i.e. direct loan scheme, investment fund formation and guarantee scheme etc).
- Understand the role and process of "technology financing" to promote technology commercialisation.
- Identify various factors and key factors in commercialising technologies.
- Understand various types of SMEs based upon growth stage and their technologies.
- Understand various type of financing such as "debt financing" and "equity financing"
- Understand "technology evaluation" a key factor for "technology financing"

For the objectives shown above, the recommended solution would be dependent upon individual economy's status (such as geography, resources and main industry sector etc), it is noted that the case studies shown are no more than reference. Although there is no absolute answer, the solution seeking process itself is still important, since the arbitrary establishment of this basic concept on their own may induce confusion which results in failure in applying policies. Each economy should set up its own criteria for financing support toward SMEs in order to manage limited fund effectively. This basis and criteria should provide basic framework for applying government-driven technology financing. Once this suffices, the legislation and corresponding budgeting planning could be commenced. The outcome can be measured initially in terms of No. of SMEs supported, supported financing, and the financial indices of SMEs etc. But, it is required to prepare economical impact evaluation tool eventually to accurately measure the performance of newly introduced financing programme.

6. Discussions

6.1. Implications and Suggestions

The discussion agenda are not limited to certain topics and opened to any related matters. Some of the examples would be (1) What are the main issues related to this subject in participating economies? (2) Why does each government want to design and implement technology financing programme? Which kind of outcome they initially expect? (3) What are the differences between different financing system and process? (4) What are practical

limitations and/or problems which should be considered? and (5) Are there any chances of building up international cooperation or assistantship?

6.2. Key Issues for Technology Financing

Understanding the relationship between "technology evaluation" and "technology financing" is crucial. The effective technology financing programme could not be progressed without the proper implementation of technology evaluation system. It should be noted that technology evaluation act as a tool which indicates the direction as well as the performance of technology financing programmes. This suggests that they need to be interacting each other dynamically.

When considering financing policies, it is common that various unexpected factors are often neglected not only during the process of setting up policies, but also during the process of operating those policies successfully. These factors may include infrastructure or resources (i.e. policies, budget, manpower etc). In spite of this uncertainty, it is recommended to remind the general structure and flow always, as depicted in the next figure, when policy maker is dealing with either technology financing or evaluation system.

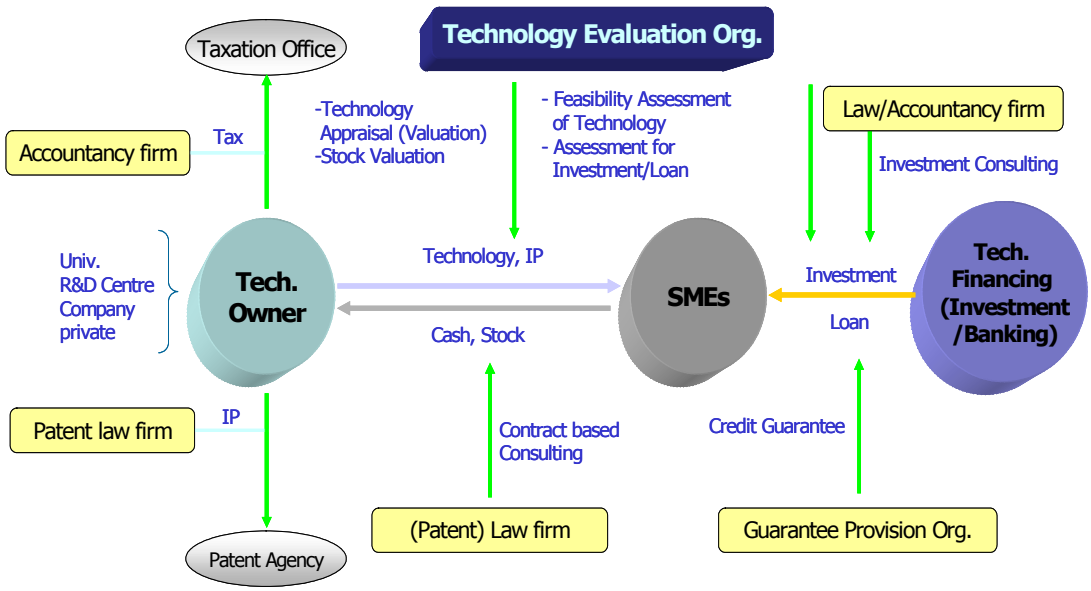

Fig 14 Technology (IP) evaluation and financing processes

In addition, one of the most important factors in expedite governmental policies would be "impartiality," "equality" as well as "efficiency." Since these factors are closely related to the overall reliability of policies, it is crucial to establish a standardized criteria and guidelines for reviewing the technology financing applications. By doing so, it could also have a effect of preventing potential malicious fraud in some extent. It is also noted that this is getting more important as the size of government support increases.

After implementation of financing programme, it could be important issue for government to evaluate whether public funding increases the total spending on research or merely displaces funding from other sources. Given that public resources are raised via socially costly revenue mechanisms, then the total economy will be worse off if society's total R&D investment remains unchanged but public research-grant programmes, by crowding out, replace privately funded investment.

6.3. Final Reminder

After seeking a solution to above, the following questions could provide answers: The first will be "What is difference between financing and technology financing." This question involves general financing process for corporate, then more specifically for "technology-based" corporate. Also, similar and different factors comprising "general corporate financing" and "technology financing" need to be dealt with. In addition, key and non-negligible factors for "technology financing" need to be thought. The second would be "How does technology financing generally work?" This question involves elucidating different types of financing process. After learning various types, "Pros & Cons" for each type of financing process with regard to SME promotion, policy making, and efficiency in practice can be perceived.

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Chapter 7. Technology Evaluation

Sanghoon Kim[1]

This subject aims to assist policy makers in APEC developing member countries in establishing policies for SME promotion. It also introduces concept and issues of "Technology Evaluation" as a key factor for the implementation of technology financing, surveying several case works previously practiced and finally proposes viable policies and following systems for the future.

1. Introduction

For policy makers, the survival and growth of Small and Medium-sized Enterprises (SMEs) is a matter of primary concern. The dynamic disposition of SMEs is an interesting factor in the aspects that they invigorate the stagnant economy and are necessary as an infrastructure for large enterprises. Since SMEs are flexible in terms of organization and production structure in general, they are supposed to seize new business opportunities rapidly, thus overcome financial crisis at a lower cost. SMEs also contribute to the stability of society by accounting for a large share of total employment.

In addition, technology is recognized now to be the most sought after human made help-mate, which can be utilized effectively and efficiently as a capital-good for economic wealth generation, all over the world. There is also widespread agreement now that technology management is critically important for the survival and growth of all enterprises in the new world economy, which has become extremely competitive and increasingly interdependent (Sharif, N, 2006).

Technology innovation, which requires a close interaction between science/technology and industry, has been attracting policy makers' interest as a key for economic growth. However, the linkage between science/technology and industry is complex than it appears. For instances, those who are involved in the process of 'science and technology into product and market (technology commercialization)' consist of various parties from different interests, which include not only scientists and engineers, but also government officials, investors, entrepreneurs etc. Since their major concerns are different from each other, it is natural that individual viewpoint from each party has limitations in communicating with others properly, resulting in forming barriers for cooperation between each party which is meant to be critical issue in 'technology commercialization (Park, H-W, 2006).

[1] Vice President of EBSI

The evaluation of technology (The word ‘evaluation’ in this text is used as a general term for assessment, valuation or audit etc. Therefore, the ‘evaluation’ can be altered with other word when it is more appropriate.) is essential tool for providing opportunities to communicate and thus cooperate between each parties. i.e., people from science/technology, from business, and from finance can learn mutually and share interests through using their own knowledge and technology in valuing technologies.

Moreover, it is true that we cannot manage something that we do not understand fully and to manage something reasonably well, we need to measure it. Therefore, there have been continuous efforts to implement such a measuring system in various countries for several years, which can be used a guide for the prospect of technology of interest. This technology evaluation has been used as a tool to promote technology innovation and financing especially for SMEs which was raised as an important part of governmental policies to achieve sustainable growth of national economy. This technology evaluation has been finding more crucial roles both in R&D activities and SME promotion in public sector, since policy makers recently have more emphasis on business feasibility.

In this regard, this article is focused on the understanding and assessment of all types of technology assets and their evaluation techniques for the enterprises (especially SMEs) operating in the present day global economy. Detailed experience in Korea for designing and implementing such a system will be introduced with a close relation to technology financing. In Korea, systematic research on technology evaluation began with the recognition of its importance for practical use of R&D results through technology transfer and commercialization from the late 1990’s. Also, Korean government has been actively utilising technology evaluation system (or programme) for the public financing of technology commercialization.

With this article, it is anticipated that this subject assist policy makers in APEC developing member countries in establishing policies for SME promotion by introducing concept and issues of “Technology Evaluation” as a key factor for implementation of technology financing, surveying several case works previously practiced, and finally proposing viable policies and/or following systems for the future.

2. Basic Concept and Definitions

Even though present life is intertwined with technology, there is yet no universal definition of the term for technology. Various definitions can be made by people with different professional backgrounds that are partial or narrowly focused. For examples, technology can

be defined as means for performing industrial arts and infrastructure building from the typical viewpoint of engineer or it can be seen as the things that human create to alter their everyday life-styles from the viewpoint of journalist, whereas it can be defined as a capital good utilized as a production factor for economical growth from the economist viewpoint.

Apart from this type of partial definition, a comprehensive definition is available from graduate level academic textbook. According to the textbook, "Technology" refers to that theoretical and practical knowledge, skills and artifacts that can be used to develop products and services, as well as their production and delivery systems. Technologies can be embodied in people, materials, cognitive and physical processes, plant, equipment and tools. Key elements of technology may be implicit, existing only in an embedded form (like trade secrets based on know-how) and may have a large tacit component (Burgelman, R et al 2004).

All of the above definitions are correct for the special focus group. However, all of the partial as well as comprehensive definitions do not readily lend themselves to be actionable managerial definition for the purpose of performance assessment and resources allocation in an enterprise. Moreover, the definitions are neither universal nor measurable for sound managerial decision-making, which implies the above definitions are not readily useful for everyday decision-making purposes in the enterprises.

It is, therefore, suggested that more actionable term of "technology" or "technology-system" needs to be introduced in order to facilitate technology related management in an enterprises. Fortunately, a generally accepted and actionable definition has been developed in terms of evolution of the economic and business factors of production through a series of attempts by several researchers (UN-ESCAP, 1984). According to these researches, "Technology" can be defined as simply human-made help-mate for all economic value addition activities. But, since "technology' is as technology does. i.e., application being the essence, technology is a capital good utilized by all economic systems. Considering technology is a critical factor of production, it is possible to isolate the factors which comprise technology as we review the evolution of technology as a crucial factor of economic activities. In a general management context, technological systems utilized by an enterprise for economic wealth generation, can be seen as comprising of four interrelated components, which manifest in one of the following four forms – object-embodied physical facilities (Technoware); person-embodied human abilities (Humanware); record-embodied codified knowledge (Inforware); and organization-embodied operational schemes (Orgaware). More details of these technology components are as follows.

Technoware is the material capital for all organization work: This component is the object-embodied technologies, like artifacts, implements, machines, vehicles and structures.

Technoware represents the physical facilities of technical performance that amplifies human capacities (both muscular and brain related) for producing different kinds of goods or/and for providing services through various types of physical transformation activities (that either systematically converts available inputs to desirable outputs, or uses different platforms to give a service sought by clients). Certain Technoware are also used as specific operations' enhancers for process restructuring and all other management functions (increasing efficiency and effectiveness) in organizations.

Humanware is the talent capital for all organized work: This component is the person-embodied art-of-doing-type technologies, like ingenuity, craftsmanship, dexterity and skills. Humanware is everything which makes people at work do things; which manifests in what people really do with their Technoware by applying acquired qualifications (that comes from their education and training) and experiences (from successes and failures). Most importantly, it is their problem solving ingenuity and creativity. It includes all of tacit knowledge (which is knowledge that is not documented, or recorded, or codified). Humanware is crucial capital for transformation activities and services activities, as well as for managing various processes/functions of organizations.

Inforware is the knowledge capital for all organized work. This component is the record-embodied know-what-why-how-type technologies, like systematized concepts and technical specifications (parameters, diagrams, formulae, theories and manuals). Inforware is the codified (which is explicit and documented) knowledge and data-mine related to work-requirements and work-conventions that are underpinning a technological system for transformation operations, services provisions, or other specific management processes in use (efficiency and effectiveness related). Good Inforware enables quicker skill development and also results in savings in terms of time and resources utilized.

Orgaware is the relational capital for all organized work: This component is the organization-embodied work-operations-schemes-type technologies, like recipes, operational techniques and procedures. Orgaware is the implemented work process for producing quality outcomes by a team, at a particular time with a permissible cost. Orgaware is like a work management routine for a desired team endeavor. Orgaware includes the logic of systematized method for integration and coordination of activities and resources for achieving planned goals of an organization in producing any goods or providing a service. Orgaware also includes actually practiced procedures of value networking and coordination as well as cooperation among various stakeholders.

All of the four components are required simultaneously as part of an integral system, and the four components interact dynamically to produce resultant effect. Each of the utilized

technology components, making up a specific system, generally has a wide range of sophistication levels and tradeoff situation. The relative contribution of any technology component in a given system varies by type and over time for any activity and its designed outcome.

3. Underlying Hypothesis

There is no doubt that technology based SMEs are crucial for national economies especially nowadays. However, it is often observed that market itself appears to be indifferent to the SMEs' promotion, especially for start-ups and early stage ones, partly because of the lack of patience to wait for their outcome. Therefore, efficient government-driven technology financing system may be required, in order to achieve the goal of efficient SME promotion.

Prior to discuss possible government roles, it is useful to consider on background and some related practical issues which have been raised. First, since it is usual that the fund supported by government is usually smaller than that required by the SMEs, the introduction of systematic tools for efficient fund distribution is crucial. Second, these tools should have objective and strict criteria measuring technology status and expansion possibility, business feasibility forecasting as well as reflecting national strategy for science & technology development. Third, the failing in establishing proper evaluation system would give a catastrophic result in obtaining reliability and thus authority of technology financing system. Fourth, but not the last, since the number of attempts to introduce evaluation system to introduce the evaluation system have been made in various countries, and some of these attempts appear to be successful.

Considering the background described above has been understood, the followings need to be clarified successively. The first will be is concerned with "What is difference between traditional "technology assessment" for R&D project and "technology evaluation" in this case?" This question deals with traditional technology assessment for selecting R&D project which has neglected business feasibility consideration, many of which lead to commercialisation failures. In other words, it is pointed out that the roles of the corporate which make technologies into businesses should have not been overlooked. The corporate analysis, such as credit analysis for example, would be non-trivial problem in some cases, as well as technology level assessment, because one of the main activities of the corporate is related to finances.

The second questions will be "Which factors does comprise 'technology evaluation' system?". This is the task excavating factors which really makes technology into business, and

identifying which kind of extra resources are necessary (such as human resources, IT backbone etc)? in introducing technology evaluation techniques (or tools).

The third will be “Does governmental policy need to care about ‘technology evaluation’?” To answer this question, it is required to understand the relationship between the technology evaluation and the technology financing, i.e., the evaluation is a tool for effective financing system management. In addition, it should also be noted that the most important factors for technology evaluation are impartiality, reliability and standardisation, which also rationalize governmental driven system. It is recommended to understand, after keeping the above in mind, which kind of methodologies and processes are involved in evaluation process.

4. Forecasting the Business Feasibility of Technology

In this text, technology evaluation can be generally referred as systematic forecasting of the business feasibility of technology. According to economic theory, the definition of business feasibility study cab be written as activities / efforts / analysis to measure the cost and benefit of a business project in order to define the efficiency and effectiveness of the project's method and tools.

In many cases, business feasibility studies are performed on case-by-case basis. These procedures are acceptable when the number of technologies of interest for the studies is small. But, in the case of public funding allocation, for example, the number of application for the funding is enormous, conventional case-by-case report is not appropriate in terms of effectiveness.

The technology evaluation, in this case, needs to be standardized with several key performance indices extracted from the factor for technology commercialisation, and this system can be utilised as a quick guideline for the business feasibility forecasting.

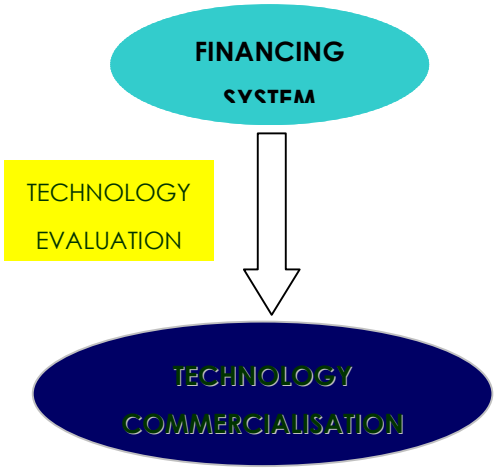


Fig 1 Role of technology evaluation

Recent research in strategy suggests that the creation of new technology is an important driver of firm success (Eisenhardt and Martin, 2001). However, not all firms can create technology within their boundaries (Teece, 1982), and even firms that can do so sometimes make use of externally generated technical knowledge (Tripsas, 1997; Cohen and Levinthal, 1990; Chesebrough and Teece, 1995). Such sourcing helps firms to obtain access to new technologies that are valuable to their performance in the market place but unavailable within organizational boundaries. Many observers have commented on the problems that firms experience commercializing new technology created outside of the organization (Teece, 1986; Nevens, Summe and Uttal, 1990), but little empirical research has identified factors that make for the successful commercialization of imported technology (Porter and Stern, 2001).

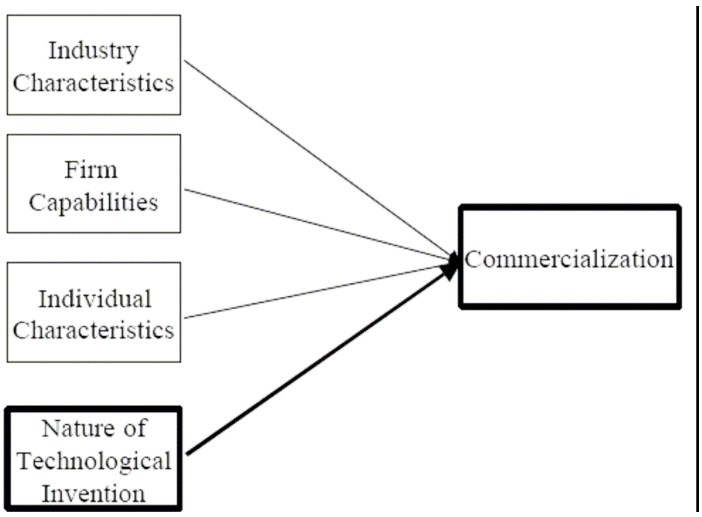


Fig 2 Drivers of Technology Commercialization

The body of literature that documents the importance of new technology commercialization for economic as well as firm growth is extensive (Schumpeter, 1934; Solow, 1956; Penrose, 1959; Nelson and Winter, 1977). Three streams of research are relevant for understanding the determinants of commercialization of technologies sourced from outside of organizational boundaries (Drazin and Schoonhoven, 1996; Schilling, 1998). The first one focuses on the role of communities, populations and the broader environment. Examples of research in this stream include Wade (1996), who examines the effects of new entrants to the industry on the sources and rates of technological innovation in the microprocessor industry; Abrahamson and Rosenkopf (1997) who focus on social networks and their impact on innovation diffusion; and David (1988), who offers network externalities and increasing returns as an explanation for emergence of standards. The primary explanation for successful commercialization is embedded in the environment and manifests itself via social networks, bandwagon effects or network externalities.

The second stream focuses on understanding the capabilities of individual firms in commercializing new technologies, with particular focus on dynamic capabilities that allow repeated success at commercialization (Teece, Pisano and Shuen, 1997). Examples of research in this stream include Dougherty and Hardy (1996), who examine firm resources and processes and their role in sustained product innovation; McGrath, Tsai, Venkataraman and MacMillan (1995), who show that firm competence is a necessary antecedent for innovation success; and Pennings and Harianto (1992) who present evidence that firms with technological networking capabilities are the most successful.

The third stream of research examines the role of the individual in technological commercialization. Scott and Bruce (1996) suggest that leadership, individual problem solving style, and work group relations affect innovative behavior directly, while Howell and Higgins (1990) examine the importance of individual champions in the innovation process. Other research has examined the context of the teams or groups that innovators belong to within the firm. Bantel and Jackson (1989) show that educated top management teams are positively associated with successful innovative activity in the banking industry while Nerkar, McGrath and MacMillan (1996) demonstrate that team satisfaction mediates the relationship between effort and innovative success.

The prior research streams have generally not focused on the nature of the technology itself (Henderson and Clark, 1990 and Anderson and Tushman, 1986 are notable exceptions). Moreover, even when researchers have examined the nature of the technology itself, they have not examined the determinants of commercialization of externally sourced knowledge. While the role of the environment, the culture, the firm and the individual are important factors in explaining the commercialization of new technology, the nature of the new

technology needs to be explored in greater detail for researchers to develop a fuller understanding of the commercialization of new technology.

5. Technology Evaluation (TE) – Types and Functions

5.1. Technology as an Intangible Asset of Corporate

The competitive advantage of firms lies in those business activities which the firm knows how to do well. Factories and equipment can always be bought, employees hired, and technology licensed in but unless the firm and its management know how to combine and exploit these resources effectively a viable and competitive business will not be created. The knowledge which the firm possesses, its "knowledge base", thus plays a key role in the survival, profitability and growth of the firm.

Firms possess a number of different types of knowledge including scientific and technological knowledge, knowledge of their markets and customer base, knowledge of sources of supply of materials and components, the knowledge and skills of its employees, etc. Firms need to know how to organise various activities such as procurement, production, marketing, after sales service, innovation etc. and how to combine these to secure the profitable delivery of competitive products to the market. The firm also needs to know how to recruit and develop skilled employees and managers, to motivate them to work effectively and to encourage them to co-operate in the best interests of the firm as a whole.

Some of this knowledge can be purchased in the market place or by investing in activities such as R&D. This knowledge is often codified, that is it can be written down and easily absorbed by someone with the necessary expertise. If not protected by some form of intellectual property rights or by secrecy it can be readily acquired by competitors. In contrast other types of knowledge are only acquired through experience of the business concerned, through 'learning by doing'. Such knowledge is often 'tacit', not easily written down or communicated except by direct human experience, and is not easily acquired by competitors who must create such knowledge for themselves. Much organisational knowledge is of this kind. Tacit knowledge is a major source of competitive advantage for firms.

It is easy to show the role which knowledge now plays in the competitiveness of firms. Many firms particularly in high technology and high value added sectors show a very large gap between the stock market value of the company and the book value of its tangible assets. This reflects the value of firms' intangible assets most of which consist of the stocks of knowledge which the firm has built up or acquired.

The importance of knowledge in firms' competitiveness and economic activity is not new. The craftsmen's guilds of medieval Europe placed great importance on the 'mysteries of their trade' which they were very concerned to protect. However those changes which are making up the transition to a 'knowledge based economy' are greatly increasing the importance of knowledge in economic activity and the competitiveness of firms. They are also changing the kinds of the knowledge which firms need to possess, the way that knowledge is acquired and managed, the way firms are organised and the kinds of knowledge and skills required of their employees.

The increasing importance of knowledge is shown by the fact that in many sectors investments in intangible assets are now much greater than those in fixed capital equipment. Thirty years ago advanced industrial economies were dominated by sectors such as steel, bulk chemicals and power generation which invested large amounts in plant and machinery. By contrast the rapidly growing sectors of the 1990s such as electronics, pharmaceuticals and telecommunications invest mainly in R&D, software and information technology, advertising and training. Some emerging sectors, such as those associated with the Internet, hardly invest in fixed assets at all. Many firms and organisations including the OECD are directing a lot of effort towards improving the measurement both of intangible assets and of the returns to investments in knowledge acquisition and creation such as R&D and training. Some firms are now appointing senior executives with responsibility for 'knowledge management'.

The number of technologies used in the production of a given product or service is increasing and firms need expertise in a greater range of technologies than before. This combined with the accelerating pace of scientific and technological change means that firms increasingly resort to R&D collaboration and out-sourcing to acquire the technologies they need. Development of leading edge science and technology is now undertaken in many more locations and, together with the increasing globalisation of markets, this means that firms must be prepared to seek technology relevant to their business from wherever in the world it is to be found. Developments in information and communication technologies, particularly the Internet, provide radical new ways of doing this.

The nature of technology used by firms is changing as well. Twenty years ago firms in sectors such as mechanical and electrical engineering mainly depended on the skills of their designers, draftsmen, production engineers and craftsmen for their technology. Now the technology of leading edge firms in this sector consists of computer aided design and manufacture (CADCAM) and knowledge of a range of advanced technologies including electronics, advanced materials and software. The various stages of the production process and the interface between the firm and its customers is now managed electronically rather than via engineering drawings. Traditional craft and production engineering skills have been replaced

by computer design and the ability to integrate successfully the various elements of a computer controlled manufacturing system.

Such production systems need to be organised in a very different way from traditional mass production. Workers operate in small self organising teams carrying out a range of tasks and need to be multi-skilled. Together with the huge improvements in information processing brought about by developments in information technology this result in big reductions in the number of layers of management. The increasing complexity of technology has increased the extent to which key components are sourced outside the firm and the degree to which firms need to understand the technology of their customers. The firm must be able to use information gathered at all levels within its organisation and from its customers and suppliers and the outside world generally. There is much greater interdependence and communication among workers, firms, their customers and suppliers (Barber 1998).

Managers and workers now need to be much better educated and much more highly trained. The increasing speed of technological and organisational change means that employees need to be much more flexible and require much more training and upgrading of their knowledge and skills during their lifetime. There will need to be mutual commitment between firms and their employees so that firms will have an incentive to invest in training while employees have an incentive to acquire knowledge and skills specific to the firm in which they work. At the same time the firm will need flexibility between what it produces itself and what it sources from outside and therefore in the numbers and types of workers which it employs. The management of these conflicting requirements is a challenge not just for firms but also for society as a whole.

Studies carried out by the OECD show that the Industrialised World is coping with the transition of a knowledge-based economy in a variety of ways and that a solution to the challenges which this transition poses is not to be found in any one region of the OECD. North America, Europe and the Asia-Pacific Region all have something to learn from each other. Such exchanges of knowledge will be a key part of all our economic futures.

From above sections, it is possible for the trainees to understand the role of technologies as a key for creating value-added and have a general consensus that “technology” is an intangible asset in corporate. After having general agreement on the concept of “technology” for commercialisation, the effort to identify the factors which make technologies into business can be made, and through this process the role of “technology evaluation” for “technology financing” can be perceived.

5.2. Comparative Studies with Respect to "Corporate Evaluation"

It may be also helpful to learn the origination and background of "technology evaluation" briefly, since it makes easier to understand the connection between evaluation for corporate and for technology. From the similar pointed of view, it is also helpful to learn the different types of technology evaluation methodologies (such as "assessment or rating" and "valuation") and their practical applications. Technology evaluation is mainly conducted on the technology which comprises the assets of corporate (see above – the definition of technology differs from conventional definition). In this sense, technology evaluation techniques have essentially their roots in corporate evaluation processes in principle.

The corporate evaluation processes are normally classified into two categories. The one is credit rating and the other is business valuation. The brief introduction of credit rating is given in below:

Before you decide whether to invest into a debt security from a company or foreign country, you must determine whether the prospective entity will be able to meet its obligations. A ratings company can help you do this. Providing independent objective assessments of the credit worthiness of companies and countries, a credit ratings company helps investors decide how risky it is to invest money in a certain country and/or security.

As investment opportunities become more global and diverse, it is difficult to decide not only which companies but also which countries are good investment opportunities. There are advantages to investing in foreign markets, but the risks associated with sending money abroad are considerably higher than those associated with investing in your own domestic market. It is important to gain insight into different investment environments but also to understand the risks and advantages these environments pose. Measuring the ability and willingness of an entity - which could be a person, a corporation, a security or a country - to keep its financial commitments or its debt, credit ratings are essential tools for helping you make some investment decisions.

There are three top agencies that deal in credit ratings for the investment world. These are: Moody's, Standard and Poor's (S&P's) and Fitch IBCA. Each of these agencies aims to provide a rating system to help investors determine the risk associated with investing in a specific company, investing instrument or market.

Ratings can be assigned to short-term and long-term debt obligations as well as securities, loans, preferred stock and insurance companies. Long-term credit ratings tend to be more indicative of a country's investment surroundings and/or a company's ability to honor its debt responsibilities.

It is important to note that ratings are not equal to or the same as buy, sell or hold recommendations. Ratings are rather a measure of an entity's ability and willingness to repay debt. The ratings lie on a spectrum ranging between highest credit quality on one end and default or "junk" on the other. Long–term credit ratings are denoted with a letter: a triple A (AAA) is the highest credit quality, and C or D (depending on the agency issuing the rating) is the lowest or junk quality. Within this spectrum there are different degrees of each rating, which are, depending on the agency, sometimes denoted by a plus or negative sign or a number.

Thus, for Fitch IBCA, a "AAA" rating signifies the highest investment grade and means that there is very low credit risk. "AA" represents very high credit quality; "A" means high credit quality, and "BBB" is good credit quality. These ratings are considered to be investment grade, which means that the security or the entity being rated carries a level of quality that many institutions require when considering overseas investments.

A credit rating is a useful tool not only for the investor, but also for the entities looking for investors. An investment grade rating can put a security, company or country on the global radar, attracting foreign money and boosting a nation's economy. Indeed, for emerging market economies, the credit rating is key to showing their worthiness of money from foreign investors. And because the credit rating acts to facilitate investments, many countries and companies will strive to maintain and improve their ratings, hence ensuring a stable political environment and a more transparent capital market.

The business valuation can be understood in following ways: “Fair market value” is defined as the price, expressed in terms of cash equivalents, at which property would change hands between a hypothetical willing and able buyer and a hypothetical willing and able seller, acting at arms length in an open and unrestricted market, when neither is under compulsion to buy or sell and when both have reasonable knowledge of the relevant facts. The fair market value standard incorporates certain assumptions, including the assumptions that the hypothetical purchaser is reasonably prudent and rational but is not motivated by any synergistic or strategic influences; that the business will continue as a going concern and not be liquidated; that the hypothetical transaction will be conducted in cash or equivalents; and that the parties are willing and able to consummate the transaction. These assumptions might not, and probably do not, reflect the actual conditions of the market in which the subject business might be sold. However, these conditions are assumed because they yield a uniform ·standard of value, after applying generally-accepted valuation techniques, which allows meaningful comparison between businesses which are similarly situated.

In order to perform the valuation there are a couple of elements which need to be considered. The first is economic conditions. A business valuation report generally begins with a description of national, regional and local economic conditions existing as of the valuation date, as well as the conditions of the industry in which the subject business operates. A common source of economic information for the first section of the business valuation report is usually published by the national bank of each country. Local governments and industry associations often publish useful statistics describing regional and industry conditions.

The financial statement analysis generally follows a description of the subject company. One of the first techniques that a business valuation professional applies is called “normalization” of the subject company’s financial statements. Normalizing the company's financial statements permits the valuation expert to compare the subject company to other businesses in the same geographic area and industry, and to discover trends affecting the company over time. By comparing a company’s financial statements in different time periods, the valuation expert can view growth or decline in revenues or expenses, increases or decreases in assets or liabilities, or other financial trends within the subject company. Valuation professionals also review the subject company’s financial ratios, such as the current ratio, quick ratio, and other liquidity ratios; collection ratios; and other measures of a company’s financial performance.

The second is normalization of financial statements. The most common normalization adjustments fall into the following four categories: (1) Comparability Adjustments. The valuator may adjust the subject company’s financial statements to facilitate a comparison between the subject company and other businesses in the same industry or geographic location. These adjustments are intended to eliminate differences between the way that published industry data is presented and the way that the subject company’s data is presented in its financial statements. (2) Non-operating Adjustments. It is reasonable to assume that if a business were sold in a hypothetical sales transaction (which is the underlying premise of the fair market value standard), the seller would retain any assets which were not related to the production of earnings or price those non-operating assets separately. For this reason, non-operating assets (such as excess cash) are usually eliminated from the balance sheet. (3) Non-recurring Adjustments. The subject company’s financial statements may be affected by events that are not expected to recur, such as the purchase or sale of assets, a lawsuit, or an unusually large revenue or expense. These non-recurring items are adjusted so that the financial statements will better reflect the management’s expectations of future performance. (4) Discretionary Adjustments. The owners of private companies may be paid at variance from the market level of compensation that similar executives in the industry might command. In order to determine fair market value, the owner’s compensation, benefits, perquisites and distributions must be adjusted to industry standards. Similarly, the rent paid by the subject

business for the use of property owned by the company's owners individually may be scrutinized.

Three different approaches are commonly used in business valuation: the income approach, the asset-based approach, and the market approach. Within each of these approaches, there are various techniques for determining the fair market value of a business. Generally, the income approaches determine value by calculating the net present value of the benefit stream generated by the business; the asset-based approaches determine value by adding the sum of the parts of the business; and the market approaches determine value by comparing the subject company to other companies in the same industry, of the same size, and/or within the same region. In determining which of these approaches to use, the valuation professional must exercise discretion. Each technique has advantages and drawbacks, which must be considered when applying those techniques to a particular subject company. Most treatises and court decisions encourage the valuator to consider more than one technique, which must be reconciled with each other to arrive at a value conclusion. A measure of common sense and a good grasp of mathematics is helpful.

5.3. General Methodologies

Technology valuation & Technology scoring (Rating)

As technology develops in a speedy manner, its life cycle tends to be reduced faster and the importance of successful commercialization of developed technology is getting higher. Many small and medium enterprises which have a new technology developed usually lack of funding for commercialization. In order to support such companies, many governments have established various types of technology evaluation so that they can get financial aids from the several financial institutes for technology commercialization. Therefore, accurate technology evaluation is crucial. Use of inadequate evaluation model would jeopardize the entire funding process causing critical loss.

In general, it is said that technology evaluation (e.g. including valuation and assessment) is not a science but an art. The reason may be attributable to the following factors. First, technology is neither visible nor tangible. It is frequently embodied in human knowledge or in physical assets and hence difficult to identify the exact contents and scope. Second, economic value of technology is affected by various non-technical factors and realized only after it is commercialized to market (Tipping et al., 1995; Mard, 2000a; 2000b). Third, evaluation of technology is a subjective activity. Evaluation of technology is very much like the evaluation of beauty that is framed in the eye of beholder (Boer, 1999). Furthermore, technology is traded in a supplier's market and thus hard to reach balanced price through market mechanism.

Indeed, there are a number of traps or pitfalls in evaluating technology that technology manager may encounter (Boer and Traps, 1998).

However, there has been growing recognition that worth of a corporate or a business cannot be gauged without knowing the value of technological assets. Social demands for technology evaluation have increased rapidly. In public side, the government needs to evaluate technology in implementing such policy schemes as national R&D programs, subsidy or loans for R&D, and technology transfer programs. In private sector, venture capitalists, consulting firms, and technology brokers need systematic evaluation methods for making decision on investment, licensing, and strategic alliance (Park & Park, 2003). In response, various evaluation methods, ranging from intuitive judgment to complex options model (Black and Scholes, 1973; Mitchell and Hamilton, 1996), have been developed. Recently, academicians and practitioners on knowledge management (KM) have joined this research area to propose evaluation methods for knowledge or information (Wilkins et al., 1997). Although individual methods may differ one another in terms of criterion and procedure, the results of technology evaluation is expressed in score, index, or monetary value.

These evaluation approaches have their roots to corporate evaluation. For examples, technology valuation is performed when the monetary value is needed, such as technology transfer, M&A process etc. Many of this valuation processes are attributed to those of business valuation, and thus valuation process is similar, except the isolation process of technology assets.

The major approaches for technology valuation are shown in figure 5.1-4. Figure 5.1 presents the major methods for valuing technology, expressed in abbreviated fashion as "cost," "market," and "income", while figures 5.2, 5.3, and 5.4 present brief definitions for each of these major methods, as well as the primary advantages and disadvantages of each.

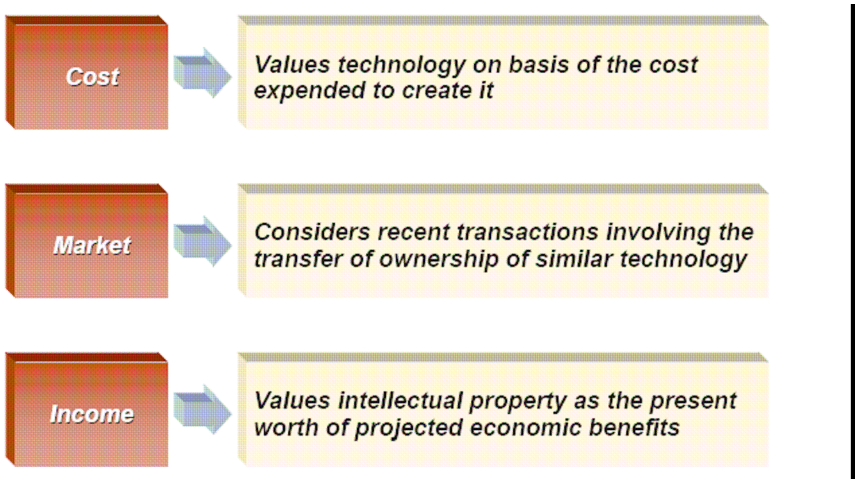


Fig 3 Technology valuation approaches

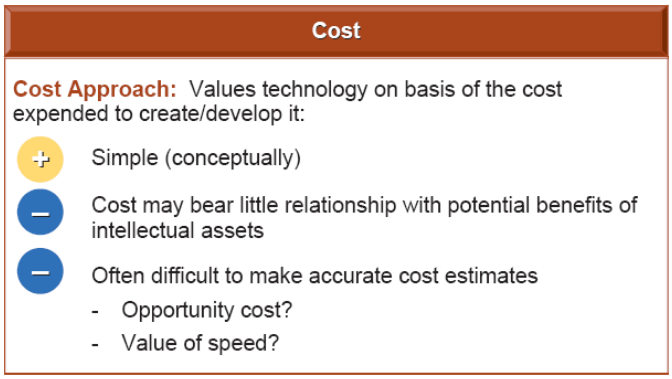


Fig 4 Cost approach.

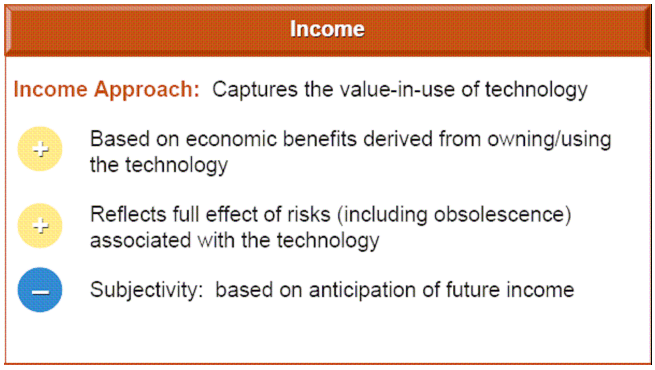


Fig 5 Income approach

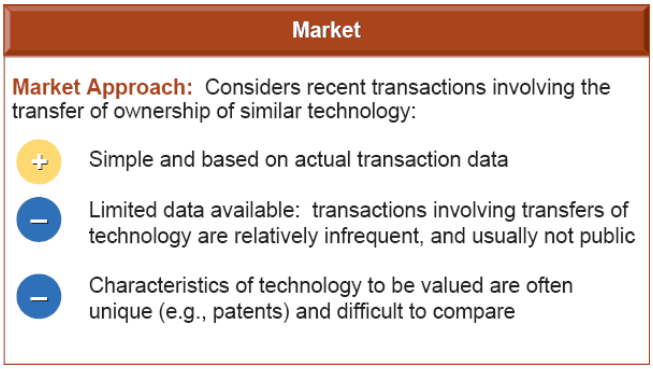


Fig 6 Market approach

In most cases, income approach is generally accepted method since we are more interested in the future of the firm. Although market approach is regarded as an objective approach, this method can only be validated when the firm is listed in the stock market. Cost approach is used when the firm goes into liquidation.

When performing income approach, various types of model are available but traditional NPV (Net Present Value) theory based upon DCF method is still widely used in practice, although decision tree or real option is getting growing attraction for the investment in such as bio-, or IT-industries. The technology valuation based upon income approach can be performed as follows:

Technology Value = NPV x Technology Factor

Where, Technology Factor = Industrial factor × Technology rating

Industrial factor : Maximum contribution ratio of technology asset for commercially viable enterprise values in certain industrial sector

Technology rating : Relative impact factor of a certain technology in business

The Technology Factor is also expressed as follows:

Technology Factor = Contribution Ratio of Technology

× Technology Completion Coefficient

In above equation, the Contribution Ratio of Technology is derived from portion of technology assets in whole assets (i.e., market, and human resources and technology assets etc). The calculation flow for the technology valuation and valuation history are seen in following figures respectively.

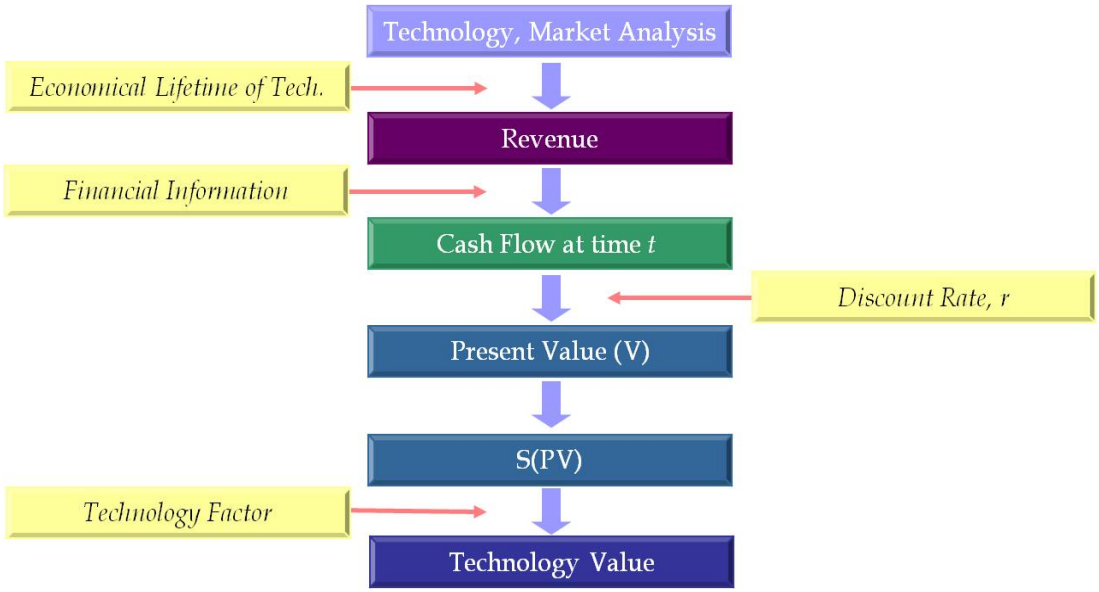


Fig 7 Flow of technology valuation

In practice of technology valuation, how valuable a technology is in the marketplace is a complex question. The evaluation process includes a commercial analysis, the inventor's profile, the propriety position, what stage of development the technology is in and a financial analysis. Specific areas of analysis that must be covered before a technology can be given a value in the market place are:

Defining the product

Assessing its perceived industrial value

Identifying the end user

Determining the size of the market

Identifying the competitive edge or uniqueness the technology or invention will have in the market place

Evaluating how mature the market is

Knowing what regulatory or liability considerations exist

Assessing prospective licensees

Determining the length of the product cycle

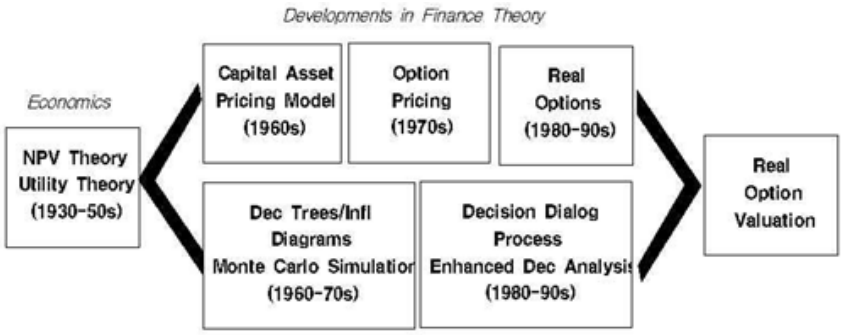


Fig 8 History of valuation

Technology valuation usually obtained by the product of the firm value by the ratio technology asset. Therefore, the isolation process of factors comprising technology asset is important. Considering the asset of the firm is categorised into tangible and intangible assets. The amount of intangible asset can be calculated easily. Then the degree of contribution by technology asset can be obtained by calculating degree of technology asset proportion in intangible asset. The general idea of assets comprising the firm is shown in table in below.

Although technology valuation is useful to assess the business feasibility of technology, it is true this method has inherently ad-hoc property. Since this method is focused on specific time spot rather than time period, this method is essentially lack of business risk consideration.

Table 1 Intangible assets

Asset	Tangible Asset		Current Assets, Investment Assets, Fixed Assets
	Intangible Asset	Intellectual property	Industrial Property Inventions (Patents) Trademarks Industrial Designs Geographic Indications Copyright and Related Rights Copyright Rights Related to Copyright Collective Management of Copyright

		Market asset	Loyalty corporate Image brand name value Customer relationships
		Human asset (resources)	CEO, Organization Structure, Decision Making Process

In the aspect of SME funding to promote sustainable growth, predicting business risk (or uncertainty) is more important than predicting future cash flow. For this reason, scoring model has been widely used. Briefly, scoring model uses a number of evaluation factors and makes evaluator subjectively rate score for each factor. Then the overall score of the technology is computed by addition or multiplication of individual scores (Souder, 1972). The main reason for popularity of scoring model is due to its simplicity and robustness. However, scoring model is subject to critical drawbacks. First, score itself never tells the real meaning of value. It merely indicates the relative preference among alternatives. Second, the relationship between various factors is ignored. It assumes that they are mutually independent and treats them separately in scoring. Frequently, there are certain degrees of correlation between the evaluation attributes and it may cause misleading results.

Nonetheless, scoring method has been a popular choice for many institutes due to its simplicity. In general, an expert committee is formed to assess the score of the technology owned firm in terms of several aspects: ability of management, level of technology, marketability of technology, technology potential and profitability. This again requires scoring of individual attributes of each factor. The evaluation of each attribute considers not only the characteristics of the technology itself but also the characteristics of an owner (e.g. company or research institute) etc. In Korea, it has been found that the bankruptcy or default rate of the companies, which got warranty by this kind of scoring method, has been well predicted by the recently established system. Subsequently, multicollinearity among many attributes was questioned and the demand of revised version of technology evaluation model was apparent.

A technology scoring model typically tries to examine the firms which have the ownership of the technology with many individual attributes. The attributes for the evaluation include not only the characteristics of the technology itself but also the characteristics of an owner (e.g. company or research institute) in terms of the ability of management, level of technology, marketability of technology, technology profitability (or potential). The following figure depicts the differences between technology scoring (rating) and technology valuation.

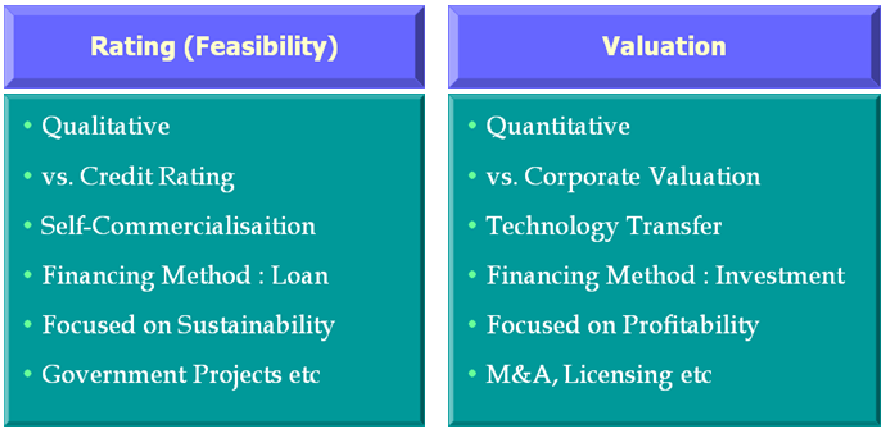


Fig 9 Technology Evaluation Methodologies

Criteria for the technology assessment

Recently, the detailed research on the assessment of new technology in UK was reported (Coster, 2003) and the part of this article is introduced as follows: Assessment of new technology reported in the research literature includes assessment of new technology ventures and new technology projects for new product development. The research identifies two approaches to assessment. The process-based approach (Khurana and Rosenthal, 1998) employs established procedures, e.g. for assessing project proposals based on new product development. In contrast, a culturally based approach (Cooper and Kleinschmidt, 1997) is one where there is no formal methodology that all projects are assessed against—assessment is based on the assessor's experiences both individually and collectively.

The research literature relating to the assessment of new technology ventures identifies the different approaches taken by the main parties active in this area— business angels and venture capitalists. Business angels come from diverse backgrounds ranging from former entrepreneurs to finance specialists (Prowse, 1998). They are inclined to target the less risky proposals compared to those favoured by venture capitalists (Mason and Harrison, 2002) and their assessment focus reflects this. They focus less on assessment of market risk than venture capitalists (Fiet, 1995), and focus more on assessment of the entrepreneurs—their methods also vary in that they use more informal networks than venture capitalists.

Venture capitalists (VCs) use a culturally based approach to achieve a holistic appraisal during their involvement in the early stages of new technology ventures. In contrast, approaches based on decision models (e.g. by actuaries or universities) are essentially process-based to achieve a holistic appraisal in their assessment of new technology ventures.

The benefits for a VC of using a culturally based approach to their assessment of new technology ventures (rather than a formalised process or decision model) are that they are free to adapt to individual circumstances. This suits their mode of operation, as they are often in close contact with many of the different players in a given sector. This may be advantageous although potentially risky in a newly evolving market situation.

It is also a speedier approach to assessment with times of 12 min reported (Sandberg and Hofberg, 1987; Shepherd et al., 2000). Speed is an important criterion to venture capitalists who need to make a quick initial screening of the hundreds of proposals that they receive. From this they select those worthy of further scrutiny, typically less than 1% of the total. Previous studies have shown that decision models can also be successfully used in the initial screening stage (Zacharakis and Meyer, 2000).

The disadvantage of a culturally based approach that has been reported (Zacharakis and Shepherd, 2001) is that of overconfidence. This research into venture capitalists' decision-making highlighted the fact that they make decisions without obtaining additional information to check areas of concern. The use of decision models by venture capitalists is reported to be rare (Zacharakis and Meyer, 2000). However, the mode of operation of venture capitalists (which is based on their closeness to a given marketplace) can be improved by the use of decision models (Shepherd and Zacharakis, 2002).

The assessment of new technology is based on identifying key criteria for analysing high technology ventures presented to banks in the first instance. The order of the criteria given below is one considered appropriate to the nature of this task. VCs would be likely to choose and order that which achieves rapid elimination.

High technology ventures are inherently riskier than other business ventures as they are likely to involve technological and product developments. Research has shown that this risk is increased when innovation involves both technological innovations and market innovations, such that the product capabilities are new to the market (Veryzer, 1998). The promotion of products to the market is also affected by the complexity of a product (Ahearne et al., 2000; Kim and Wilemon, 2003).

Technological uncertainty is recognised in the research literature (McDermott and Connor, 2002) as one of the four dimensions of radical innovation (the others being technical inexperience, business inexperience and technology cost). The product risk increases with the greater number of functions or technologies (Kim and Wilemon, 2003) so the level of complexity of the proposed product requires assessing. In the cases where there is no prototype to assess, there is a need to focus on whether a company can develop its area of competence by developing products with a high market distinction

(Tatikonda and Rosenthal, 2000; Kim and Wilemon, 2003).

The technological and commercial risk in developing and promoting the proposed products or services is one of the criteria used in the assessment method as shown in Table in below

Table 2 Technological and commercial risk

Criteria	Questions to rate criteria
Will it work? How well?	Does a prototype exist? Has it been tested and by whom? What is the nature of the prototype? To prove principles/bench prototype Pre-production single unit Pre-production batch Has it been evaluated by a (or more than one) potential customer? Has any value engineering carried out? Has it been tested in the environment where it will be used? Have the details of manufacturing been worked out? Does this development depend on any key product or service outside your control? If no prototype: What evidence is offered that product will work effectively? (Drawings, theoretical analysis, computer simulation) What IPR exists or could exist?

Many of the business plans that have been assessed are from entrepreneurs who are frequently overly optimistic about their business proposal and have a tendency to underestimate competitors' capabilities. Research shows that this is an important area with reports that ''firm competitive strategies were direct predictors of venture growth'' (Baum et al., 2001) along with a CEO's specific competencies and motivations.

Products can be technically successful but fail in terms of business performance due to a lack of competitive advantage—there needs to be sufficient ''meaningful product uniqueness'' (Stevens et al., 1999). The term ''meaningful'' refers to an identifiable market requirement for the product (not just an interest by the technology developer). The level of product innovation is one of the criteria used in the assessment method as shown in the following Table.

Table 3 Level of product innovation

Criteria	Questions to rate criteria
Is it better than the alternatives, if any?	What are the nearest competitive products and who produces them?
The unique selling proposition (USP)	The unique selling proposition (USP) (Large/small companies, imports, well established dominant supplier) What is your USP (unique selling proposition)? (Single most important advanced improvement) What are your competitive advantages? (Cost, function, size, appearance, range of application . . .)

The importance of the potential size of the market as a criteria for affecting the business performance of technology innovation is well recognised (Rosenkranz, 2003). The market characteristics that improve the chance of success of new product developments include a fast growing market (Zirger and Maidique, 1990 in Loch, 2000).

For high technology products the criteria that are important to customers in their buying decisions can change during the product life cycle (Waarts et al., 2002). This life cycle is referred to as the adoption life cycle. How the proposed products or services will satisfy the market is one of the criteria used in the assessment method as shown in Table.

Table 4 Market criteria—how it satisfies a market sector

Criteria	Questions to rate criteria
How does it satisfy a sector of the market?	What problem does it solve? What does the target market sector use at present? Why will they change to your solution? Will your customer have to rely on you? (What risk to the customer if your product fails to meet his needs)

The market opportunities for a high technology venture are dependent on various market characteristics. Research in Australia of the criteria used to assess breakthrough products has been reported (Shepherd et al., 2000):

. Competitive rivalry;

. Timing of entry;

. Lead time;

. Key success factor stability.

Predictions of market forecasts are not easy to establish. The difficulty of predicting the market opportunity is due partly to being unable to conduct market research to assess customers' reaction. Further, the development of complementary technologies is yet to occur and these will affect the market reaction (Rosenberg, 1994; Deszca et al., 1999). Timeliness is one of the market criteria used in the assessment method as shown in Table 5.

Table 5 Market criteria—Timeliness

Criteria	Questions to rate criteria
Timeliness?	Has there been a recent change or new development which makes the product attractive to users? (powerful PCs, new chips, Internet developments, associated products, government legislation, EU directives, industry standards or trends etc.) Is the market ready for the product? (Could it be premature or too late?) Could the product become obsolete? (What timescale?) Can you launch the product quickly enough to catch the market?

The potential for re-using technological and product developments is of importance to high technology start-ups. A high technology venture has to put more resources into developing products than most other ventures. To maximise the returns on this investment it is desirable to have a product that will lead to repeat purchases (rather than a one-off purchase).

A similar aspect is the usable lifetime of the product. This is dependent on the nature of the product, e.g. a fashion product may only be acceptable to the market for a short period of time. In contrast, a product that provides a basic function is likely to have a long lifetime (e.g. providing a basic function such as lighting). These aspects are one of the criteria used in the assessment method as shown in Table 6.

Table 6 Product extensions—longevity/repeat orders

Criteria	Questions to rate criteria
Longevity/repeat orders?	What is the usable lifetime of the product? Will there be repeat business? (Replacement, servicing?) Is there a fashion or fad element?

Once a new venture has won customers then there is the opportunity to sell related products. For example, a customer may have requirements for a product of similar functionality but a different capacity—either larger or smaller. It is easier and less costly to sell additional products to these existing customers rather than trying to win new customers. How the proposed products or services will fit into a family of products in the market is one of the criteria used in the assessment method as shown in Table 7.

Table 7 Product extensions—family of products

Criteria	Questions to rate criteria
Does it fit into a future family of products?	Is there enough potential business for this product alone? (Saturation, marketing problems) If a single product company is proposed, is it reasonable to build a business on one product? (Distributors may not open an account for one low cost product.) What is the potential for added value to this product line? (Accessories, larger/smaller units, lightweight/ heavy duty . . .)

An entrepreneur's background has been established as very important in the literature (Jo and Lee, 1996) along with their strategic focus and the strategic direction that they bring to a new venture (Bantel, 1998; Daily et al., 2002). Studies into the extent of business planning in small firms indicate that many small firms do not prepare written plans for the various functions (Perry, 2001). This is part of the difficulty in trying to appraise the business and management capabilities of a technology venture. For this reason the past record of the people in the venture is used as the basis for assessing the competence of personnel.

Studies into the criteria assessed by venture capitalists (Shepherd et al., 2000) have identified two aspects relating to entrepreneurial background:

. Educational capability;

. Industry-related competence.

Research has shown that start-ups with key staff having attributes of creativity and inventiveness need also to be working to business disciplines (Stevens et al., 1999). The entrepreneurial background is one of the criteria used in the assessment method as shown in Table 8.

Table 8 Entrepreneurial background

Criteria	Questions to rate criteria
Previous record of technical innovation?	Any previous successful products? Previous experience of manufacturing? R&D? Design? Marketing? Quality assurance? What areas of required functional expertise are not represented amongst the applicants?

How the proposed products or services will be protected in the market by means of patents is one of the criteria used in the assessment method as shown in Table 9.

Table 9 Protecting competitive advantage

Criteria	Questions to rate criteria
Do you have any patents, registered designs or any other form of protection?	Did you employ a patent agent or other professional assistance? If the patent is provisional, when do you have to decide to pursue the application? What coverage has been sought? Barriers to entry to the market can be mentioned in this section.

To improve the reproducibility of the assessment method a scoring method has been developed. The benefits of using this approach are that the assessments are more objective and there is less reliance on the individuals undertaking the assessment.

In order to attach a realistic assessment to each criteria, a word description is employed. The best fit determines the number, intermediate numbers being used as necessary. The scales were developed by identifying the two endpoints, i.e. the least credible position of an early stage venture (for a score of 1) and the best conceivable (for a score of 10). The scale for the midpoint (a score of 5) was set to represent the median state of a new technology venture when seeking funding. The scoring system relating to these criteria is given below.

Criteria 1: Technological and commercial risk

Aim: to assess will it work?

1. Idea only, little evidence of practicality or manufacturability.

3. Prototype exists—principles established—internal evaluation only.

5. Manufacturing preparations well advanced, but no customers yet.

7. Recently launched—early reports from customers good.

10. Established product, satisfied customers, good order book.

Criteria 2: Level of product innovation

Aim: to assess the Unique selling proposition, USP

1. No innovation—other factors contribute to viability.

3. Some distinct, probably minor, improvements over existing products.

5. Innovative but could be difficult to convert customers.

7. Obviously innovative and easily appreciated advantages to customer.

10. Very innovative satisfies a well-known market need.

Criteria 3: Market criteria—how it satisfies a market sector

Aim: to assess how it satisfies a market sector?

1. No specific market sector has yet been identified.

3. Preliminary investigations indicate that there is potential customer base but quantification is not yet possible.

5. The market sector can be defined in general terms. There is limited feedback from customers, which is encouraging.

7. There is a clear market demand and it is possible to demonstrate that some customers will be satisfied with the product (prototypes/test marketing).

10. There is a strong demand from a well-defined sector of the market. The product can be demonstrated to meet the requirements of customers fully.

Criteria 4: Market criteria—timeliness

Aim: to assess the market timeliness

1. (a) The product anticipates a demand but customers are not yet buying such products since they are not aware of availability or benefits.

   (b) The market is already supplied with many products of the type proposed and shows signs of saturation or decline.

3. (a) Some customers are seeking and purchasing such products, but an expanding customer base is not yet proven (highly specialised interest area at present).

   (b) There are alternative established products and establishing a new product may be difficult. Not strongly differentiated from existing products.

5. There is some discernible activity in the area of the innovation indicating potential but the evidence is not yet firm.

7. There is definite growth in the area of the innovation which will support establishment of a new product.

10. Recent developments/innovations which support the product show strong growth curves. The product fits closely in this scenario and would be expected to benefit from this growth.

Criteria 5: Product extensions—longevity/repeat orders

Aim: to assess whether it fits into a family of products to permit company establishment/development?

1. Product is a single member of what would normally be regarded as a product group—e.g. special drawing instrument, office product, injection moulded product. Would need complementary products to gain a foothold in the market, but not viable as a single item.

5. Viability as a single product is questionable. Difficult to see how modest profits could lead to successful business growth (‘living dead scenario’).

10. A viable business may be built on a single product initially. Further added value or complementary items are clearly identifiable for future growth. Other members of the product family exist.

Criteria 6: Product extensions—family of products

Aim: to assess the Longevity of product or product line?

1. Only one purchase per customer likely for the product. Could be a fashion or a fad for a limited time period.

5. The market for the product exists but not necessarily firm. Demand may be variable. Success depends on whether this market becomes more stable.

10. Similar products satisfying this market sector have been established for a period of years and will definitely be required for the foreseeable future. Once established the product may lead to repeat purchases.

Criteria 7: Entrepreneurial background

Aim: to assess the previous record of technical innovation

1. No previous successful product. Background of applicant(s) does not provide confidence that their knowledge is state-of-the-art.

5. Some evidence of successful innovation. but not necessarily a financial success. Applicant(s) provide some confidence that technical expertise exists.

10. Strong record of innovation from more than one product—as business venture or as part of a larger organisation (spin-off). Applicant(s) very knowledgeable about the area of development.

Criteria 8: Protecting competitive advantage

Aim: to assess the Intellectual property rights

1. No patent possible. None proposed. Unpatentable.

3. Provisional patent only. Patent possible (unpublished).

5. Full patents applied for but not yet granted. Coverage in appropriate market areas.

7. Apparently strong patent position although could be contested by identifiable major player.

10. Full patents granted with good coverage. Possible successful prosecutions for infringement.

Not all the criteria are considered to be of equal importance or independent of one another. Weightings were assigned to each of the criteria to reflect the levels of importance as shown in Table 10.

Table 10 Weightings applied to assessment criteria

Criteria	Weighting for criteria
Criteria 1: Technological and commercial risk	x3
Criteria 2: Level of product innovation	x2
Criteria 3: Market criteria—how it satisfies a market sector	x1
Criteria 4: Market criteria—timeliness	x1
Criteria 5: Product extensions—longevity/repeat orders	x0.5
Criteria 6: Product extensions—family of products	x0.5
Criteria 7: Entrepreneurial background	x1
Criteria 8: Protecting competitive advantage	x1

It should be noted that this assessment process shown above has a strong focus on technical issues rather than financial factors or the personal qualities of the management team. This is because the technical appraisal (evaluation) reports are intended for investors who already have extensive knowledge and experience in these other areas. But, if this report is intended for various type of users at the same time, financial factors can also be strongly focused.

The determination process of criteria and their weighting factors for criteria may vary. To obtain these criteria, the BSC (Balanced Scorecard) or Delphi methods have been widely

adopted. Kaplan and Norton (1996) suggested the BSC that gives corporate managers strategic and corporative vision as the substitution for the conventional finance measurements.

Among non-financial measurement criteria, customer satisfaction, internal business process, and organizational innovation are included in the Balanced Scorecard. But, comparing the actual performance results seems to be difficult, when we use these non-financial measurements. Thus, we suggest general criteria for each measurement index based on the BSC, then induce the aggregated measurement criteria by calculating the priority weight of each index. The Analytic Hierarchy Process (AHP) method is used to calculate the priority weights. This AHP has recently been attracting more attention in building BSC more effectively.

Experiences in Korea

In Korea, the scoring model based upon BSC and Delphi was initially implemented. This initial model was used by many public institute to select the firms which will benefit public funding or certification. After using this model for more than 5 years, the criticism has arisen on the effectiveness of the model.

It has been found that the many beneficiaries of this model appeared to fail in their business. The rate of failure seemed to be large than government initially intended. The demand for the re-design of the model had increased. As a result, several taskforce teams in the government were formed to tackle the problems. Although there has been unsolved argument yet, the main reasons which caused the problems were clarified. One of these is the discrepancy between the model and real world. The model is focused on strategy, technology level, impact on national economy and government philosophy etc. Unfortunately, these focuses are not always represents business success in certain amount of time period (which is usually 3 years in Korea). In other words, the model may only represent ultimate goal for the ideal firm which does not account time period, but this approach does not correspond to the real world. Since the model deals with the firm's (static) state rather than its (dynamic) path, it could not account for the characteristics of industry sector, growth stage and technology area etc. In addition, many private banking institutions are essentially indifferent to what the firm is doing. They are rather interested in the firms' stability based upon financial status, and transaction history etc., for which credit rating is traditionally employed. This discrepancy also put the policy makers as well as the SMEs in dilemma.

Therefore, it was suggested that the initial model needs to be restructured in accordance with the requirements described above. From this section, the experiences of technology evaluation system build-up in Korea will be explained. Korean government (especially Ministry of Finance & Economy/MOFE, Ministry of Commerce, Industry & Energy/MOCIE, and Small

& Medium Business Agency) have had a leading role in implementing technology evaluation system (TE) to be used for SMEs in Korea. The main purpose of this TE has been set to support the programmes or firms which are related to the technology commercialisation. The proposed demand of government-driven technology evaluation system in Korea is shown in next figure. The technology evaluation scheme facilitates variety of business like technology appraisal guarantee, loan on credit, M&A, technology transfer, direct investment and support on policy fund and so on.

Before explaining the implementation process, it should be noted that the ultimate goal include utilisation in private sector as well as public sector. With the strength of fairness, objectivity and reliability which is based upon the authority of government, the government seriously anticipate that this system (or policy) would be widely used in private sector as corporate credit analysis. Although technology evaluation is used initially for the government funded programmes, this system can be used as valuable information for investment, loan, technology transfer and consulting etc. Moreover, this system can be very forceful tool for overcoming information asymmetry problems facing most of countries, especially developing countries.

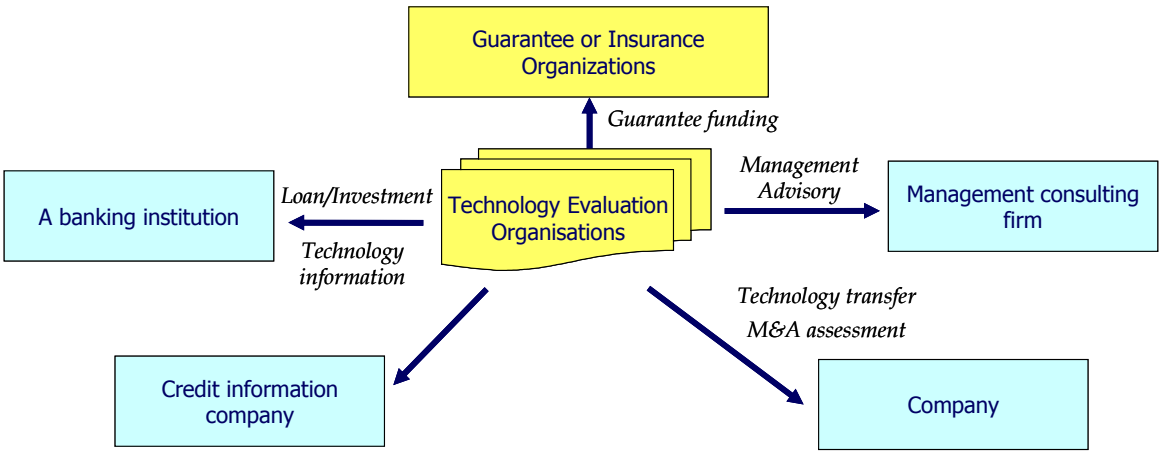


Fig 10 The estimated demand of technology evaluation in Korea

In Korea, the TE was initially employed by each governmental institution separately until late 1990s. Because of separate system operated by different institution, compatibility has been a major concern. From early 2000s, the necessity for the integrated system has been pointed out, which triggered action from the President's Office in 2003. This action formed taskforce team out of MOFE, MOCIE, SMBA and governmental institutes, where the first effort of building nationwide integrated system was started.

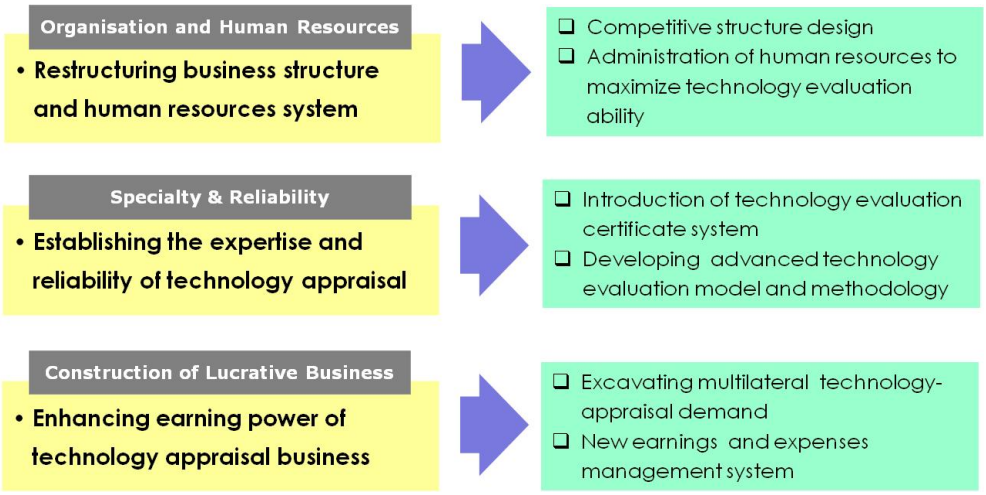


Fig 11 Main Directions of Restructuring "Technology Evaluation"

The main directions of the integrated technology evaluation system are shown in above figure. According to the figure, main directions can be summarized as follows. The first is setting up infrastructure for the programme. The technology evaluation requires high level of specialty in the field of technology itself (most of science and engineering area), market analysis, finance, accounting, intellectual property, law and other business related area. Therefore, the requirements for the human resources and the continuing education are highly demanding and crucial. The second is building up reliable technology evaluation model. The model is required to have reliability along with universality. These requirements apply to both evaluatee (the firm) and evaluator (government and bank etc). In order to meet these requirements, several attempts have been made, which will be explained in detail later. The last is establishing self-supporting business out of technology evaluation programme. By doing that, independency and thus authority of the evaluation can be guaranteed. All the three issues are cross-linked and should be considered simultaneously. For example, Korea is currently adopting "technology evaluation (appraisal) certificate" programme using the recently updated model. This programme is operated by Technology Appraisal Division in KIBO (non profit institute under the MOFE), which has almost 150 specialists in various field (PhD in Engineering, Certified Accountant and Patent Attorney etc). The following diagram shows flow of Technology Evaluation Certificate process.

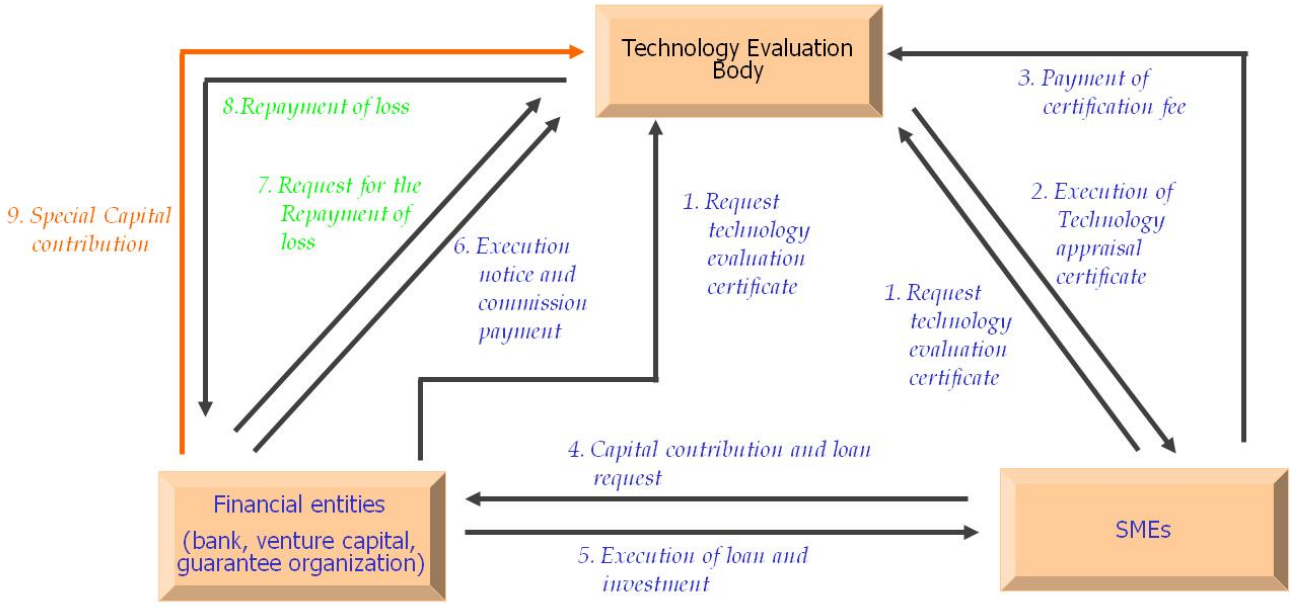


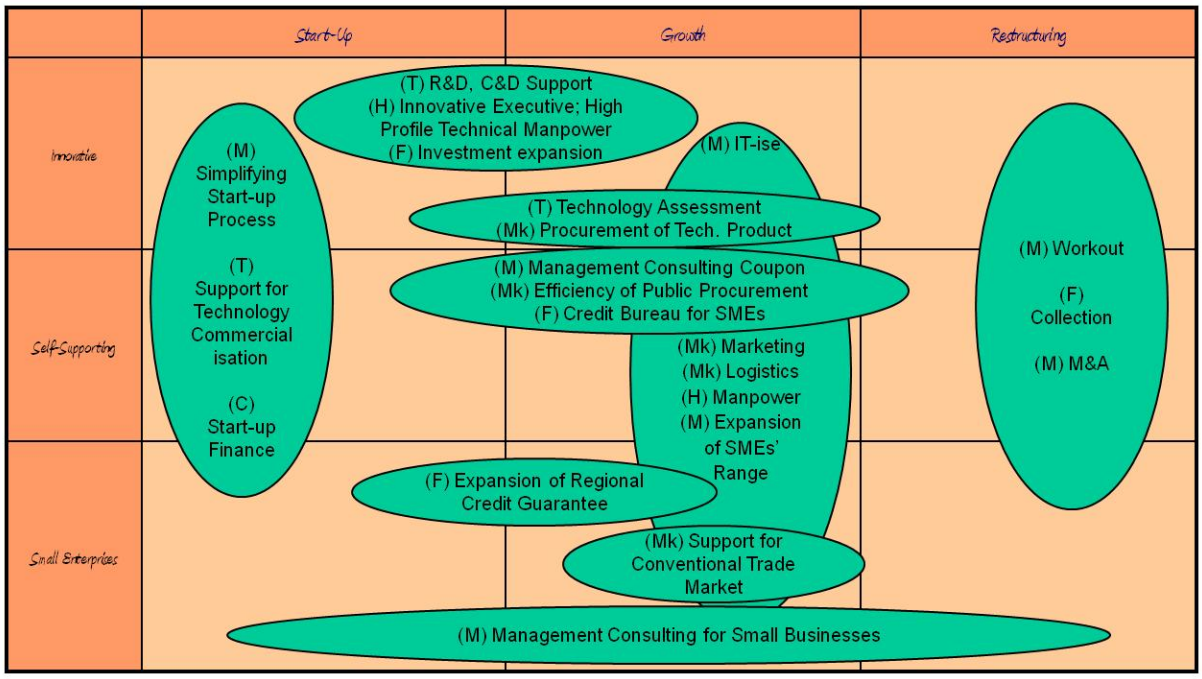
Fig 12 Flow of Technology Evaluation Certificate Process

(Evaluation Model)

In the respect of government, it is desirable to support the start-ups and venture enterprises with the focus of the prospective growth rather than past performance since they are more technology-oriented and more equipped with intangible assets than tangible assets. Therefore, the model needs to be focused in this respect.

It should be noted that the technology evaluation mentioned in this text is mainly for SMEs and/or start-ups. Since the technology evaluation (in Korea, “technology appraisal” often used in some organisations such as government institutes, which has same meaning as “technology evaluation” in this text) plays an important role for the public benefit by selecting the right enterprise to assist financially and technologically, this should insure the efficient distribution of the limited financial resources, and enhances the quality and efficiency of government policies/financial system for supporting promising SMEs and venture enterprises. Principally, high rating should be possible according to this system, even for early stage businesses in their early stages, if their technologies are original and competitive.

Since the main reason of technology evaluation scheme introduction is to enhance SMEs’ competitiveness, it is critical to set the overall direction and concept based upon criteria which help the competitiveness. The next figure shows countermeasure for enhancing SMEs’ competitiveness for various SME categories.



(T) Technology, (H) Human Resources, (Mk) Marketing, (F) Finance, (M) Business Infrastructure

Fig 13 Comprehensive countermeasure for enhancing SMEs' competitiveness

In Korea, the technology evaluation model used for business feasibility consideration had its basis on the BSC method. The original core criteria initially included in the model were based upon Technology, Marketability, Human Resources and Financial History. These criteria still apply to current model in broad spectrum. The next figures show the traditional core criteria and recent core criteria consisting the technology evaluation respectively.

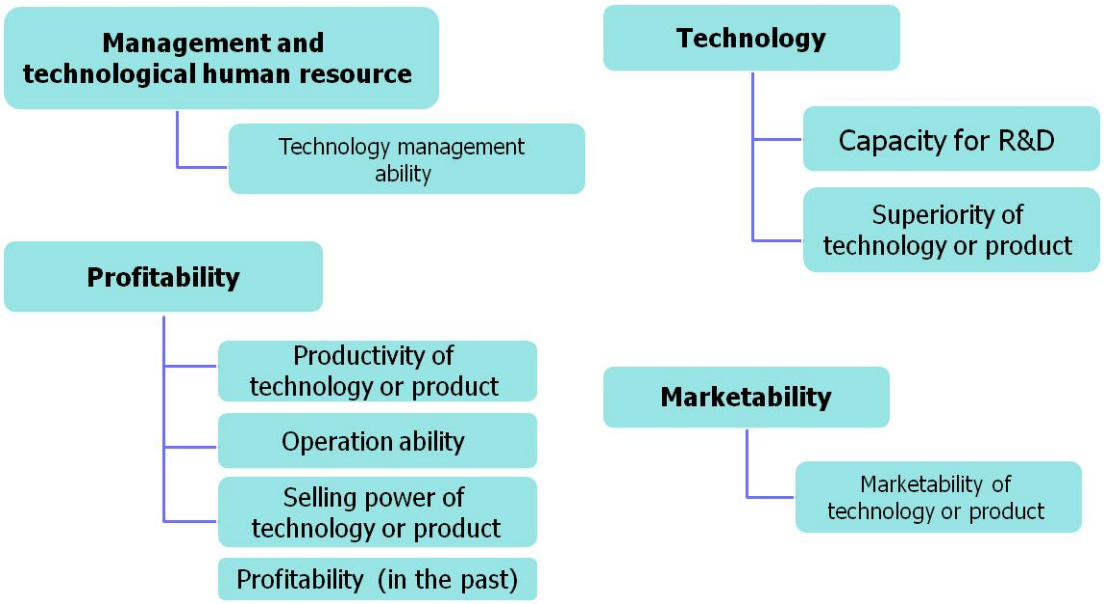


Fig 14 Core criteria of Technology evaluation (Technology grade)

Fig 15 Core criteria of recent Technology Evaluation Certificate System

The above mentioned criteria are largely attributed to the Oslo Manual by OECD, although many other ones are accumulated from Korea's own experiences of technology evaluation. Oslo Manual refers to the ability to determine the scale of innovation activities, the characteristics of innovation firms and the internal and systemic factors that can influence innovation is a prerequisite for the pursuit and analysis of policies aimed at fostering innovation. The Oslo Manual is the foremost international source of guidelines for the collection and use of data on innovation activities in industry. This third edition, published in October 2005, has been updated to take into account the progress made in understanding the innovation process and its economic impact, and the experience gained from recent rounds of innovation surveys in OECD member and non-member countries. For the first time, the Manual investigates the field of non-technological innovation and the linkages between different innovation types. It also includes an annex on the implementation of innovation surveys in developing countries.

Although there have been various derivatives, the most widely used criteria can be found in the technology rating (scoring) model used by KIBO (formerly KOTEC) in Korea from 1997 (model A) for the purpose of technology credit guarantee. In Korea, liquidity problem is a major setback for many companies with a great degree of growth potential in technology. In order to support such companies, technology credit guarantee fund has been established. A fidelity guarantee is given to the companies which obtained a high score by technology evaluation model so that they can get loan from the several financial institutes. However, critical loss had occurred with the model A, which in turn produced criticism on the model as an inadequate evaluation model and necessitate the model reconstruction. Finally, this model (model A) is reviewed and completely reconstructed in 2003-2005 (Model B), which will be shown later.

In the case of scoring model A, all of the attributes are measured in 5 or 10 point Likert scale by the experts committee as shown in Table in below. Those which are evaluated in 10 points scale are considered to be worth two times more than those in 5 points. The determination of weighting was done through so called Delphi process, which is simple but produced universality problems. There were also inter-relationship problems (multicollinearity) between KPIs, which are supposed to be independent with each other.

Table 11 Technology Evaluation Factors and Attributes used for a Scoring Model A

Factors (Criteria)	Abbrev	Attributes (KPI)	Score
Management	KMA	Knowledge management score	5
	TEPS	Technology experience score	5
	MAS	Management ability score	5
	FSS	Fund supply score	5
	HRS	Human resource score	5
Technology	ETDS	Environment of technology development score	5
	OTDS	Output of technology development score (e.g. patents, certifications)	5
	NTS	New technology score	5
	TSS	Technology superiority score	10
	TCS	Technology commercialization score	10
Marketability	MPS	Market Potential score	5
	MCS	Market characteristic score	5
	PCS	Product competitiveness score	10
Profitability	SPS	Sales schedule score	10
	BPS	Business progress score(new*)	5
	ASS	Amount of sales score(old+)	
	RIS	Return on investment score (new*)	5
	PFS	Profitability score(old+)	

* New: Less than 3year old companies, + Old: older than 3 years

In model A, the score is obtained as the simple sum of the scores of the sixteen attributes where two different attributes are used for the firms depending on the length of their history:

(BPS and RIS for new ones vs. ASS and PFS for older ones). As mentioned, one can easily suspect that there would be some problems associated with multicollinearity among these sixteen attributes.

To examine the older scoring model, the empirical results of 6057 cases of technology evaluation were analysed for scoring model A during 1997-2002. The data contains information of the companies which obtained the credit guarantee by technology evaluation model A. Among the 6057 companies, 150 (2.5%) went to bankrupt after 1 to 7 years. Although the bankruptcy rate in 2003 has been not published yet, it was predicted to be a lot higher. In the context of scoring model, it is very important not to pass those who would go bankrupt after getting the fund and this rate could be decreased by eliminating potential multicollinearity among the sixteen attributes.

The potential multicollinearity was examined first using the multiple regression analysis with VIF (Variance Inflation Factor) where each attribute is used as the dependent variable and the others are used as explanatory variables. The results are given in next table. As seen in the table, all variables except for BPS or ASS are associated with high VIF values and they may cause the multicollinearity with the others.

Table 12 Results of Multicollinearity Test

Attributes	KMA	TES	MAS	FSS	HRS	ETDS	OTDS	NTS
VIF	22.282	24.026	48.664	23.094	36.074	34.466	17.881	21.859
Attributes	TSS	PCS	MPS	MCS	PCS	SPS	BPS or ASS	RIS or PFS
VIF	46.215	37.403	29.261	31.315	47.744	35.589	6.991	41.881

Through the intensive review process, it had been validated that the existing scoring model in an effort to provide an improved version of technology evaluation model and suggested an adjusted technology evaluation score to eliminate the multicollinearity among the evaluation attributes based on the empirical study results of the existing one.

As a result, new scoring model based on independent factors was reconstructed. In addition, completely new approach for the reconstruction was employed after reviewing possible problems which could be engaged in intangible assets evaluation, i.e., technology evaluation as shown in the figure.

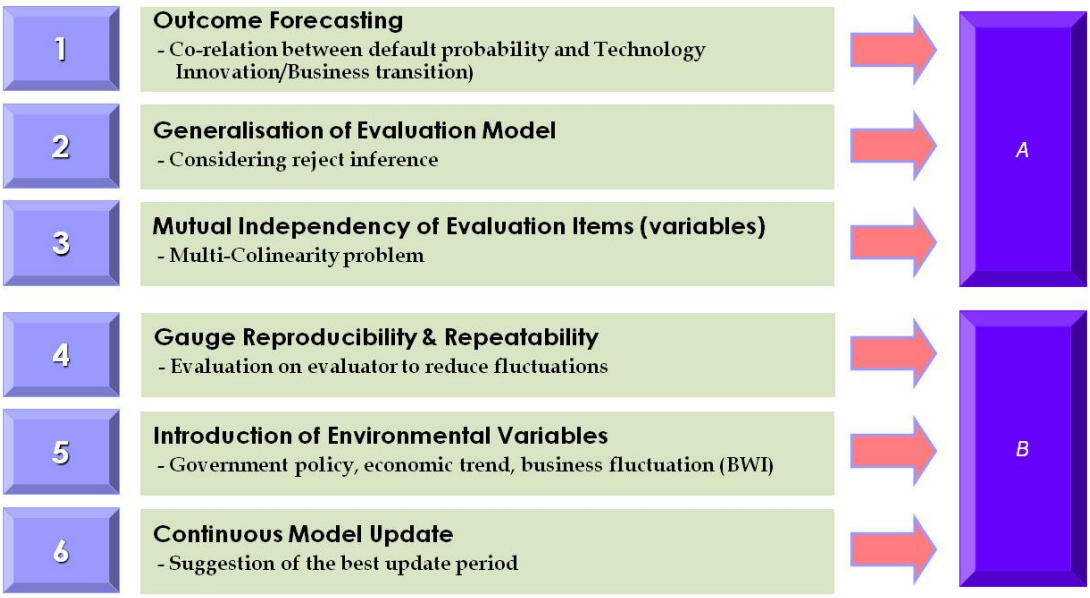


Fig 16 Problems in intangible assets evaluation

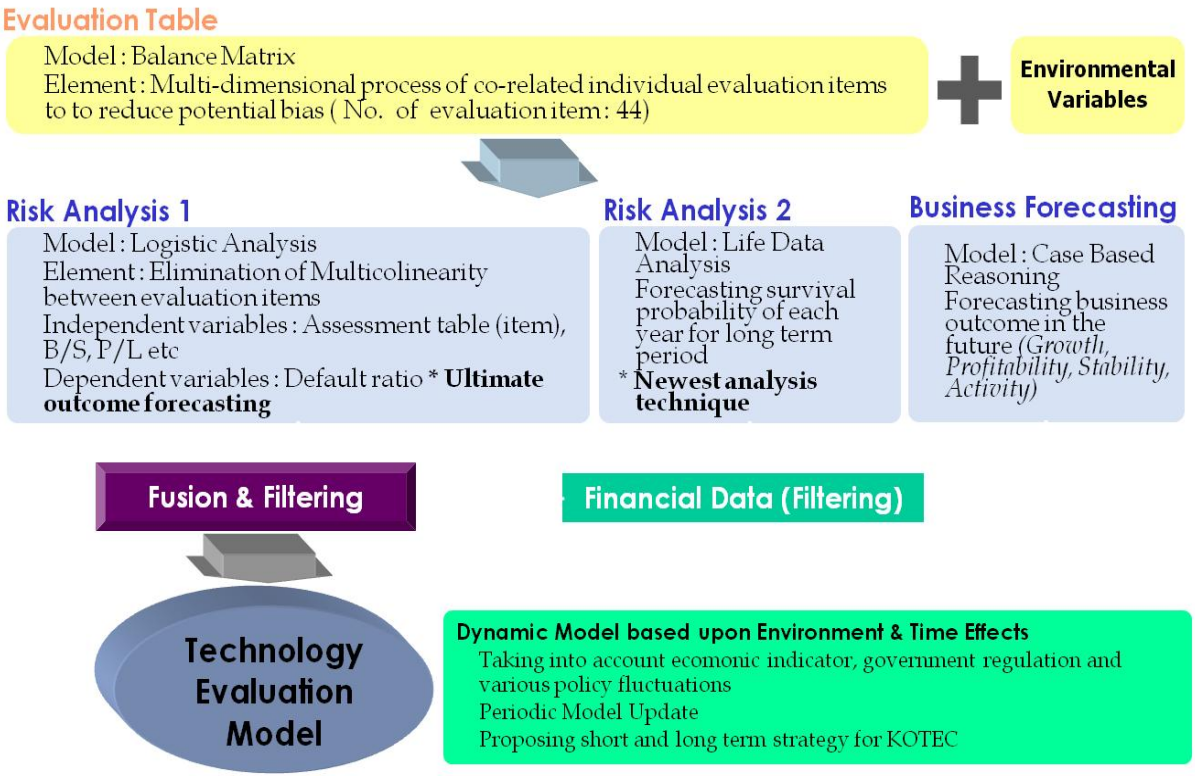


Fig 17 Techniques used in technology evaluation system construction

After considering such potential problems, various approaches to overcome had been suggested as shown in the figure. In order to receive general agreement of technology evaluation, different characters of various parties involved in the evaluation process should be considered. For example, bank is usually concerned about financial stability while the

applicant (the firm) only cares the technology. In the similar manner, investors are concerned about future profit. Therefore, for the policy maker's point of view, the model needs to embrace not only technological impact but also sustainability and future growth potential.

Unfortunately, there had not been a unique model which could consider all the issues simultaneously. The major issues can be categorised into three sections. The first is originated from inside of the firm (internal issue). The second is originated from outside of the firm (environmental issue). The last is nothing to do with the formers, but related to the evaluator and model's inherent error. The internal issue could be subdivided into further, such as the default rate and/or survival duration (bank), and future business forecasting (investor). Different methods were employed to work on different issues. It should be pointed out that same criteria and KPIs were applied to different method, otherwise the model could be too complex to be used.

Concerning the internal issues, the logistic function was used for the analysis of default rate, and this method is hinted from the risk analysis of traditional corporate credit analysis. The estimation of survival duration was constructed from life data analysis. This technique is still very new techniques even in academia. The case based reasoning was employed to forecast future business prospect, and this method was often used for national policy evaluation model. For the technology level, AHP was employed. Consequently, internal issues can be summarised as combination of risk level and technology level.

Unlike internal issues, environmental issues nothing to do with companies. It is rather related to the economical or industry status. Environmental variable can be extracted from various indices related to economy and can be updated regularly. In addition, KPIs consisting of the model can be structured as multi-dimensional matrices. In such way, evaluator's error or unwanted exaggeration caused by certain KPI can be diminished.

Based upon above process, new technology evaluation model was developed and reconstructed. Once this basic model fixed, the simpler derivatives can be extracted when the handy evaluation process is more appropriate. Next figure shows examples of technology evaluation structure currently used in KIBO in Korea. Corresponding to the object technology, KIBO uses 3 levels of appraisal (evaluation) models, High, Middle, Basic. This structure applies to all industry section and technology field except for Culture technology which has completely different model. However, the various criteria and KPI table version (input variable for the model) often to be prepared for the different technology area or industry section. In the case of KIBO, 6 different tables are used (Manufacturing, Software, Online business, Bio technology, Environmental technology, Design)

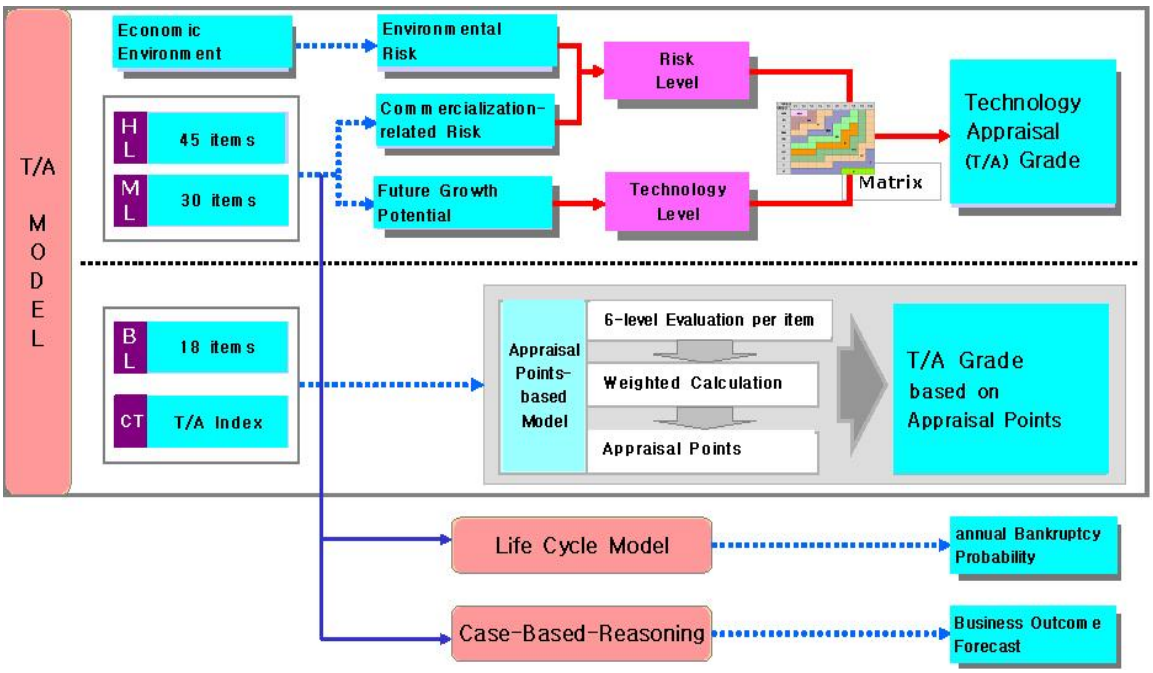


Fig 18 Structure of Model Technology Rating System

When compared to the previous model, the new model showed an outstanding decrease in default rates, enhancing KIBO's managerial soundness. This enabled KIBO to be awarded the Grand Prize of Korean Innovation Management 2006. This soundness also heightened the utilization of Technology Appraisal Certificates. During the year of 2006, a total of 404 certificates were issued and The number of loans related with these certificates were 217 and the amount 129 billion Won (approximately 150 mil USD).

Table 13 Achievement of Technology Evaluation System (Example)

(Unit: Cases, 100 Million Won)

Comparison on 3-year Default Rate	Cases			Amounts		
	Total	Default	Default Rate	Total	Default	Default Rate
KTRS	3,889	9	0.23%	17,853	24	0.13%
Former Model	1,456	29	1.99%	4,741	88	1.86%

Awarded "Grand Prize of Korean Innovation Management 2006"

The above table clearly demonstrate the importance of technology evaluation in technology financing. Technology financing can be defined as all kinds of financial activities including guarantees, investments and loan-lending which are accompanied by a series of technology

innovation processes like R&D and commercialisation. Technology financing is thought to play a role of bridge which connects both ends of so called Death Valley. The estimated technology evaluation process in combination with technology financing is shown in the next figure.

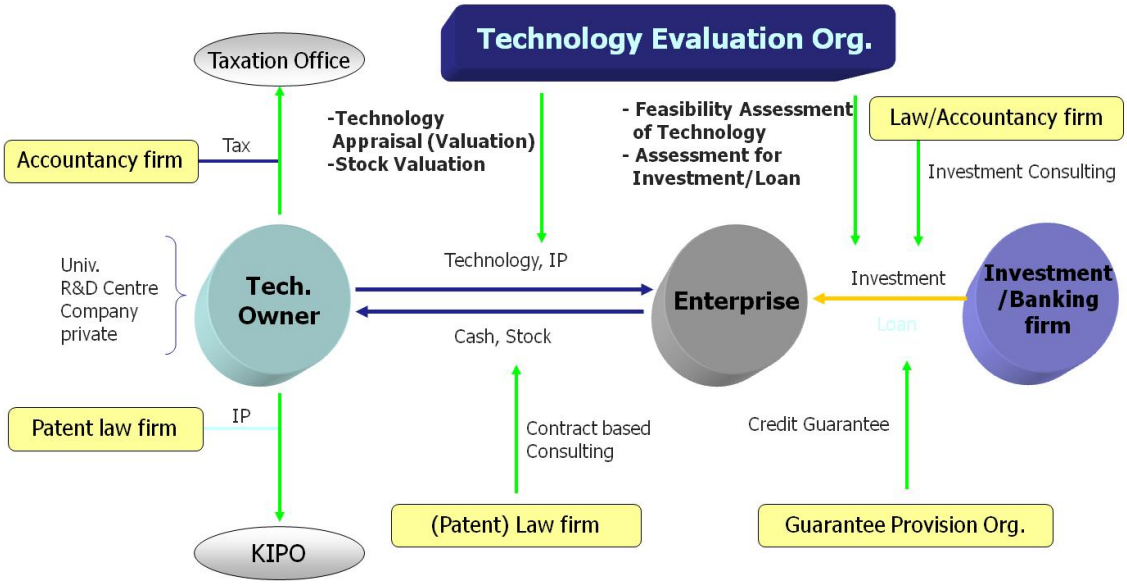


Fig 19 Technology (IP) evaluation and financing processes

6. Technology Evaluation (TE) Systems

6.1. Precursors for embedding TE

In order to implement technology evaluation system successfully, there are various pre-requisite to be satisfied. Most of all, willingness of government to implement such system is important. The embedding process of the system requires consensus among the different interest groups. It is essential that they mutually need such system. Such demand can be increased spontaneously or intentionally by government. Government might need to solve the conflict between the interest groups. Even after forming such consensus, sufficient human resources to be devoted to such job should be found.

It should be reminded that the candidate system and related policies need to be in harmony with practical status. This applies not only TE related policies but also all the other policy making. Since TE system essentially can be regarded as regulation or guideline for the evaluator, the new system also needs to be in accord with or embrace previous system if any. The following table which made in UK can be useful general guidelines for making new system.

Measuring Regulations Against the Five Principles of Good Regulation (UK)

TRANSPARENCY

• The case for a regulation should be clearly made and the purpose clearly communicated
• Proper consultation should take place before creating and implementing a regulation
• Penalties for non-compliance should be clearly spelt out
• Regulations should be simple and clear and come with guidance in plain English

Those being regulated should be made aware of their obligations and given support and time to comply by the enforcing of authorities with examples of methods of compliance

ACCOUNTABILITY

• Regulators and enforcers should be clearly accountable to government and citizens and to parliaments and assemblies
• Those being regulated must understand their responsibility for their actions
• There should be a well-publicised, accessible, fair and efficient appeals procedure

Enforcers should be given the powers to be effective but fair

PROPORTIONALITY

• Any enforcement action (i.e. inspection, sanctions etc.) should be in proportion to the risk, with penalties proportionate to the harm done
• Compliance should be affordable to those regulated-regulators should 'think small first'

Alternatives to state regulation should be fully considered, as they might be more effective and cheaper to apply

CONSISTENCY

• New regulations should be consistent with existing regulations
• Departmental regulators should be consistent with each other
• Enforcement agencies should apply regulations consistently across the country
• Regulations should be compatible with international trade rules, EC law and competition policy

EC Directives, once agreed, should be consistently applied across the Union and transposed without 'gold-plating'.

TARGETING

• Regulations should be aimed at the problem and avoid a scattergun approach
• Where possible, a goals-based approach should be used, with enforcers and those being regulated given flexibility in deciding how best to achieve clear, unambiguous targets
• Regulations should be reviewed from time to time to test whether they are still necessary and effective. If not, they should be modified or eliminated
• Where regulation disproportionately affects small businesses, the state should consider support options for those who are disadvantaged, including direct compensation

Source: extracted from Principles of Good Regulation published by the UK Better Regulation Task Force.

6.2. Required Resources (Standardization and reliability)

Standardization is crucial for the successful implementation of technology evaluation system, since it is closely connected to diversity, simplicity and universality and thus reliability. Most of all, the necessity of the introduction of technology field, industry classification and SME or/and start-up categories should be reminded. Without this process, the effort to understand major driving forces and hurdles for technology-based business to create value-added cannot be performed systematically.

The standard can be different based upon each county's situation. In the case of Korea, Start-up category refers the firm within 3 years after establishment (This category has been changed to 5 years in 2006). SMEs are divided into medium enterprises and small enterprises according to the number of constant workers and the volume of capital and sale. (General Criteria (Article 2 of Framework Act on SMEs and Article 3 of Enforcement Decree of the Act)

Table 14 SME criteria in Korea

Sector	SMEs		Small Business	Micro-enterprises
	No. of Workers	Capital & Sales	No. of Workers	
Manufacturing	Less than 300	Capital worth $8M or less	Less than 50	Less than 10
Mining, construction and transportation	Less than 300	Capital worth $8M or less	Less than 50	Less than 10
Large general retail stores, hotel, recreational condominium operation, communications, information processing and other computer-related industries, engineering service, hospital and broadcasting	Less than 300	Sales worth $30M or less	Less than 10	Less than 5

Seed and seedling production, fishing, electrical, gas and waterworks, medical and orthopaedic products, wholesales, fuel and related products wholesales, mail order sale, door-to-door sale, tour agency, warehouses and transportation-related service, professional, science and technology service, business support service, movie, amusement and them park operation	Less than 200	Sales worth $20M or less	Less than 10	Less than 5
Wholesale and product intermediation, machinery equipment rent for industrial use, R&D for natural science, public performance, news provision, botanical garden, zoo and natural parks, waste water treatment, waste disposal and cleaning related service	Less than 100	Sales $10M or less	Less than 10	Less than 5
Other sectors		Sales worth $5M or less	Less than 10	Less than 5

* For micro-enterprises, Article 2 of the Act of Special Measures on Assisting Small Business and Micro-enterprises shall apply.

For many countries, the standards for the industry sector and SME criteria are already set. But, it should be noted that there are not many developing counties which have a nationwide standard or compatible for technology field. It is true that different KPIs or sometimes even different TE system might be required for the different technology field, since it is natural that no one would think that the attribute of BT is identical to IT.

7. Policy Matters

The technology evaluation system is not solely related to policy making process, since it is closely linked with financing and SME policies. In other words, TE related policies should be considered after setting up the other policies such as financing. For example, depending on the direction of financing policies, the matching evaluation system can be greatly differs.

In spite of this situation, the policy makers are supposed to have basic knowledge on followings to facilitate the TE setup process when it is necessary:

- Understand the role of “technology evaluation” for “technology financing”
- Understand the necessity of technology and industry classification
- Understand major driving forces and hurdles for technology-based business to create value-added in each technology area and industry sector
- Understand required resources to implement each type of “technology evaluation”
- Learn how these systems are applied in various areas (such as investment, loan, technology transfer, corporate analysis etc)
- Understand “technology” as an intangible assets in corporate
- Understanding the role of technologies in creating value-added
- Identify the various factors which make technologies into business
- Learn the origination and background of “technology evaluation”
- Understand the connection between evaluation for corporate and for technology
- Learn different types of technology evaluation methodologies (such as “assessment or rating” and “valuation”) and their practical applications

For the objectives shown above, the recommended solution would be dependent upon individual economy’s status (such as geography, resources and main industry sector etc), it is noted that the case studies shown are no more than reference. Although there is no absolute answer, the solution seeking process itself is still important, since the arbitrary establishment of this basic concept on their own may induce confusion which results in failure in applying policies. Each economy should set up its own industry classification as well as technology classification. Since technology evaluation requires standardisation eventually, the pre-requisite status can make large effect on the evaluation system implementation However, the plausibility can be tested upon a couple of institutions first, such as the business incubator, without great effort. This kind of attempts has been made successfully elsewhere.

8. Discussions

8.1. Implications and Suggestions

The discussion agenda are not limited to certain topics and opened to any related matters. Some of the examples would be (1) What are the main issues concerning this subject in participating member economies? (2) Why should government care about technology evaluation? (3) What are the initial areas where this subject can be applied in each participating countries? (4) What are practical limitations and/or problems which should be

considered? and (5) Are there any chances of building up international cooperation or assistantship?

8.2. Key Factors Measuring Successful Implementation of Technology Evaluation

Technology evaluation as a business feasibility measurement is not just mentioning technology level measurement. This consists of measurements not only for technology status, but also for market status where the designated technology would be applied. In addition, corporate credit including the integrity of financial transactions would be very important in terms of mid- or long-term growth of corporate.

Understanding the relationship between “technology evaluation” and “technology financing” is crucial. It is then possible to define the role of the “technology evaluation” system according to market demand, which facilitate design process of the system in more practical way. As mentioned earlier, it should be noted that “technology evaluation” in this subject is concerned with government policy. This suggests that the system should reflect the philosophy of each economy’s science and technology roadmap (or strategy). On the other hand, since this system is used for financial support distribution which is related to budget management, risk management function should be considered at the same time.

In order to implement technology evaluation system effectively, the followings need to be considered. First, defining who will be the user for technology evaluation result. This can be done through investigating whether there has been existing demand for the system, by judging the possibility to create new demand after the system is implemented, and/or by estimating practical possibility for government to persuade potential users to participate. Second, designing the proper system depending on various financing schemes. The major interest of debt financing and equity financing are completely different. Therefore it is a natural thing, to design different system in accordance with different type of financing. One of the major reasons for previous failures in adopting evaluation system is because the system for debt financing has often been confused with the one for equity financing. Third, the identification of the required resources to build up and administering the system needs to be performed. To guarantee fairness and expertise, independent legislation, budget, organisation may be required. Fourth, it is necessary to ensure repeatability and reproducibility is key issue for successful implementation of the system. Standardisation process can be helpful. The proposed technology evaluation system needs to have attributes which described in the figure shown in below.

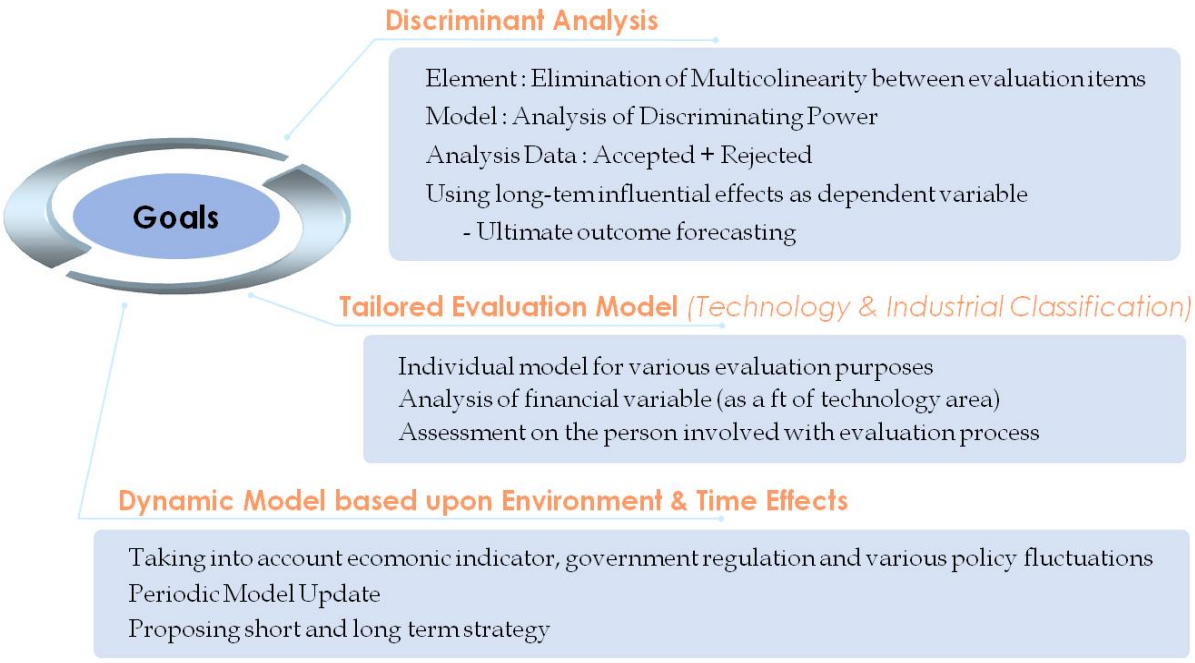


Fig 20 Proposed Technology Evaluation Model

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