

**FINANCIAL NEEDS FOR DEVELOPMENT OF SCIENCE
AND TECHNOLOGY ENTERPRISES:
MERGENCE OF VARIOUS RESOURCES**

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Abstract:

Science and technology enterprises (S&T enterprises) are considered a new form of producing forces [3] which is a channel for technology transfer, an address for accommodation and adaptation of advanced technologies from overseas sources. Also, S&T enterprises create new jobs and make greater contributions to economic development. In this optics, S&T enterprises have been the object of interests of many policy makers and researchers. The development of this form of enterprises, however, depends on many factors, particularly the financial ones. This paper is focused on the financial needs for development of S&T enterprises in various stages of development cycles of S&T enterprises.

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1. Conceptual aspects of science and technology enterprises

Recently there exists numerous concepts used to define the so-called S&T enterprises. For example, they could be: new technology based enterprises (*Autio, 1997, 1998; Fontes & Coombs, 2001*); small - medium size new technology based enterprises (*Dahlstrand, 1999*); technology intensive small size enterprises (*Keeble et al., 1998*); high tech small - medium size enterprises (*Oakey, 1991*); new type of enterprises developing new products on basis of knowledge and presenting high competences in natural science - technical science units (*Candi & Saemundsson, 2011*); new and small size R&D based enterprises (*Maine et al., 2010*). In addition to them, some researchers note a concept of indicators to present development cycles of enterprises (which may be 3, 5, 8,.. years or more). Some research works use the rate factor of R&D staffs to the total staffs of enterprises (which may be namely about 30%).

It is possible to say that the main idea of the new concepts of S&T enterprises is focused on some key aspects, namely: enterprises of this new type which are new, independent small - medium size are based on new

knowledge and intensive use of technologies [8]. The most focus of attention would be paid to the concept of being “new” which has numerous ways of interpretation. Some researchers use this concept to emphasize on the technology newness (*Fontes & Coombs, 2001*) or simply to adjust it to the concept of “being newly established” (*Rickne & Jacobsson, 1999*). Majority of research works use the term of “new” to indicate the status of “being newly established” or the “newness” of used technologies.

As it is, this way of interpretation of S&T enterprises leads to a new and popular type of “*spin-off/spin-out*”, knowledge (new science-high tech) based enterprises (which can be small - medium size and independent). Founders of this type of S&T enterprises are, as rules, scientists with entrepreneurship minds. They hold technologies which permit them to create new products or services of high growth potentials.

On basis of the above notes by numerous researchers, this paper makes a study of S&T enterprises as small - medium enterprises (SMEs). *First*, products and services of these enterprises are mainly based on application of S&T knowledge or skills. In this aspect, the application may be a novel use of advanced technologies or an innovative use of known technologies to make fully new products or services. *Second*, these enterprises conduct their activities where technological application is the main component for their competitiveness.

2. Internal risks of science and technology enterprises on financial aspects

The nature and the sources of finances of S&T enterprises vary during the whole life cycle of their development. Financial needs of S&T enterprises and difficulties they face with during access to financial sources change in various stages of development [4]. But, why do S&T enterprises experience different financial needs in different stages of their development? The following presentation provides some interpretations of researchers for this question.

Rivaud-Danset [7] pretends that, in initial stages, the uncertainty appears in the possibility to transfer from an idea or hypothesis to designing works or prototype fabrication. In the next stages, the risks come from reactions of potential customers and the gap between the growth speed of expected markets and real markets.

A study of the Bank of England on financial problems of S&T enterprises [4] makes a conclusion that S&T enterprises really face to bigger financial difficulties than SMEs do. Here, the researchers think that, despite their faster growth, S&T enterprises, experience a bigger problem of financial

lacks, if being compared to SMEs. As interpretation for this situation, the authors propose the following reasons: i) Higher risks; ii) Lower management skills and business capacities of owners or founders of S&T enterprises; iii) More difficulties in evaluation of potentials of a product or service; iv) Shorter life-time of products and services; v) Higher uncertainty in application of results of R&D activities.

Studies of Delapierre, M. *et al.* [5] deal with the behaviors of banks. They make a list of arguments by banks for their attitude toward investments for S&T enterprises, namely: i) banks lack their professionalism in consideration of financial needs of S&T enterprises; ii) bank officers, when making consideration and appraisal of projects from S&T enterprises, always pretend that their works consume more time and bring back less benefits than other investment projects.

In a research by Chamanski and Waagø [6], some elements which prevent S&T enterprises from development were presented. They deal with risks the S&T enterprises face, namely: i) Risks related to application of new technologies due to their uncertainty. Here, we need to note not only the uncertainties of novel technologies but also the unconformity of new technologies and existing ones. More actually speaking, the more complex technologies are, the more risky they are for implementation by enterprises; ii) Higher investment level for new technologies and longer time they get to market. The authors note that, for application of new technologies, S&T enterprises need bigger investment sources and longer time to produce certain profits; iii) The scale of potential markets is not evaluated fully for application of new technologies, products and services.

In summary, through interpretation by numerous researchers, we can see the main reasons of internal risks of S&T enterprises, namely: complexity of technologies, intangibility of assets and unpredictability of capital cycles. S&T enterprises have high potentials for growth but face high uncertainty.

3. Specific aspects of financial needs of science and technology enterprises

It is possible to say the financial needs of S&T enterprises have specific aspects which are very different from the ones of ordinary business-production enterprises in the whole life cycle of their activities. In every stage of development, S&T enterprises have different financial needs. Figure 1 shows an illustration of financial needs of S&T enterprises in various stages of development cycles of S&T enterprises [8].

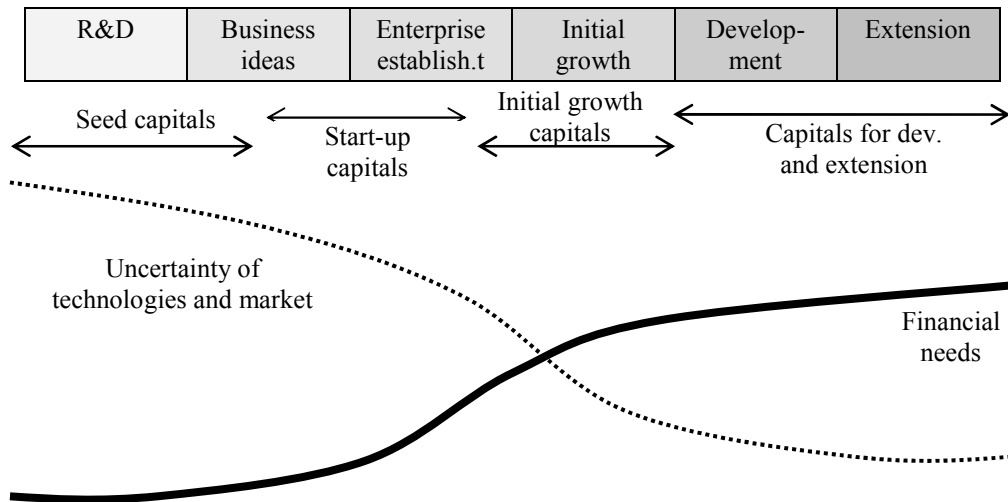


Figure 1. Financial needs of S&T enterprises through various stage of development life cycles

Similarly to other ordinary enterprises, S&T enterprises, in global, pass 4 main stages in their process of establishment and development, namely: incubation (including R&D, set-up of business concepts), establishment, initial growth, development and extension. In every stage, they have different financial needs to meet their specific objectives. Table 1 demonstrates them clearly.

Table 1. Development stages and specific financial needs

Development stages	Financial needs
Incubation	Finances for R&D activities and evaluation of initial business concepts and ideas.
Establishment	Finances for establishment of enterprises and initial marketing activities.
Initial growths	Finances for initial production/service and sales activities.
Development and extension	Finances for development of production/business capacities, extension of production/business capacities and markets.

Source: Bank of England, 1996

There exist, however, some differences in financial needs of ordinary enterprises and S&T enterprises in every development stage: i) Costs in the stage of incubation and initial growth of S&T enterprises, because of complexity of their nature, are different from the ones of ordinary enterprises; ii) Higher risk levels and longer time of development lead to specific financial sources which would come from venture funds and government supports; iii) The development level of S&T enterprises is

subject not only to the approaching concepts they apply to financial sources but also various factors such as types of products/services, types of markets, growth priority objectives, and management skills and capacities.

In this optics, S&T enterprises do not compulsorily need more than ordinary enterprises may do. S&T enterprises have specific financial needs for their specific products/services and high growth rate. The best illustration for this case comes from the financial needs from venture funds for bio-technology enterprises which experience a longer time from the identification of products up to the market introduction of products. The counter-case is the one of software enterprises which have a very short time for product fabrication and a very fast time for turnover collection. Therefore, almost all the S&T enterprises need to have diversified capital sources including venture funds crucially important in initial stages and special sources of loans for next stages.

4. Venture capitals and their roles for science and technology enterprises

4.1. Concepts of venture capitals

Researchers commonly agreed that the era of venture capitals started in 1946 when Doriot G. and his associates established AR&D (*American Research & Development*) which was an organization specially making investments in intransferable securities for enterprises in their initial stages. According to Doriot G. and his associates, the activities of investment by AR&D include:

- New technologies, new marketing methods and their applicability for new products;
- Involvement of investors in management process of enterprises;
- Venture investments focused on individuals with outstanding capacities and highly systematic minds;
- Products/processes which at least had passed trial stages and are under protection by patents for inventions or trade secrets.
- Evidence of potential growths within a couple of years with highly promising chances of benefit generation;
- Chances where venture investors can make non-cash contributions but added values.

The initiatives by Doriot G. opened the way for promotion of venture capitals. What are, then, the venture capitals?

The venture capitals, in the most regular meaning, can be interpreted as investments for shares which require the patience and acceptance of high risks in highly innovative start-ups or fast growth potential enterprises. The most crucial element for venture investment is the entrepreneurship of share holders. The success of investments depends mainly on technological capacities and entrepreneurship of the management team. Venture investors when providing the capitals are ready to accept risks and, at the same time, contribute their management skills, competences and experiences which are highly required for fast growth of potential business.

The traditional way of capital funding is not very suitable for innovative and audacious enterprises. This type of enterprises, from one side, usually is not enough tangible sources for mortgage and, from another side, does not accumulate enough business success, even does not start yet real business activities, to convince finance providers. For that reason, majority of enterprises of this type look for supports initially from their families, friends and supporters who accept risks from newly established enterprises.

Experts in field of venture capitals, in majority of cases, are also risk managers. Every year they do evaluations of numerous business plans and venture capitals for promising projects, particularly the ones of new and high tech based enterprises. Venture companies and fund providers have, of course, certain roles in operation of Boards of Management of enterprises they make investments for. From their side, venture companies and fund providers mobilize capitals from the network of financial institutions such as insurance companies, banks and even from venture investors.

4.2. Particularities of venture capitals

The venture capital model is a new type of models which are accompanied with the following particularities.

a, High level of risks

Venture investors make their financial provision for new enterprises which cannot provide credibility and tangible evidence of capacities in practice. Traditional financial institutions, as rules, do not pay attention to this type of enterprises. Instead of loan offering, they provide capitals to hold certain shares in these enterprises and they hope to get huge benefits in case of success. It is in fact a great stake of capital providers. In order to control the uncertainty of their investments, venture capital providers usually examine carefully proposals, business plans and keep active roles in management of the enterprises they provide funds for.

b, High level of innovations

Venture investors keep searching and developing S&T based business plans which are oriented to create new products and services, to enhance productivity, to raise life quality, to create more jobs, to improve economic growth and to develop international competing capacities. Venture capital sources play very important roles for innovations which are seen clearly in many sectors of high techs. Enterprises supported by venture capitals gain very fast the leading positions. Here the fields of high techs include information technologies, software technologies, bio technologies, new material technologies, automation and others.

c, High added values

Venture capital providers offer also non-financial supports for S&T based enterprises through their active involvement and consultation for management. They have rich experiences and large connections which can help enterprises in many aspects including legal consultation, protection of IP rights, accounting services, techniques, marketing and other types of support services. All of these supports create very attractive added values for venture capitals and facilitate successes.

d, High strategic visions of investment moves

Venture investments require high strategic visions. Starting businessmen make contacts with venture investors and try to convince them through presentation of technological ideas and business plans. The visions of venture investors is shown through their evaluation of these business plans on basis of originality of proposed products and technologies, analysis of market potentials (scale, competition elements) and marketing strategies. The sensibility of the group of businessmen in quantitative assessment of enterprises is the most crucial element in this assessment process which permits venture investors to put down their moneys and then expect the wanted return rate [1].

Then, the venture investments have specific particularities different from business guarantors, angel investors and traditional loan providers.

4.3. Roles of venture capitals to S&T enterprises

While considering difficulties of S&T enterprises in their access to traditional sources of loans, policy makers and authorities note that the model of venture investments is suitable for S&T enterprises, particularly in their initial stages of life cycles.

Experiences show that, for majority of SMEs, bank financial sources, under schemes of loans, are the most important external sources of finances.

However, for S&T enterprises, bank loans can meet only partially financial needs in certain stages of their life cycles (namely the last stages) because bank loans can meet only short term financial needs (for example, operational costs) [2].

5. Investment and financial incentives from the Government

5.1. Limited aspects of private venture capitals. Roles of the Government

Whether the sources of venture capitals are absolutely good and reasonable for S&T enterprises? For enterprises in field of high techs with high speed of growth, this system, of course, is naturally perfect sources. But what would be for start-ups, in initial stages, with their different technological ideas and business plans? The most important point for venture investors is expected benefits or potential increase of their shares of ownership in enterprises. In ordinary cases, businessmen, paying attention to increase of their capital contribution, get attracted by potential benefits, long term stability and close links with enterprises. But, venture investors, when keeping their shares in hands, will keep their positions and attachment up to the time the enterprises bring back great benefits or bankruptcy. During this time period, venture investors usually put down their requirements towards management, organizational and personnel structure of enterprises.

In addition to that, while technological innovations being supported by venture capitals can push up technological progress, they may lead to unbalanced distribution of resources. The short term focus on increase of loans and benefits means that enterprises, with their share packages, can be posted on securities market without having enough time for development. Businessmen find themselves under pressure to sell early shares to permit venture investors to take back fast their invested capitals. The existence of business environment in all kinds of trends of globalization, under pressure from venture investments, gives some stimulation to staffs to move to other jobs or to open new enterprises. This reduces loyalty of staffs and disturbs seriously many R&D projects under implementation. These trends distract also researchers from their research works and they, if not rectified, in final account would cause serious impacts to universities and research institutes.

Therefore it is required to design programs encouraged and invested by the Government in order to cover the misbalance in financial market caused by the stressing needs of capitals of S&T enterprises. It is particularly important for the countries where the securities market is not developed yet.

5.2. Programs directly invested by the Government/Programs of loans

The Government can set up venture funds under State ownership for investment in enterprises (possibly, in joint venture companies). These investments by the Government are to assist S&T enterprises in incubation stage where risks are high. It could be a kick-off to attract private capital sources and to create self-sustaining capacities. Programs oriented to incubate S&T enterprises would maximize the involvement of private sectors. At the same time, these funds can provide S&T enterprises with capital supports in long term vision of potentials which do not yet correctly evaluated by private capital sources.

The Government can also offer programs of loans to S&T enterprises. Generally, this source of loans play only supplementary roles when other capital sources are not available yet. Supports from these loans can be seen through:

- Preferential interest rates;
- Longer term of loans;
- Schemes of grants (to be applied in case of justified failure of projects).

These measures are quite supportive for S&T enterprises during their initial stages when activities could not bring back fast benefits and, then, they find difficult to re-pay loans and interests. This issue should be considered reasonably when the payment terms are determined [2].

5.3. Credit guarantees/Share guarantees

Higher risks of S&T enterprises are the main reasons limiting their access to sources of loans and credits. In addition, S&T enterprises do not have much tangible assets to be mortgages for bank loans. Therefore, many countries set up special schemes of credit guarantees as measures to facilitate access to loans. It is preferentially applicable for S&T enterprises and innovative enterprises. The central element of these schemes is the possibility to transfer some of risks or loans to public sector. Main objectives of these programs are to encourage financial institutions to provide capitals to innovative enterprises which have promising potential projects but cannot meet demands of mortgages. The guarantees from the Government can play alternative solutions to meet demands of mortgages. The two main parameters of programs of credit guarantees are the guarantors and the guarantee fees. Government authorities need to balance carefully these parameters to keep the right address of provided guarantees and to maintain the financial sustainability of programs.

In addition to credit guarantees, some countries apply programs of share guarantees for S&T enterprises. This would cover partially worries of investors in their investments for high risk projects/programs.

5.4. Incentive taxations

Taxation is the effective tool which is used by many countries as incentive measures for knowledge intensive enterprises, R&D institutions and, particularly, S&T enterprises. They may be reduction and/or exemption of taxes. In addition, some countries have incentive taxation measures for investments of private sources in S&T enterprises. Tax exempted part of incomes can be applied for the total invested capitals (incentives for inputs) or the cash transferable interests (incentives for outputs). Incentives for inputs can encourage investments while incentives for outputs are preferentially applied for successful investments.

6. Other types of financial supports for S&T enterprises

They are mainly the financial sources of founders of enterprises, their families and friends. They are found extremely important for S&T enterprises, particularly in incubation stage. Experiences from many developed nations always show that majority of S&T enterprises make their starts from financial sources of founders, their families and friends.

Capitals from *business angels* or non-official shares are recognized as sources of share capitals to support S&T enterprises. This scheme of capital contributions is to encourage *business angels* to search investment chances and to offer more financial sources for entrepreneurship-minded scientists when the latter have plans to set up enterprises.

Commercial banks are also financial sources for S&T enterprises. As noted above, S&T enterprises face most difficulties in access to commercial banks in initial stages. Some studies show also the reluctance of commercial banks in their offers of capitals for high tech based S&T enterprises in their early stages. However, commercial banks remain the most important external financial sources for S&T enterprises in late stages of development cycles.

There also exist other forms of supports such as the ones from mother organizations. They may be investments of mother organizations for their newly established S&T enterprises in related sectors (such as investments for projects, technical contribution or co-ownerships, organizational and management activities). Non-financial funds are also sources of supports for S&T enterprises.

7. Conclusions

As demonstrated above, in various stages S&T enterprises may have different financial needs. They would identify adequate financial channels for best development. In initial stages (incubation and establishment of enterprises) the risks are very high and then the most suitable financial channels are their own capitals or the ones of families, friends, business angels and venture investment funds. In early development stage, when risks are reduced already, the suitable financial sources may come from investment funds and support programs. In the last stages (development and extension), when the risks become low, the suitable channels for financial supports are commercial banks and ordinary investors. On basis of financial needs and availability of suitable financial channels, developers of S&T enterprises and policy makers for development of S&T enterprises would set up adequate strategies to secure the best development of this type of enterprises./.

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