

Technology auditing and risk management of technology incubators/science parks

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Abstract

Purpose – The purpose of this paper is to discuss the application of risk management and auditing to technology incubators/science parks. The proposed audit plan focusses on the risk assessment using the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework.

Design/methodology/approach – The risk-based audit plan for auditing and managing the risks associated with the operation of technology incubators/science parks is based on the application of the COSO framework.

Findings – The proposed audit plan and performance analysis as a result of COSO application can be used as a risk management tool to improve effective operation of the incubator programmes.

Originality/value – The paper addresses the challenges of new auditing approach. In particular, the study applies the COSO framework to manage the risks of technology incubators/science parks which would help fill the gap in technology auditing. The audit plan and the performance analysis tool provide a new approach to assist R&D managers in performing risk assessments across various aspects of incubation operation.

Keywords Risk management, Committee of Sponsoring Organizations of the Treadway Commission (COSO), Science parks, Technology auditing, Technology incubators

Paper type Technical paper

1. Introduction

Technology incubators and science parks play an important role to support economic growth and sustainable development. Policy makers around the world establish them to improve innovation commercialization, a path to improve national innovative capacity. The objective of this paper is to apply the Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework to reduce the high risk nature of technology start-ups. Given the theories of risk management and technology management have been conceptualized widely independent from each other, this study therefore attempts to integrate the theories into practice. That is to say, the paper attempts to bridge risk management approach to technology start-ups. In particular, it discusses the application of the COSO framework from the literature to design effective auditing for improving the performance of technology incubators/science parks. It is argued that the proposed audit plan and performance analysis can be used as a risk management tool to enhance operation of the technology incubation programmes.

The structure of this paper is as follows. Section 2 reviews the concept of technology incubators, the COSO framework as well as the auditing approach. Section 3 discusses the risk management and auditing of technology incubators/science parks. It also sketches the audit plan focussed on the risk assessment using the COSO framework. Section 4 provides the performance analysis tool to help perform risk assessments across various aspects of incubation operation. Conclusions and recommendations are drawn in Section 5.



2. Theoretical framework

2.1 Technology incubators

Technology incubator is a kind of infrastructure playing a critical role of supporting and nurturing small and medium-sized enterprises and entrepreneurial development (Barrow, 2001;

Wonglimpiyarat, 2014; Pauwels *et al.*, 2016). The incubator programme provides business assistance to firms in the early stages of development to increase firm survival rates. The characteristics of technology incubators are shown in Table I. The incubators provide value-added services such as laboratories and equipment, management and technical support, legal advice and networking to incubating companies (Organisation for Economic Co-operation and Development (OECD), 1997, 2010, 2015). The incubator resources could help young entrepreneurial firms access new knowledge, expertise and industrial networks (Barrow, 2001; Rothschild and Darr, 2005). By increasing access to financial resources, the business incubation programme assists in the process of technology commercialization, leading to new job creation and wealth of nation (Lewrick *et al.*, 2011; Wonglimpiyarat, 2014).

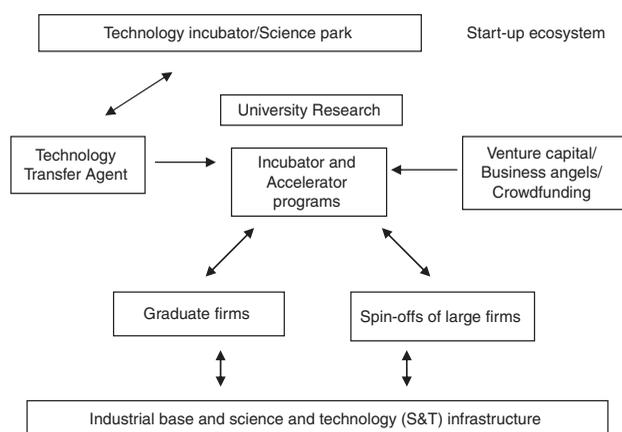
Technology incubator functions as a part of the ecosystem to foster entrepreneurship and sustainable economic development. Technology incubators are generally known under various names such as research transitional labs, innovation centres, science parks, accelerators, technology centres, venture labs and company builders. Figure 1 demonstrates a schematic presentation of technology incubator/science park. Given the high risks associated with the formation of new enterprises, many governments

| Host institution | University | Research facilities | Production facilities | Technology transfer office | Park facilities | Incubator | Venture capital |
|----------------------------|------------|---------------------|-----------------------|----------------------------|-----------------|-----------|-----------------|
| Science and research parks | X | X | o | X | X | X | o |
| Innovation centre | o | o | X | X | o | X | o |
| Technology park | X | X | X | X | X | X | X |

Notes: X, essential feature of technology incubator; o, desirable feature of technology incubator

Source: The Working Group on Innovation and Technology Policy (TIP) of the OECD Committee for Scientific and Technological Policy (CSTP)

Table I. Characteristics of technology incubators



Source: The author's design, adapted from OECD (1997, 2010, 2015)

Figure 1. Schematic presentation of technology incubator/ science park

attempt to use technology incubator/science park as a vehicle for linking technology, entrepreneurs, small and large firms and sources of capital to support technology development and commercialization (OECD, 1997, 2010, 2015; Lofsten and Lindelof, 2005; McAdam and McAdam, 2008; Wonglimpiyarat, 2010; Murthy, 2012; Khan, 2013; Pauwels *et al.*, 2016).

2.2 COSO framework

The important role of business incubator in the ecosystem challenges the model of performance measurement. Interestingly, the performance of business incubators can be assessed in various dimensions. From the literature review, the indicators of incubator performance are, for example, the occupancy rate, the number or proportion of firms graduated, the number of business spin-offs, the number of jobs created, the number of patent applications per firm, etc. (Colombo and Delmastro, 2002; Chan and Lau, 2005; Hackett and Dilts, 2008; Schwartz and Hornych, 2010). In the recent study by Özdemir and Şehitoğlu (2013), risk management is one of the important dimensions to measure the performance of business incubation programmes.

The COSO issued the internal control framework to improve efficiency and effectiveness of enterprise risk management . The COSO integrated framework (Figure 2) consists five components and 17 relevant principles and serves as an integrated guidance on internal control. The 2013 framework components are: control environment; risk assessment; control activities; information and communication; and monitoring.

The COSO Framework 2013 comprises five components and 17 principles as follows:

2.2.1 *Control environment.* The control environment covers the policies, procedures, organization structure and serves as a basis to carry out organization activities.

The control environment comprises principles from one to five as follows:

- (1) the organization demonstrates a commitment to integrity and ethical values;
- (2) the board of directors demonstrates independence from management and exercises oversight of the development and performance of internal control;
- (3) management establishes, with board oversight, structures, reporting lines, and appropriate authorities and responsibilities in the pursuit of objectives;



Source: Internal Control COSO Framework 2013

Figure 2.
The COSO integrated framework

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- (4) the organization demonstrates a commitment to attract, develop, and retain competent individuals in alignment with objectives; and
 - (5) the organization holds individuals accountable for their internal control responsibilities in the pursuit of objectives.

2.2.2 Risk assessment. Risk assessment is the analysis of risks and potential impacts on the achievement of organization goals and objectives.

The risk assessment comprises principles from six to nine as follows:

- (1) the organization specifies objectives with sufficient clarity to enable the identification and assessment of risks relating to objectives;
- (2) the organization identifies risks to the achievement of its objectives across the entity and analyses risks as a basis for determining how the risks should be managed;
- (3) the organization considers the potential for fraud in assessing risks to the achievement of objectives; and
- (4) the organization identifies and assesses changes that could significantly impact the system of internal control.

2.2.3 Control activities. Control activities include control policies and procedures to ensure that the organization actions are effectively carried out to meet its objectives for financial reporting.

The control activities comprise principles from 10 to 12 as follows:

- (1) the organization selects and develops control activities that contribute to the mitigation of risks to the achievement of objectives to acceptable levels;
- (2) the organization selects and develops general control activities over technology to support the achievement of objectives; and
- (3) the organization deploys control activities through policies that establish what is expected and in procedures that put policies into action.

2.2.4 Information and communication. Information and communication provide an information exchange system to assist systematic sharing and dissemination of information across the organization.

The information and communication comprise principles from 13-15 as follows:

- (1) the organization obtains or generates and uses relevant, quality information to support the functioning of internal control;
- (2) the organization internally communicates information, including objectives and responsibilities for internal control, necessary to support the functioning of internal control; and
- (3) the organization communicates with external parties about matters affecting the functioning of internal control.

2.2.5 Monitoring. Monitoring is the process of assessing the adequacy and effectiveness of internal controls underlying the organization's activities.

The monitoring comprises principles 16-17 as follows:

- (1) the organization selects, develops, and performs ongoing and/or separate evaluations to ascertain whether the components of internal control are present and functioning; and
- (2) the organization evaluates and communicates internal control deficiencies in a timely manner to those parties responsible for taking corrective action, including senior management and the board of directors, as appropriate.

2.3 Auditing approach

There is a growing realization for many countries to adopt international accounting standards (IASs) and international financial reporting standards (IFRSs) as these standards would make financial statements comparable and prevent financial instability (Dumontier and Raffournier, 1998; Meall, 2004). The International Federation of Accountants (IFAC) is a key organization influencing the development of global accounting standards. IFAC is an organization serving the global public interest. The mission of IFAC is to strengthen the worldwide accountancy profession and contribute to the development of strong international economies by establishing and promoting adherence to high-quality professional standards. Many governments suggest the use of IAS and IFRS standards to strengthen the financial system and increase market efficiencies (Street *et al.*, 1999; Street and Bryant, 2000; Ball *et al.*, 2003; Brown and Tarca, 2005; Humphrey *et al.*, 2009; Perera and Chand, 2015).

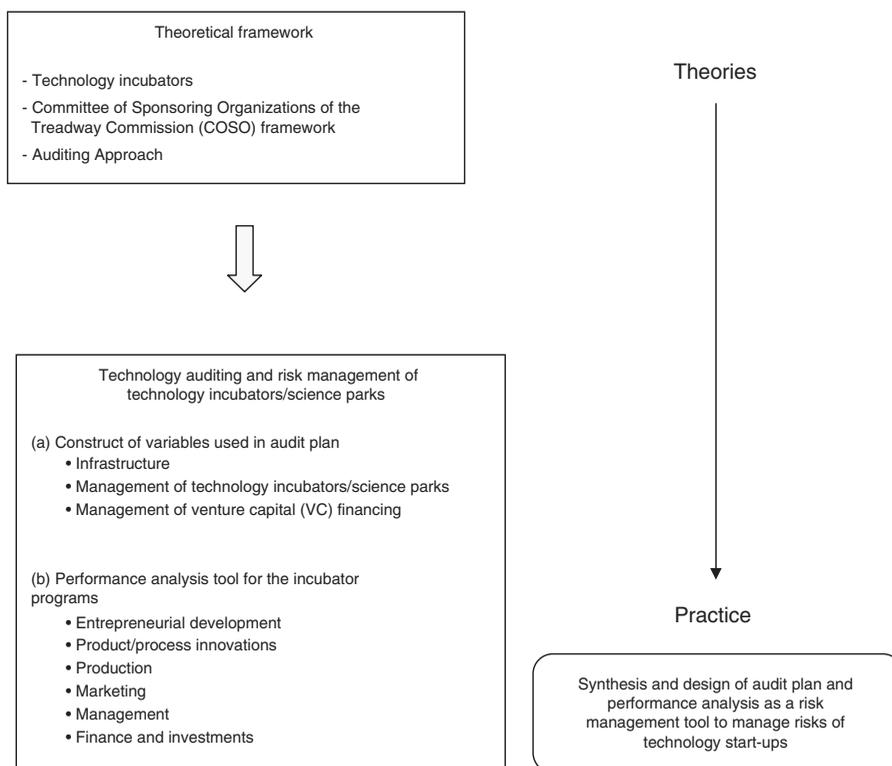
The financial auditing is an audit of the financial reporting process comprising the annual financial statements, the company's internal controls over the process, and all related financial information. The financial auditing approach can be seen as a standards-surveillance-compliance system to achieve transparency of accounts (Carmichael, 2003; Wade, 2007; Rikhardsson and Dull, 2016). The certified public accountants (CPAs) (with the CPA licensing adaptive to local economic conditions) are authorized under the law to audit and certify the accounts. In financial auditing approach, the responsibility of CPAs is to examine and analyse the accounting and financial records to ensure compliance with accounting standards and applicable laws as well as express an opinion on the financial statements based on the audit. The true and fair view based on the generally accepted accounting principles adopted by the accounting profession aims to achieve the objective of assurance and public expectations so that the investors and users in the world's capital markets can use the audited financial information for making economic decisions (Rutherford, 1985; Wade, 2007).

The tax auditing is an important aspect of financial auditing approach in public finance. The possibility of non-compliance with tax laws and loss of tax revenue are issues of critical interest to tax policy makers and enforcement agencies. Currently, many countries have placed importance on the public concern over issues of tax issues and fraud in economic activities. The government aims to use tax auditing to prevent and suppress tax evasion which would adversely affect the economy. However, the scope of tax auditing tends to have a narrower functional focus of obtaining compliance with existing laws and the Revenue Code (compared to the broader scope of financial auditing to examine the compliance with the Accounting Act, the Companies Act and a number of tax laws). Tax compliance includes the examination of activities relating to tax calculations and evaluating whether they are in line with the firm's audit policy (Cuccia, 1994; Mata and Call, 2010; Bayer and Cowell, 2016).

3. Risk management and auditing of technology incubators/science parks

Before discussing the application of risk management and auditing to technology incubators/science parks, it would be better to first understand the alignment of theories and practice. In order to put a spotlight on the integration of theories and concepts to the analyses and findings, Figure 3 portrays how the theories of technology incubators, COSO framework and auditing approach relate to the synthesis of audit plan and performance analysis proposed to manage risks of technology start-ups.

Technology incubators/science parks are used as the strategy and tool by policy makers around the world to support entrepreneurial development and increase innovative capacity of nation. However, there are no particular standards to assist technology auditing. The traditional audit approach has the limitations for application to auditing of technology incubators/science parks. Based on the COSO framework, the risk-based audit plan is



Source: The author's design

Figure 3.
The integration of theories into practice

designed to address the risks associated with technology incubators/science parks (Table II). It serves as an essential tool to help assess risk and improve security of incubation operation.

4. Performance analysis tool for the incubator programmes

In evaluating and monitoring the performance of technology incubators and science parks, the performance analysis tool as shown below provides a non-exhaustive list of aspects that should be taken into account in auditing. The performance analysis is measured on a scale of 0-5 along the spectrum of activities performed by the technology incubators/science parks. The scale of quantitative measurement would help decrease subjective judgement. Table III provides the detailed aspects of the performance analysis tool which can be used to manage the incubator programmes. The proposed performance analysis tool would provide confidence to determine whether the operation of incubating programmes meets their objectives. The audit areas covered in the performance analysis tool include the following aspects:

- entrepreneurial development;
- product/process innovations;
- production;
- marketing;
- management; and
- finance and investments.

| Technology Incubators/Science Parks | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Risk-based Audit Plan | | |
| 1. Audit objectives | | |
| To examine the operation and performance of technology incubators/science parks in meeting the goals and objectives outlined in the organization strategy. The audit work includes assessment of the program efficiency and effectiveness in line with the organization policy. | | |
| 2. Scope of audit | | |
| The auditing scope includes testing to assess adequacy of internal control designs and operating control effectiveness. | | |
| 3. Auditors assuming the audit responsibilities | | |
| (Internal Audit Department and) | | |
| 4. Period of audit | | |
| (No. of days) | | |
| 5. Budgeted expenses for auditing | | |
| (Budget amount USD) | | |
| 6. Detailed audit plan | Working paper reference | Prepared by/Date |
| 6.1 Infrastructure | | |
| 6.1.1 | Check the period of setting up the incubator programs with a building contract | |
| 6.1.2 | Determine if the developmental milestones of building infrastructure are in line with the action plan | |
| 6.1.3 | Examine, on a test basis, the activities taken to bring the incubator plan into practice | |
| 6.1.4 | Assess and evaluate the continuity of funding to support the operation of technology incubators/science parks (the going concern principle) | |
| 6.1.5 | Examine the overall readiness of infrastructure and facilities to assist incubating companies (e.g. laboratory equipment, computer facilities, etc.) to verify the existence and completeness | |
| 6.1.6 | Examine the structural layout of setting up technology incubators/science parks Organization structure Employment status (directors, managers, employees, workers, staffs, etc.) Status of the specialists working for technology incubators/science parks Sources for recruiting staffs to operate the incubation programs | |
| 6.1.7 | Calculate the breakeven point of technology incubators/science parks (the payback period that would generate excess returns to cover its fixed and variable costs) | |

Table II.
Risk-based audit plan for technology incubators/science parks

(continued)

| <p>6.2 Management of technology incubators/science parks</p> | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <p>6.2.1 Assess the ability of technology incubators/science parks in serving the incubating companies according to the incubation goals</p> | | |
| <p>6.2.2 Analyse the ability of technology incubators/science parks in functioning as innovation enabler/innovation accelerators to support technology-based firms</p> | | |
| <p>6.2.3 Analyse the success of setting up technology incubators/science parks Success in terms of job creation, increased employment, creation of new tech ventures Success in terms of transferring technology from the laboratory to commercialisation The number of technology spin-offs The number of technology patents Success in financial terms (return on investment (ROI), internal rate of return (IRR), economic value added (EVA), etc.)</p> | | |
| <p>6.2.4 Evaluate the efficiency in managing space rented to tenants in the technology incubators/science parks</p> | | |
| <p>6.2.5 Calculate the utilization rate of providing office area and manufacturing space to support start-up businesses Analyse the utilization rate of providing space and incubating services to support in-house projects, spin-off projects and other programs</p> | | |
| <p>6.2.6 Review the residency fees charged to tenants on the basis of reasonableness Rental fee (charged as a fixed rate or variable rates) Other service fees (expenses charged based on the flat rate percentage or variable rate according to the rental area) Consultancy service fees (expenses charged based on the flat rate percentage or variable rate according to the rental area)</p> | | |
| <p>6.2.7 Examine the rules/regulations for approval as an incubating company and assess the basis of incubator's selection criteria to ensure that they are in line with the policy and objectives of technology incubators/science parks</p> | | |
| <p>6.2.8 Examine if the rules/regulations for exiting companies are in line with the policy and objectives of technology incubators/science parks</p> | | |
| <p>6.2.9 Review the actions taken to address risks and uncertainties in operating the technology incubators/science parks</p> | | |
| <p>6.2.10 Assess the effectiveness of establishing collaborative partnership with other organizations at the national and international levels in promoting the process of technology transfer and commercialisation</p> | | |

(continued)

Table II.

| 6.3 Management of venture capital (VC) financing | | | |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| 6.2.11 | Examine the rules of VC financing to ensure that they are in line with the policies of technology incubators/science parks | | |
| 6.2.12 | Review the VC investments if they could finally create new tech ventures, increase exports, make value-added contribution to the industrial sector (evaluation can be performed by computing the aggregate value) | | |
| 6.2.13 | Examine sources of finance for tech ventures (e.g. grants, special rate loans etc.) and determine whether they are in line with the control objectives | | |
| 6.2.14 | Assess the effectiveness of transferring lab results to industry (Assessment can be made using the ratios of VC investments to the total budget) | | |
| 6.2.15 | Review the size of VC-backed finance to ensure that the deals are in line with the policy to support entrepreneurial development | | |
| 6.2.16 | Evaluate efficiency of investments through VC funds and their functions to support high-potential entrepreneurs and SMEs | | |
| 6.2.17 | Evaluate the VC investment ratio by comparing the portion of VC financing with the authorized share capital and determine whether the ratio is in line with the investment policy | | |
| | Prepared by | | |
| | Signature | | |
| | Examined by | | |
| | Signature | | |
| | Approved by | | |
| | Signature | | |

Table II.

Source: The author's design

By scoring the activities of the incubator programmes in details as shown in the graph of Table III, it will help identify the strengths and weaknesses of operation. By combining the risk-based audit plan and performance analysis tool in technology auditing, this form of gap analysis would provide an overall picture to understand which areas need to be improved and which areas perform well. Furthermore, the performance analysis tool can help the management gain insights of relevant risks and potential impacts along the incubator programme activities and plan for the risk management approach effectively.

5. Conclusions and recommendations

Technology incubators and science parks are seen as an important mechanism to foster innovations. Policy makers around the world establish the incubator programmes to promote technology transfer and commercialization – a path to improve technological innovations. This study makes a theoretical contribution to risk management and

| | Scores | | | | | |
|----------------------------------------------------------------------------------------------------------------------|--------|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 |
| 1. Entrepreneurial development | | | | | | |
| (a) Training programs to improve the skills of entrepreneurs | | ○ | | | | |
| (b) Activities to assist entrepreneurs in launching tech ventures | | | ○ | | | |
| (c) ... | | | | ○ | | |
| (d) ... | | ○ | | | | |
| 2. Product/process innovations | | | | | | |
| (a) Product development to increase the customer value | | | | | ○ | |
| (b) Activities to provide knowledge in business start-ups for entrepreneurs | | | | ○ | | |
| (c) Improvement of production process to increase potential for commercialisation | | ○ | | | | |
| (d) ... | | | | | | ○ |
| 3. Production | | | | | | |
| (a) Production improvement in terms of cost reduction, operational efficiency | | ○ | | | | |
| (b) Introduction of innovation to improve the production process | | | ○ | | | |
| (c) Provision of testing services to ensure that product innovations/service innovations meet the industry standards | | | | ○ | | |
| (d) ... | | | | | ○ | |
| 4. Marketing | | | | | | |
| (a) Distribution channels for the marketing of innovations | | | | ○ | | |
| (b) Training to improve skills in distribution and selling | | | | | ○ | |
| (c) Establishment of upstream and downstream industry coordination to support the marketing of innovations | | | | | | ○ |
| (d) ... | | | | | | ○ |
| 5. Management | | | | | | |
| (a) Provision of training on business skills and management to survive under tough market competition | | ○ | | | | |
| (b) Transfer of innovative technologies to the industrial sector | | | ○ | | | |
| (c) ... | | ○ | | | | |
| (d) ... | | | | ○ | | |
| 6. Finance and investments | | | | | | |
| (a) Ability to tap into various sources of finance to support entrepreneurial development in various stages | | | ○ | | | |
| (b) Set up of VC funds to increase economic potential for developing and commercialising innovations | | | | | ○ | |
| (c) Entrepreneurial networks to support the growth of new businesses | | | | ○ | | |
| (d) ... | | | | | | ○ |

Source: The author's design

Table III.
Performance analysis
tool for the incubator
programmes

traditional auditing approaches. The managerial contribution of this study is the design of innovative audit approach to support technology start-ups. The application of risk management and auditing to technology incubators/science parks is based on the COSO framework. The findings help bridge the theory-practice in terms of offering

effective risk management tool to enhance operation of technology incubators/science parks. Specifically, this paper proposes the audit plan and performance analysis tool to assist risk assessments across the aspects of entrepreneurial development, product/process innovations, production, marketing, management as well as finance and investments.

The analyses offer rich insights into the domain of technology audit. Under the rising challenges of technology incubators/science parks in fostering innovations, the proposed audit plan and performance analysis tool can be used as a risk management approach to improve effective operation of the incubator programmes and maximize the success of emerging businesses. The study suggests some thoughts on the direction of future research to improve the effectiveness of auditing approach. Future research should consider applying the Information Technology Infrastructure Library and Control Objectives for Information and Related Technology standards to examine various dimensions covering the policy and operation which would enable technology incubators/science parks to achieve challenging performance objectives.

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Further reading

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