PROMOTING INDUSTRIAL DEVELOPMENT IN ETHIOPIA THROUGH THE ESTABLISHMENT OF TECHNOLOGY BUSINESS INCUBATION

(Case Study on Basic Metal and Engineering Sector)

By

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A thesis Submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Masters of Science in Mechanical Engineering (Industrial Engineering Stream).

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Aberham Genetu

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LIST OF ACRONYMS

BDS	Business Development Services
CSA	Central Statistical Agency
EIA	Ethiopian Investment Agency
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
IP	Intellectual Property
IT	Information Technology
MOST	Ministry of Science and Technology
NBIA	National Business Incubation Association
NGO	Non Governmental Organizations
SME	Small and Micro Enterprises
TBI	Technology Business Incubator
UKBI	United Kingdom Business Incubation
UN	United Nations
VC	Venture Capital
WB	World Bank

ABSTRACT

This thesis deals with the establishment of technology business incubation center focusing on metal and engineering sector. Technology business incubators play an indispensable role for transformation of technological ideas or innovations into commercial products by providing necessary facilities and supports for entrepreneurs. Hence, the principles behind technology incubation center are reviewed from literatures, research papers and web sites. Since every sectors have their own unique facilities requirements in the establishment of technology business incubation, metal and engineering sector is selected as a case study. The sector is at forefront in the realization of industrial lead economy; therefore, the overall impacts of the progress in metal and engineering sector on development endeavor are elaborated. The problems which hinder the technological development of the sector such as insignificant support for technology oriented entrepreneurs, lack of systematic technology transfer mechanism, lack of institution which provides facility and business development services and lack of comprehensible guidelines for the establishment of technology business incubators are identified. The role of technology incubation center establishment as a tool of assisting the technological development of the sector and the prevailing Ethiopian policy environment toward such establishment are discussed.

In order to establish the center the experience and best practices of China, India, Brazil, Korea, Malaysia, South Africa and United States are incorporated. Through adoption of design parameters and procedures from these countries; a model of technology incubation center is proposed with detailed design requirements. Among others, the establishment includes design of services provided, facilities required, financial requirement, organizational structure, entry criteria and exit criteria. Based on the outcomes of benchmarked and many other successful countries, it is concluded that technology business incubation centers are crucial in Ethiopia for the advancement of technology or innovation in basic and metal and engineering sector. Finally recommendations are forwarded to promote technology incubation centers in the country.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Innovative entrepreneurs are increasingly recognized as a critical element in the process of innovation and the creation of technology based firms. However, entrepreneurs face a number of obstacles while they are starting a business. Some of the obstacles are high-fixed and entry costs, lack of access to capital, insufficient technical and market information and weak management skills. As a result, the start-up phase of a small business is associated with considerable uncertainty and new businesses often have a number of problems during this period.

Technology business incubators (TBI) evolved to overcome the aforementioned problems of entrepreneurs and to assist the new venture creation process. They provide an environment where public and private resources can combine to meet the needs of small businesses during their critical stages of development. Since technology business incubator maximizes the success of emerging companies; it subsequently creates jobs, revitalizes communities, commercializes new technology and facilitating economic development (Lalkaka, 2000).

While developed countries have already taken a lead in the development of TBI, a significant number of developing countries have begun the track and are sharing the benefits by generating wealth for their citizen. Even, some African countries have already started the projects of TBI establishment and in some cases they are vigorously promoting the projects.

Both in developed and developing countries, governments have been playing a key role in defining policies, programs and instruments which support the development of TBI. North American incubators assisted more than 27,000 start-up companies that provided full-time employment for more than 100,000 workers and generated annual revenue of more than US$17 billion (NBIA, 2009). China up to 2008 alone set up 670 technology business incubators which generated 18.662 billion Euros and employed 928000 persons. Meanwhile, in India incubated enterprises have generated cumulative revenue about US$125 million by 2009 (Tang et.al., 2010). Similarly, countries such as Korea, Malaysia, Brazil and Turkey

have established a significant number of TBI to assist their economic development endeavor. These TBI centers create most of the big firms which produce technology oriented products in their respective countries and they become technology exporters.

On the other hand, Ethiopia is importing a number of technology products, machineries and electromechanical equipments from the abovementioned countries. Most of manufacturing companies in the country are engaging on the production of consumable items that have insignificant/less technological value (Altenburg, 2010). Industries that might help accumulate technological capabilities and create dynamic inter industry linkages such as chemical, electrical and electronics, metal-processing and other engineering industries are small in numbers. Overall, the technological level of firms is very low (CSA, 2011).

Firm turnover is high in Ethiopia, especially among small firms. Small firms rarely ever grow into a medium-sized segment, reflecting a lack of entrepreneurial and managerial capability. 60% of firms exit in the first three years after entry. This situation reflects that there is a big group of necessity entrepreneurs who start own account activities without any clear business idea and some firms are constrained in their access to credit, land, and product markets (Altenburg, 2010).

Moreover, most research findings of innovators couldn't be commercialized because of lack of supportive environment. Problems of financial constraints, linkage and cooperation with industries and proper research facilities including infrastructure, equipment and supplies are evident (MOST, 2010).

Promotion of competitive knowledge and technology based products for local consumption and export is very crucial. As a result, the country has to provide conducive environment for technology based entrepreneurs. One way of providing assistant for early entrant to technology related business is through the establishment of TBI. In order to set up TBI, it is important to be based on the priority sector of the country. In this regard, the establishment of incubation centers for basic metal and engineering sector plays a significant role. It assists the development of the sector through innovative products, emerging new companies, import substituted products and export of innovation. The total impact of such establishment hastens the industrial development of Ethiopia.

1.2 Problem Statements of the Study

The Ethiopian Government's Micro and Small Enterprises (MSE) development strategy focused on linking MSE's with micro financing institutions and technical and vocational education and training (TVET) schools. While the government is busy in increasing the number of MSEs, many micro and small enterprises remain small for many years and often fail at early stage without even lasting three years in business (Altenburg, 2010). It is impossible to expect competent enterprises, while there are no organized business development services available to give training, consultancy and advisory assistance. Moreover, there is no program or organization that supports innovative entrepreneurs to commercialize their innovative ideas. Such entrepreneurs could not start their own business largely for the lack of adequate supportive infrastructures and services.

Technological incubation centers are facilities equipped in such away to render the necessary support for small scale technology related businesses that can be grown to large scale enterprises. Though, basic metal and engineering sector could play a tremendous role on overall economic development efforts of the country; there is no TBI for the sector. This is evident from the insignificant number of innovation in the sector (Asmamaw and Zelalem, 2010). Generally, the following problems, which call for the establishment of technology incubators that focus on this specific sector, are prevailed.

- ✓ The country imports a number of metal products and equipments which can easily be produced with in the country through technology transfer mechanisms and tools.
- ✓ There is no adequate knowledge transfer mechanism from universities to industries through research and innovative works.
- ✓ No/insignificant support, in any kind, to innovative entrepreneurs that are capable of creating commercial items and own business.
- ✓ There are no comprehensible guidelines and manuals which used to support the establishment of technology incubators.
- ✓ The growth of small scale firms that are in need of special support such as facility and business development services.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of the study is to analyze the prevailing situations toward the establishment of technological incubation center and designing a model of technological incubation center with detailed facilities for basic metal and engineering sector.

1.3.2 Specific Objectives

The specific objectives of the study are:

- ✓ To assess the national policy toward science and technology innovation and incentives.
- ✓ To identify the problems of basic and metal engineering sector from the perspective of technological development.
- ✓ To assess the impacts of technological business incubation on the sector.
- ✓ To assess and take a bench mark of best practices of selected countries, for the establishment of technology incubation center.
- ✓ To develop a model of technological incubation center with detailed facility, financial requirement and governance for innovators focusing on metal and engineering sector.

1.4 Significance of the Study

The study enables to establish a model of technology incubation center for innovators focusing on small scale metal and engineering sector. It includes all necessary parameters for establishment of TBI; as a result it can serve as guideline or manual. Moreover, it can serve as a benchmark for other sectors. It creates awareness on the importance of technology business incubation and their social and economical impacts on the development endeavors. Finally, policy makers and future researchers can use it as an input for exploring the TBI programs.

1.5 Scope of the Study

The study is limited to the establishment of TBI for basic innovative entrepreneurs focusing on metal and engineering sector. The foundry and mechanical shop facility is equipped with traditional machines. Hence the designed facilities are based on traditional metal manufacturing principles and it is not intended for high tech entrepreneurs.

1.6 Research Methodology

Literature Survey: The theoretical principles and foundations of technology incubation center are reviewed from the literatures written by different authors. These literatures include books, research papers, manuals, business plans and feasibility study papers.

Data Collection: Best practices from benchmarked countries are adopted to design the center. These countries are China, India, Brazil, Korea, Malaysia, South Africa and United States. Data of manufacturing industries and levels of manufacturing industries, metalworking industries, are surveyed from electronic documents and libraries. The sources of these surveys are from Ethiopian Statistical Agency and Access Capital Research. However; data used in cost estimations are collected mostly from market survey. The remaining data are collected from Ethiopian Investment Agency and Addis Ababa City Administration Investment Authority.

Interview: The data collected through interview with ministry of science and technology, with the participants of 4^{th} international exhibition on metal and engineering and discussions with professionals related to the topic.

Data Analysis: The descriptive techniques have been adopted for analysis of data. In doing so tables, graphs and percentages are used**.** While proposing the incubation facility, the measurement data is adopted from the benchmarked countries. Microsoft Project software is used for project scheduling and AutoCAD software is used for the design of facility layout.

Result and Discussion: From the adoption of best practices of benchmarked countries a model of incubation center is proposed for metal and engineering sector.

1.7 Organization of the Study

This research paper is organized into six chapters. Chapter one deals with the introduction of the study. Chapter two discusses the theoretical concepts, principles and foundations of technology incubation centers. Chapter three covers the case study. Under this chapter the situation of basic metal and engineering sector, the importance of incubation for the sector and the policy environment is discussed. Chapter four discusses best practices of selected or benchmarked countries. Chapter five covers the designed model of technology incubation center for innovators focusing on metal and engineering sector. The level of the model, the

designed facility, the designed layout, the anticipated financial strategy and the overall administration of the center and strategy for sustainability are included. The last chapter, chapter six contains conclusion and recommendation.

CHAPTER TWO

LITERATURE REVIEW

2. TECHNOLOGY BUSINESS INCUBATORS

2.1 History of Technology Business Incubators

The term business incubator gained popularity in the media between 1999 and 2001; but the business incubation model traces its beginnings to the late 1950s (NBIA, 2009). Every authors and literatures asserted that the first incubator was created by Joseph Mancuso in Batavia, New York in 1959 on a former Massey Ferguson facility (Akcomak, 2009). The Massey Ferguson plant was closed; and after the big plant closings a new economic growth plan was needed (Antoine et.al., 2008). The new plan was incubators and by the late 1980s there were 12 to 15 incubators in the United States (Antoine et.al., 2008; Monkman, 2010).

Starting in the early to mid 1980s, editors of the journal, frontiers of entrepreneurship research, dedicated a session to the subject of business incubation each year at their annual conference. It is from these proceedings that the definition of incubator used by much of the industry began to emerge. In 1985, three papers presented at the conference asserted that an incubator must have a physical plant with below market rents, shared services, logistical support, and business consulting assistance. In the beginning incubators focused primarily on industrial and technical areas (Antoine et.al., 2008). The majority of these incubators served clients ranging over many different industries, prompting the term mixed use incubators (Lewis, 2008).

While the United States was expanding its network of business incubators, other countries around the world began to embrace the concept of business incubation as a viable approach for stimulating, diversifying or even stabilizing local economies (Claggett, 2003). A number of countries, including: the United Kingdom, France, Germany and Italy, adopted technology incubation as a means of promoting job creating innovative enterprises and the commercialization of university research. Several industrializing countries followed suit, and the numbers of technology incubators in some of them grew considerably during the 1980s and 1990s (UN, 2001).

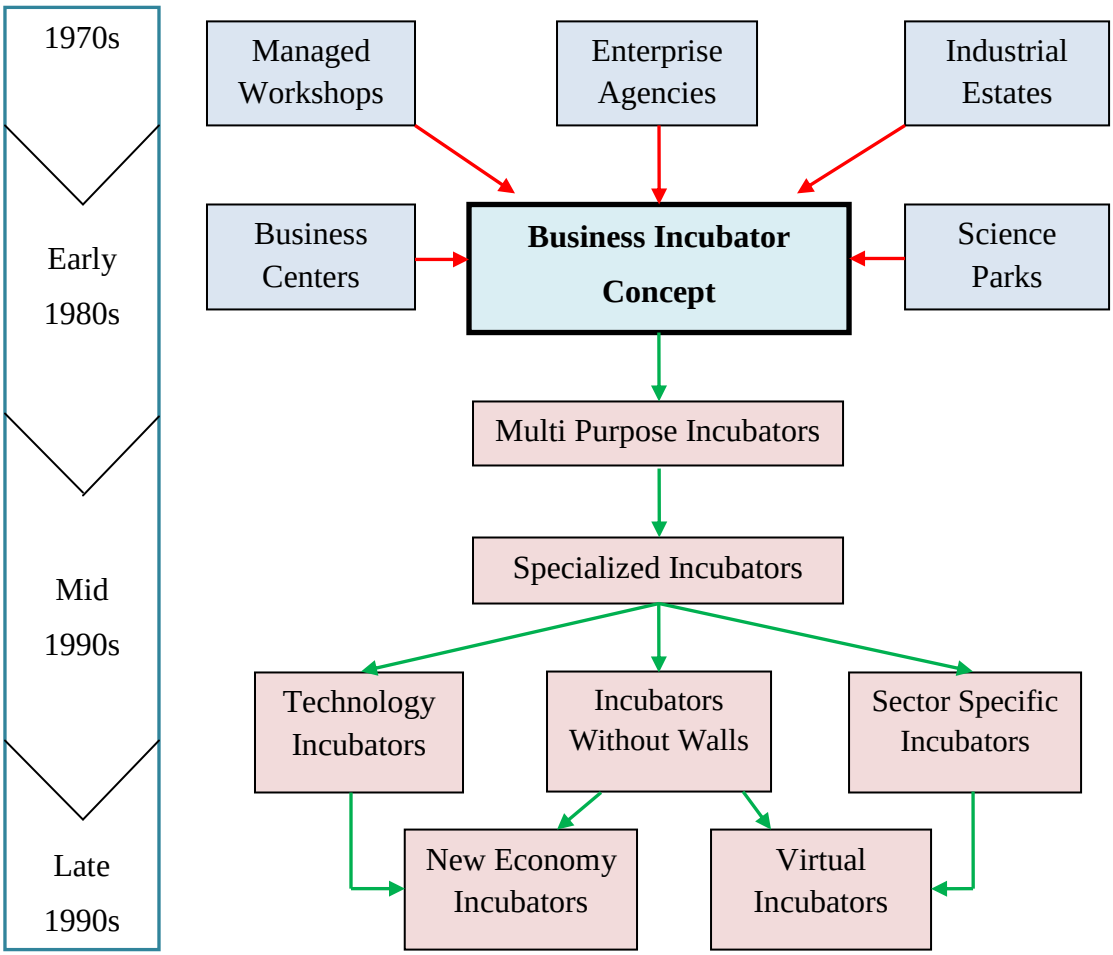

Figure 2.1. Evolution of the business incubators concept (Source: Bizzotto, 2003)

Today there are more than 1100 incubation programs in the United States alone and more than 7000 worldwide (Monkman, 2010). Incubators come in all shapes and sizes, some specializing in a single industrial niche such as biomedical, manufacturing, software development, agriculture and specialty foods, or even retail (Lewis, 2008). The development of the new high tech economy stimulated the growth and led to the creation of sector specific incubators. Another factor that enhanced the growth wave was the adoption of the concept in many developing countries such as China, Brazil, India, Malaysia, and Turkey (Akcomak, 2009). Most developing nations including Africans are vigorously promoting the concepts in their development endeavor. In these countries, the impacts of TBI on overall economic development are well recognized. Therefore, understanding their direct and indirect benefits is the main reason for the expansion of technology incubation center.

2.2 Current Trends of TBI

The traditional first and second generation incubators in industrializing countries were focused on providing technology entrepreneurs with lab, workspace, shared office facilities, administrative support with minimal advisory and networking services (Lalkaka, 2000). Although government, chamber of commerce, and university sponsored business incubators have occupied this space for years, their primary missions have not been aligned with the interests of the entrepreneurs they host. Rather, they have revolved around economic development, job creation, provision of fee based services, and generation of royalties for universities. This misalignment can ultimately hurt the entrepreneur; in some cases, the entrepreneurs may end up paying much money for services they may not need rather than getting just the services needed at a price the entrepreneur can afford. Traditional incubators are typically not staffed with full-time, dedicated executives with relevant entrepreneurial experience (Bers and Dismukes, 2009).

Currently, the third generation incubator models, such as international enterprise centers or international business incubators have emerged. They are intended to create high-tech and knowledge based ventures by synergizing and linking the global R&D community, venture capital and international joint ventures. The current 7,000 business incubators worldwide will be expected to grow as other nations also are looking to business incubators as a way to stimulate economic growth. InfoDev, an arm of the World Bank Group, is actively promoting business incubator development in less developed countries through its business incubation initiative. Also, the United Nations Industrial Development Organization (UNIDO) oversees more than 500 incubator projects in developing and transitioning economies. The European Commission provides funding to nearly 160 business incubation programs (Monkman, 2010). As the movement toward establishment of business incubation facilities has expanded during the past decade or so, the numbers of regional and national, as well as international, associations and networks have emerged (Johnsrud, 2004).

The next generation incubators are expected to be for-profit and sector specific. Incubator facilities provide space for fields varying from food services, to software development, to arts and crafts (Antoine et al., 2008). In developing countries most incubators are still funded by the government and the for-profit idea is yet to develop (Akcomak, 2009). For those wanting to make the transition in this millennium to the third generation technology incubators, the

primary requirement is to enhance the quality of their management, marketing and personnel support for client-companies, actively promote the innovation process, and facilitate access to financing (Lalkaka, 2000). In some nations; such as Korea, China and India the concept is fully understood that the private sector also engaged in the set up process. In order to promote the concept, governments should play an indispensible role by devising a supportive policy and taking the first initiation to establish technology incubators.

2.3 Definition of TBI

There are a number of definitions given for business incubation as well as technology business incubation. Since business incubation is a broader term which encompasses the technology business incubation under its umbrella, first it is appropriate to define what business incubation mean. Many authors, literatures, organizations in the fields, have given their own explanations for business incubation. Some of the definitions are quoted as follows.

National business incubators association (NBIA) defines business incubators as: It is a program that nurturing the development of entrepreneurial companies, helping them survive and grow during the start up period, when they are most vulnerable. This program provides its client companies with business support services and resources tailored to young firms (NBIA, 2009).

InfoDev an army of united nation defines it as: It is the provision of support for new businesses through the early stages of development and change. This involves helping them to establish and accelerate their growth and success, and then graduating them when they reach a certain level of maturity (InfoDev, 2010).

The national association for the United Kingdom incubation industry (UKBI) defines it as: A business development process that is used to grow successful, sustainable entrepreneurial ventures that will contribute to the health and wealth of local, regional and national economies (UKBI, 2005).

Claggett Wolfe Associates define it as: A program where businesses can receive support that accelerates their time to market, establishes a sound operational foundation, increases their access to capital, and improves their opportunities for success. An incubator offers critical tools, information, contacts and resources through coaching, mentoring, and networking in a

pro active manner that provides value to both incubator clients and those who support the program (Claggett , 2003).

All definitions which revolve around business incubation approve that it is a program to support certain objective. The objective can vary from country to country, from organization to organization or from region to region, depending on the priority of the owners. Again the support rendered to the entrepreneurs or start up business may vary according to the objective of the program. Whatever the objectives, it is intended to provide necessary support for start up businesses or entrepreneurs to grow and become self sufficient companies. Figure 2.2 shows a typical business incubation process and critical supports that rendered in the program.

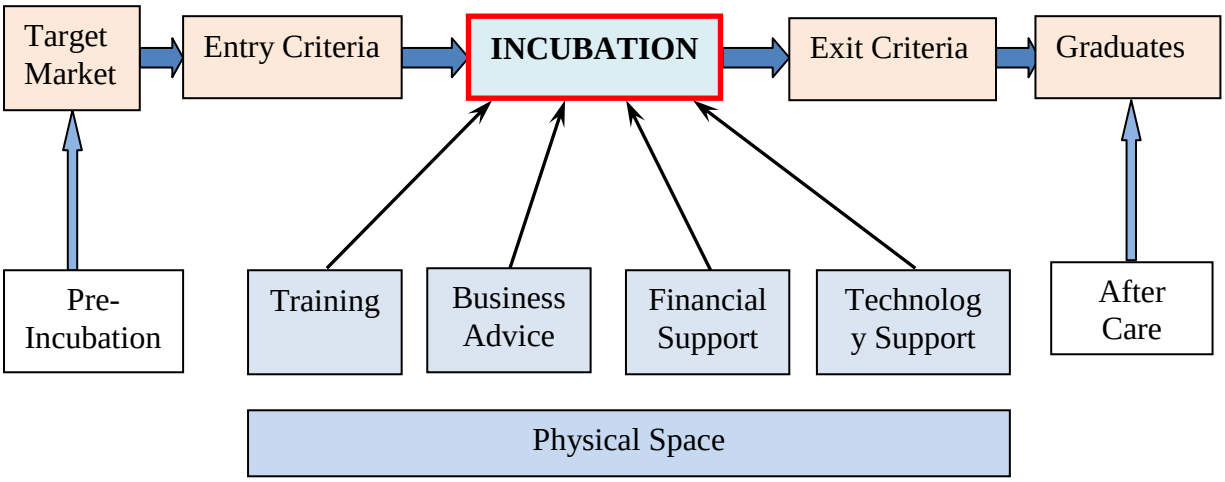

Figure 2.2. Business incubation process (Source: WB, 2010)

On the other hand technology business incubation refers to the type of incubation where the focus group consists of innovative; mostly technology oriented, or knowledge intensive enterprises and that have extensive interactions with the academic sphere (Johnsrud, 2004; Bajmocy, 2007). According to Lalkaka, technology business incubator is an environment with a small management staff that provides the physical space, shared facilities, counseling, training and information specific to selected technology ventures, with access to university research, finance and technical support services in one integrated and affordable package. TBI is usually linked to a technical university, research laboratory or technology park. It is service oriented and depends upon the use of equipment, libraries and facilities from the university/laboratory linkage, as well as professional services from an informal network of community supporters (Lalkaka, 2000).

In the same manner, the united nation for industrial development organization describes technology business incubators as a special type of business incubator specializing in new technology based companies. The primary mission of a TBI is not to create jobs or to develop a region but to facilitate the commercialization of research results as well as the acquisition and use of state of the art technologies, which would improve competitiveness of the nations (UNIDO, 1999).

Overall the definitions of TBI emanate from its objective. Since it is established to convert innovative idea into marketable items, the entrepreneurs in this industry are innovative or technology oriented. Apart from this, the entrepreneurs require unique facility and support programs that differentiate them from other incubation sectors. Therefore, their focus, mission and requirement used to define technology incubation.

2.4 Peculiar Characteristics of TBI

In order to understand the peculiar characteristics of technology business incubators in depth, it is worth of mentioning the characteristics of business incubator that distinguish it from others business set up. According to Lalkaka, the distinguishing characteristics of the business incubator can be (Lalkaka, 2000);

- A managed work space providing shared facilities, advisory services, and networking
- Small management teams with core competencies to provide early diagnosis
- Careful selection of start-up groups as incubator tenants, and their nurturing and growth
- Flexible exit policies
- Initial support is provided by the government, universities or other sponsors

Similarly, NBIA generalizes the distinguishing characteristics of business incubator into three points (NBIA, 2009). These are:

1. It must have a mission to provide business assistance to early-stage companies.
2. It must have staff that delivers and coordinates business assistance to client companies
3. It must be designed to lead companies to self sufficiency.

The next question will be what makes TBI unique from the other types of business incubation. A number of authors are elaborating these peculiar characteristics. Lewis D. A. asserts that the proportion of clients is the determinant factor in order to identify the TBI. According to him, if 50% of the client bases are technology firms then an incubator can be

considered a technology incubator. Moreover he claims that the most important differences between most technology incubators and the general population of business incubators is that operating and startup costs are greater for technology incubators (Lewis, 2001).

Similarly, Lalkaka lists the unique characteristics of TBI such as being knowledge intensive, need access to academic and scientific facilities, requirements of high finances with the probability of higher risk levels and need to draw upon experienced professionals and a skilled work force (Lalkaka, 2000).

Generally, technology business incubations aim explicitly at incubating enterprises with high or advanced technology content. A typical TBI provides its clients with a comprehensive range of services, not only the rental space at an affordable price but also a full range of business and specialized services aimed at intensifying technology utilization. TBIs generally have strict admission and exit criteria and the set of business support services is designed to include those that facilitate technology transfer and commercialization of new technologies.

2.5 Types of Incubators

The taxonomy of incubators is depending on the criteria that used to identify them. Based on ownership and capital sourcing, there are three types of incubators: public, private, and university (Zablocki, 2007). Based on their governance structures and business models they can be identified as for profit and non-profit incubators (Hallam and Devora, 2009). Some classify them according to their focus as mixed use or niche. The most frequent types of niche incubators are related to technology (technology incubators) and bio-technology (Scaramuzzi, 2002). Therefore, while identifying the types of incubators what matters is the criteria used to classify them. Though a number of criteria could be available and used; the frequent ones and their subsequent taxonomy of incubators are presented in table 2.1.

Table 2.1. Taxonomy for describing technology based business incubators (Source: Hallam and Devora, 2009)

Based on ⟶	Founders	Location	Business Model	Programs
Types	Government	Physical	For-Profit	Facility Based
	University	Virtual	Not-For Profit	Service Based
	Private			Affiliates

For-profit incubators: Their primary objective is to generate profit. Therefore, for-profit incubators charge service fees to the tenants and often take a portion of equity in the new venture (Hallam and Devora, 2009).

Not-for-profit incubators: They include government and community based incubators. The main objective for non-profit models is job creation, encouraging entrepreneurship in the community and diversifying the economic base (Hallam and Devora, 2009).

Public/Private partnerships: Large enterprises can be linked to the development of small businesses as vendors for components and services. The private sector will participate in the incubation process only after the state has financed the establishment and initial operations (Lalkaka, 2000).

University based: They might be non-profit or for profit. Usually funded by the university and co-funded by local, national and international government and public organizations, they provide support and services to new knowledge based ventures (Hallam and Devora, 2009).

Virtual technology incubator: Sometimes called as without walls incubator, is a program that helps entrepreneurs to turn their ideas into viable business without providing them with the physical amenities. A virtual program doesn't offer specialized space or equipment therefore the incubator's operating costs are minimal (Johnsrud, 2004).

International business incubators: Such a facility focuses on international collaborations, both financial and technological, to facilitate the entry of small foreign businesses, including returned expatriates, into local markets (Johnsrud, 2004; Lalkaka 2000).

According to InfoDev, in 2010 the assessment on 290 business incubation in 87 countries reveals the result that is summarized in table 2.2.

Table 2.2. Distribution of business incubation centers by their type (Source: InfoDev, 2011).

Ownership	University	Government	Private sector	Civil Society
Percentage	18	19	34	29
Business model	For profit		Not- for-profit	
Percentage	13		87	

Generally, incubators are identified by ownership, business model, business sector, scope, objective etc. Data reveals that most of the incubators are not-for- profit incubators. For profit incubators are a new generation of incubation model and might involve the participation of private investors. In terms of sectors; most of the incubators are mixed use incubators, but currently sector specific incubators are emerging and their number is increasing.

2.6 Goals for Establishing TBI

The goal of business incubation is different from one establishment to the other. The sponsor of the incubators, most of the time governments, universities etc, have their own requisite for the establishment. Therefore, it is not surprising that their missions, programs, and objectives have differed substantially.

The main objective of TBI is to facilitate the seeding stage technological development and to compete in the global market place. The goal of TBI is also to promote technology based firms, and to address regional and local developmental issues through science and technology (Monkman, 2010; KJ Smith, 2004; Dubey et al., 2005). Some of the major objectives of establishing TBIs are (Dubey et al., 2005):

- ***Technology Commercialization*:** Most universities, R&D institutions and technical institutions have technologies, which needs to be commercialized.
- ***Economic Development*:** A main underlying goal of support for new business formation is economic development through job generation.
- ***Intellectual Property Venture*:** TBIs create lucrative intellectual property based venture.
- ***Entrepreneurship Development*:** One of the main goals of technology incubators in developing countries and economies has been the development of an entrepreneurial culture and the creation of SMEs.
- ***R&D for Industry*:** Creating awareness among academic institutions about the requirements of industry and reorient their research and development programs to suit the need of industry.
- ***Problem Solving:*** Act as a problem-solving agency not only in the areas of technology but also in other related areas of business development.

Apart from the above major goals for the establishment of TBI, depending upon the incubator's focus, the specific objectives might be technological innovation through

interaction with universities and research complexes, regional development by decentralizing economic activity away from urban concentrations, industrial sub-contracting by linking up with industrial estates, international out-reach by helping foreign companies to quickly enter the domestic market and targeted development of special groups(Akcomak, 2009; Lalkaka,2000).

Each and every country has its own economic policy and prioritizes its development endeavor based on their policy direction. Therefore, TBI will be established to achieve certain objective of their owners. Whatever the direct mission for their establishment, it is widely agreed that they bring economic prosperity either directly or indirectly.

2.7 Benefits of Technology Business Incubation

Technology business incubators can play an active role in local, regional, and national economic development efforts (Claggett, 2003). For the affiliated university, the TBI offers opportunities to build firms led by local faculty, scientists and engineers while enabling society to reap the rewards from investment in local universities and research institutes. The incubator also provides employment opportunities, part time and full time, for university students and graduates. For the start up venture, the incubator offers the promise of creating a new business at higher survival rate, with reduced duration and costs. For the community, these businesses stimulate economic activity, with collateral growth of suppliers and customers. Significant tertiary effects come from the incubator playing a catalytic role in developing entrepreneurial skills, modifying the culture of university-industry relations, and influencing national policies toward small businesses. For the state, the TBI is a demonstration of its commitment to promote employment, technology commercialization, regional development and exports, while securing returns as corporate and personal taxes which are typically many times the net subsidy (Lewis, 2008; Monkman, 2010; Lalkaka, 2000; UN, 2001).

The following are the major benefits that can be achieved by technology business incubation establishments (Claggett, 2003).

- ***New Business Formation:*** It is the most common economic development focus of incubators around the world. These programs focus on supporting entrepreneurs from business concept development to product launch.

- ***Business Stabilization:*** A number of regions around the world have begun to investigate ways to use incubators to reach out to and help existing small-to-medium-sized enterprises that have become unstable for one reason or another.
- ***Business Expansion:*** A number of regions around the world have also begun to use business incubators to help existing small to medium sized enterprises expand. These programs provide service to help business owners improve operational efficiency, identify, and access new markets, expand production capabilities, hire and manage labor, and secure capital.
- ***Business Attraction:*** A recent enhancement by economic development professionals is to use business incubators to attract businesses to a region.

In general, technology incubators afford a means of enhancing overall economic growth and development, facilitating restructuring, technology diffusion and commercialization, and creating jobs. The role of technology incubators as technology transfer mechanism, as supporting the development of small and micro enterprises, and as overall economic development tool is discussed below.

2.7.1 Role of TBI as Technology Transfer Tool

Transfer of technology has been defined as the transfer of systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service. Technology exists in different forms and can be transferred through different channels (UN, 2005). In the 21st century, technological innovation is an essential factor for an enhanced competitive edge for industries within the knowledge based economic system (Marques et al., 2010; Liu et al., 2009). The basic source of industrial development, knowledge and technological change comes from industrialized countries through technology transfer (Saad, 2000). Some countries such as Japan and Korea fulfilled technology transition through the successful technology transfer and technology learning. With the establishment of formal research and development operations, they are making the transition from imitation to innovation, including the creation of patentable knowledge (Li, 2010).

The ability of businesses to engage with innovation and development is generally recognized as being the driving force behind increased revenue and improved living standards. Small innovative firms, including the new technology based firms, are decisive actors in this process, since they accelerate structural change and create new forms of employment.

Technology business incubation is the mechanism and infrastructure that is tending to be used to support the generation of new firms, commercialize technology and attract investment. They are established to facilitate the transfer and commercial development of university or laboratory owned discoveries and inventions. They provide the scientist/inventor-turned-entrepreneur with a structured environment in which to perfect the scientific and technical aspects of the technology and to gain experience in areas such as management, marketing, finance, product design, and other critical to successful business development. In this context, they play an important role, to support and increase this dynamic trend, as a knowledge/technology transfer mechanism (Johnsrud, 2004; Marques, 2010).

2.7.2 Role of TBI for Supporting Small and Micro Enterprises (SMEs)

In both developed and developing economies, small and medium enterprises (SMEs) are considered crucial to fostering economic and social development. The failure rate of small new businesses in their initial years is high in both developed and developing economies, particularly in Africa where there are higher percentage of inexperienced workers starting businesses. The failure may arise from the competitive environment within which the businesses are launched and also the effectiveness of the specific business idea. It is also a consequence of the lack of experience of the entrepreneur who is launching the business and deficiencies in the environment such as shortage of capital, legal difficulties, lack of information, etc (WB, 2010).

Business incubators provide focused support to entrepreneurs through a supportive environment that helps them establish their business ideas and develop their concepts into market ready products, supports the acquisition of business knowledge, facilitates the raising of necessary finance, introduces the entrepreneurs to business networks, all of which should substantially reduce the level of failure. They increase new entrepreneurs' chances of survival and success by building capacity and networks (Monkman, 2010; Scaramuzzi, 2002).

Moreover the TBI can play a vital role in increasing the awareness levels of the SMEs to know the emerging trends in technology and business opportunities. This attempt of bringing in business incubators to support the SMEs technology transfer issues will provide a new dimension to the business incubation movement and will also lead to evolving growth accelerator programs as a major value benefit to SMEs. The SMEs in need will get a personalized and holistic support (A.Balachandran, 2008).

Figure 2.3 depicts that the rate of growth for SMEs while receive incubation assistance program is much more than when they do not so.

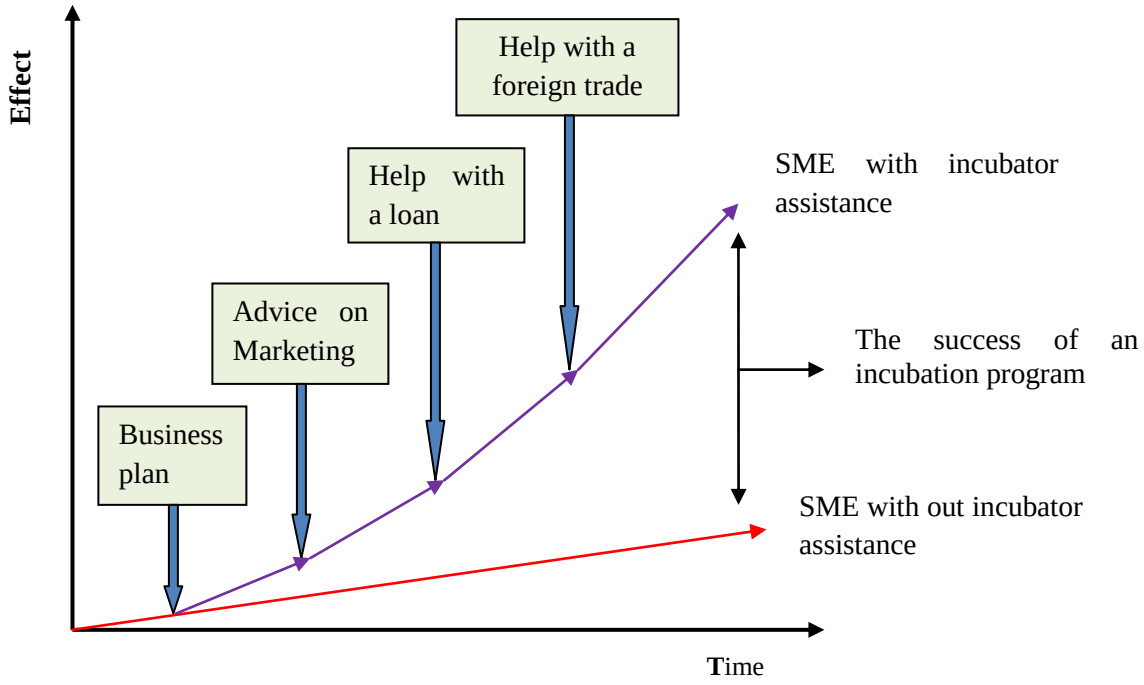

Figure 2.3. Package of assistance that makes a difference in the business success (Source: NBIA, 2009)

Generally, incubation programmes can increase survival rates dramatically when programmes are well run and help SME to manage risk and build competitiveness through early, high risk growth stages. In this respect technology incubation program play a major role by providing business development services for SMEs.

2.7.3 Role of TBI as Economic Development Tool

TBIs help to strengthen local economies because their small business tenants and clients are more likely to survive the precarious early years than start up enterprises that do not receive incubator support services. Thus, governments often fund and support business incubators as a way to increase the number of successful new companies. As the number of companies increases, so do the number of better paying jobs which, in turn, broadens the community's and state's tax base (Johnsrud, 2004).

According to Lalkaka, the rationale behind the incubator as an economic development tool arises from its potential to do some of the following (Lalkaka, 2000):

- Empower disadvantaged groups and backward regions
- Promote technology commercialization
- Promote synergy among businesses and with university, research and civil society,
- Reduce costs and consequences of business failures
- Modify the cultures of risk-taking, teamwork, networking, information sharing
- Create direct and indirect jobs
- Generate income, sales and exports for the community/country

Generally, if incubators are supported with comprehensible policy direction and full commitment, their impacts on overall economic development is tremendous. Specially for developing nation such as Ethiopia, the program will assist the economic growth efforts through multiple directions. Apart from increasing employment rate, broaden tax base and increasing survival rate of emerging business; the major impacts of TBI is in creating innovative entrepreneurs and businesses in the society.

2.8 Facilities and Supports Included in TBI Centers

A typical business incubator is a multitenant facility with common office equipment and a shared conference room. There is also an on-site full-time manager to assist in the delivery of business assistance training and services. The facility should provide flexible space so that an emerging company can expand within the facility during its period of incubation, as well as be able to accommodate new firms. In the case of technology incubation, high speed broadband internet access, specialized laboratory space or other unique research, design, or production capacity and, where possible, access to university research facilities are considered critical for attracting clients (Lewis, 2001).

Moreover incubators offer flexible leases, reception, and other common areas. They provide emerging businesses with an infrastructure of telephone, local area network along with shared use of basic business equipment such as copier, fax machine, and other office equipment. An incubator can give a new company a much needed visible identity to help promote its offerings and find funding or investment capital (KJ Smith, 2004).

Z. Sipos and A. Szabo grouped these necessary support services into four groups and list down them as (Sipos and Szabo, 2006):

1. Basic services:

A) Rent of space: Renting flexible space (office, production space, laboratories).

B) Usage of places: These services include physical and industrial infrastructure, conference hall and conference rooms, shared meeting and board rooms, communal rooms for guests and visitors, computer rooms, cafeteria and other similar services.

C) IT services: IT service comprise of telecommunication and information technology, access to high-speed internet, electronic mail, design of websites, shared office services.

2. Advanced level services

A) Consulting: Consulting services include business plan processing, continuously provision of business consultancy, consulting on tax and customs, financial management, consulting on innovations, modern technology, acquisition and protection of license, and other on-demand issues.

B) Business Training: Trainings and courses offered in the center include professional business training courses, business management skills training, knowledge transfer, tutorship and personnel training services, entrepreneurial training programs and offering special courses.

C) Business Information: The service comprise of information on tax and customs, information on innovations, new technology and protection of intellectual property rights, information on available financial sources, hi-tech advisory and data base.

D) Cooperation: The services include assistance with networking with professional, networking with other incubators and different support institutions.

3. Financial help

Financial help services comprise of reducing start-up costs, assistance with early financing (early bank loans, angel and commercial finances), financial services like micro loans, credit program, intermediation of financial sources, fundraising, access to favorable financing resources.

4. Additional services

Office services, usage of equipments: Office services include reception, postal services, office equipment, usage of tools, shared office administration (for example secretarial services), Library, actual legal, accountant and other.

Moreover, technical services, technological help and security and insurance are supports included in the TBI. Some incubators provide as many services as possible while other provides some of the basic services. All the services offered by technology incubators might fall in one or more support programs listed above. The mission, focus, level and other aspects of the TBI will determine what types of services should be offered by the program.

2.9 Frame Work for Establishing TBI

Typically, the preparatory work comprising feasibility and business planning for a business incubator requires 6 to 9 months, and the implementation takes a further 6 to 9 months, that is, a total of almost one year before the TBI can start operations. Where the concept is new, the implementation process can take longer; with strong leadership and assurance of funding, the process can be accelerated (Lalkaka, 2000). The general steps for preparatory process are listed below.

Step 1: From the start, responsibility has to be established to coordinate program development. It should stress that government enabling policies and financial supports are essential initially. Further, private sectors have a responsibility by helping create businesses.

Step 2: A small study team of key selected sponsors could undertake a well prepared reconnaissance tour to TBIs and related developments in industrial and industrializing countries.

Step 3: The feasibility study then looks at the main parameters. Entrepreneur surveys are useful to broadly indicate the local profile, attitudes, strengths and needs, in order to determine the services and facilities for which the TBI is to be designed

Step 4: Consensus has to be developed among the key players on the viability of the program. This is followed, if warranted, by the business plan to determine management, market, and money needed, to identify the options regarding objectives, facilities and services design, and to analyze investment, income and expense estimates, risk factors, working capital, marketing, implementation actions and other parameters.

Step 5: The critical assumptions have to be discussed and final decisions taken whether and how to proceed with the TBI implementation process.

Step 6: Once the project is starting, legal incorporation has to be studied or executed and the funding pursued seriously.

Step 7: The appropriate organization structure is developed and the board of directors formally appointed, with the necessary responsibilities and authority. Figure 2.3 shows an incubator preparation process.

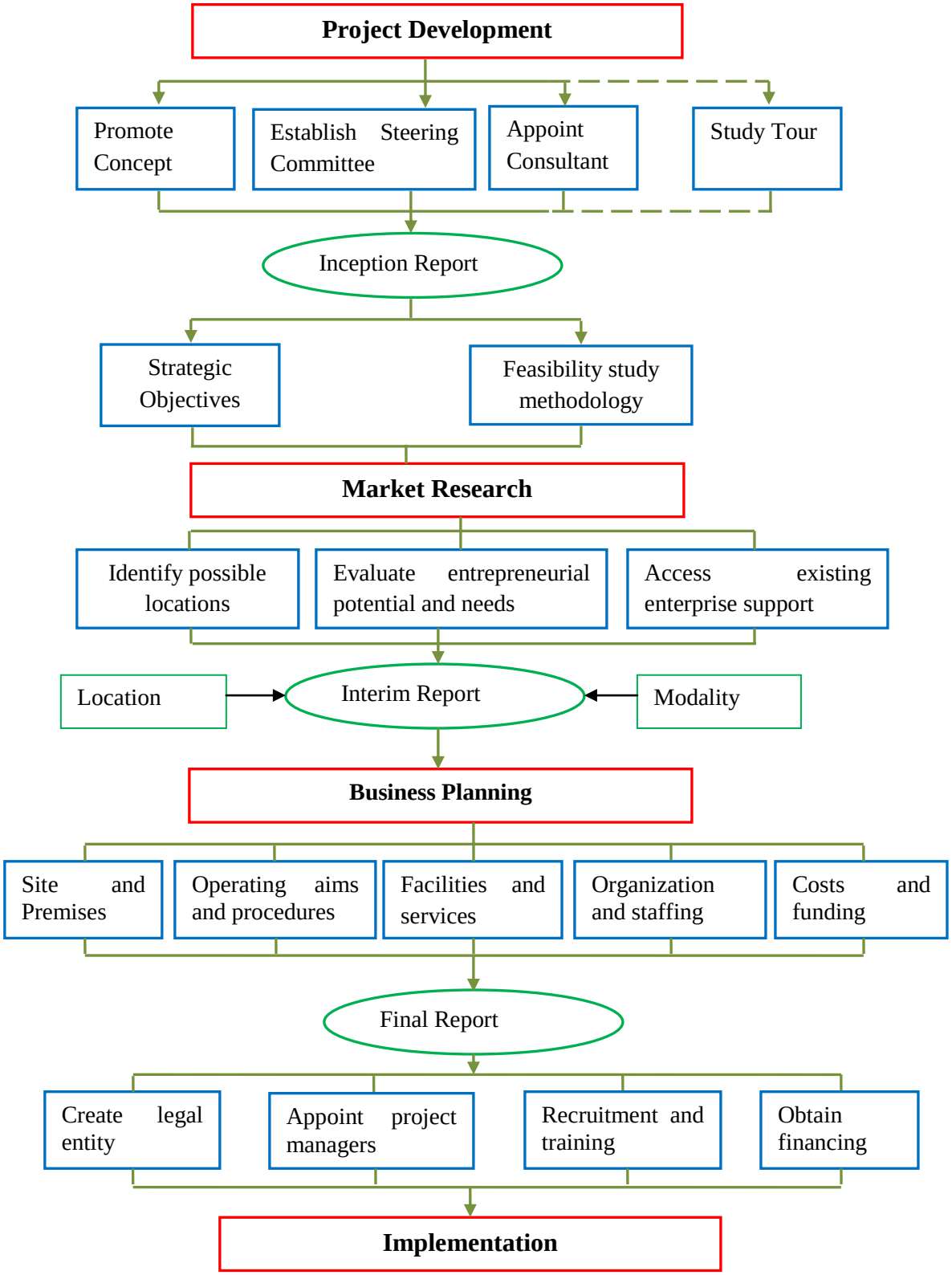

Figure 2.3. Incubator establishment process (Source: UKBI, 2005)

The above seven steps show the general procedure to establish technology incubation programs; however, the detailed procedures can be developed by the project management team. Since the success of the program is largely dependent on the viability of procedures for establishment, it is very important to design an effective and efficient procedure.

2.10 Challenges and Failure Factors of TBI

For a variety of internal and external factors, incubator planning and operations in developing countries have problems which constitute risks in its successful operation. These include the following (Lalkaka, 2000):

- Feasibility process is often skipped, or not promptly implemented
- There is inadequate involvement of business/community.
- Inadequate start up finance and working capital for incubator.
- Over-lapping SME support initiatives cause waste of resources.
- Location may be chosen for political considerations.
- Entrepreneurship is poorly understood and nascent.
- Manager with poor communication, networking and business skills, and low salary.
- Constraints such as access to markets, management skills, trade and technology information.
- Difficulty in accessing sources of finance due to bureaucratic appraisal, high collateral and interest, and lack of information on sources.
- Legislative environment and tax structure are unfriendly to small enterprise development.
- Weak international linkages.

Generally, TBI fail to perform according to expectations for a variety of reasons, starting in the planning stage such as lack of feasibility study, inadequate pool of entrepreneurs, weak demand for services, poor governance, location with poor business infrastructure and inappropriate building layout. Moreover, they might fail because of weak operating factors such as manager without business experience and skills, inadequate counseling, information and networking services, poor systems for accessing finance for tenants, high investment and operating costs and insufficient professional linkages. Therefore, it is important to consider such challenging factors at the very beginning, and providing a sound working environment for incubators to succeed.

2.11 TBI from the Perspective of Ethiopia

The role of technology business incubation in technology development is being universally recognized. Their rationale for supporting technology transfer mechanism, SMEs and overall economic development lies in their contribution to employment, new business development, innovation and growth. The data regarding business incubator effectiveness show that the survival rate of incubated firms range is much higher when compared to the survival rates of non incubated businesses. In terms of job creation, the program generates a substantial number of employments in countries where such programs and projects are implemented. Generally, incubators have a multiplier effects on the overall economic development. Therefore, Ethiopia can be benefited from TBI establishment if significant support is given to the program. Government has to provide a sound policy environment and financial incentives for the implementation and expansion of TBI programs. Additionally, the first initiation for the introduction of the program should be start from the government.

Currently, encouraging initiatives is seen by the Ministry of Science and technology in preparing policy document which favors the establishment of incubations. Moreover, there are few ICT focused incubators in some regions. These include Mekelle Information Communication Technology Business Incubation Centre, Bahir Dar ICT Business Incubation Centre, South Nation and Nationalities People Regional State ICT Business Incubator, Adama Business Incubation Center (InfoDev,2011). All the aforementioned TBI establishments are focusing on ICT and their scales of establishments are considered to be small.

Apart from these initiatives, the country much lags behind in the development of TBIs even in comparison with some developing nation. Therefore, the program should be given a proper attention and support from the government and concerned authorities. While developing technology business incubators program, Ethiopia can tailor the experience of other countries to fit into its context, as there is sufficient experience across the world. However, in order to start a business incubator project there is a need to carryout comprehensive planning and preparation. Sectors which have a great impact on overall economic development and which increase the competitiveness of the country, such as Basic metal and engineering, should be supported with incubation program.

CHAPTER THREE

CASE STUDY

3. BASIC METAL AND ENGINEERING

3.1 An Overview of Basic Metal and Engineering Sector

According to the central statistical agency, the manufacturing industries in Ethiopia are categorized into three groups. These are:

1. Large and medium scale manufacturing establishments(engaging 10 or more persons and using power driven machinery),
2. Small scale manufacturing establishments (engaging less than 10 persons and use power driven machinery) and
3. Cottage or handicraft manufacturing establishments (performing their activities by hand).

Since TBI facilities are intended for the commercialization of innovative or technological idea, the use of specialized and simple machineries in the production process is inevitable. Therefore, under this study only the first two categories of basic metal and engineering manufacturing industries are analysed.

Basic metal industries include production of metal from ore, scrap and conversion of billet, slab etc. into primary metal products while engineering industries include manufacture of fabricated metal products, machinery and equipment, computing machinery, electrical machinery and apparatus, communication equipment and apparatus, motor vehicles, trailers and semi-trailers.

The small scale basic metal and engineering sector is engaged on the manufacture of structural metal products, cutlery, hand tools, treatment and coating of metals, general mechanical engineering and hardware. According to the survey of 2008, there is no small scale basic metal and engineering sector engaged in the production of machinery and equipment. There were 4355 establishments and created 15,301 permanent and temporary employment. It is next to grain mill services and manufacture of furniture in number of establishment, numbers of persons engaged, gross value of production and value added which constitute 10 %, 11 %, 15 %, and 15.6 % of the total respectively. Therefore, this sector has a viable source of employment and has a tremendous economic impact among the small

manufacturing sectors. Figure 3.1 and 3.2 compare the basic metal and engineering with other manufacturing sectors in numbers of person engaged and gross value of production respectively.

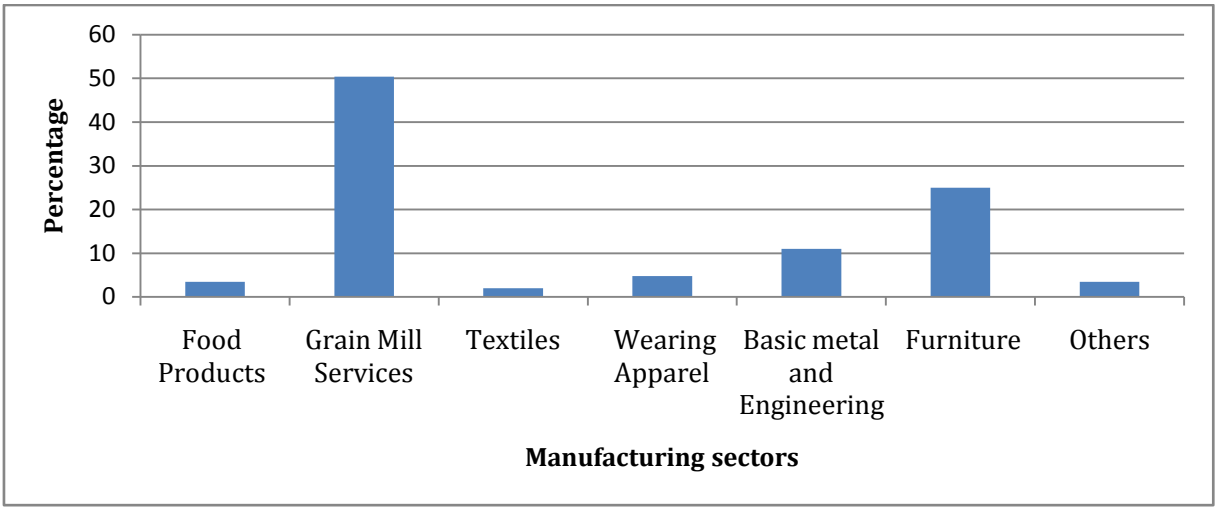

Figure 3.1. Comparison of small scale manufacturing sectors in number of person engaged

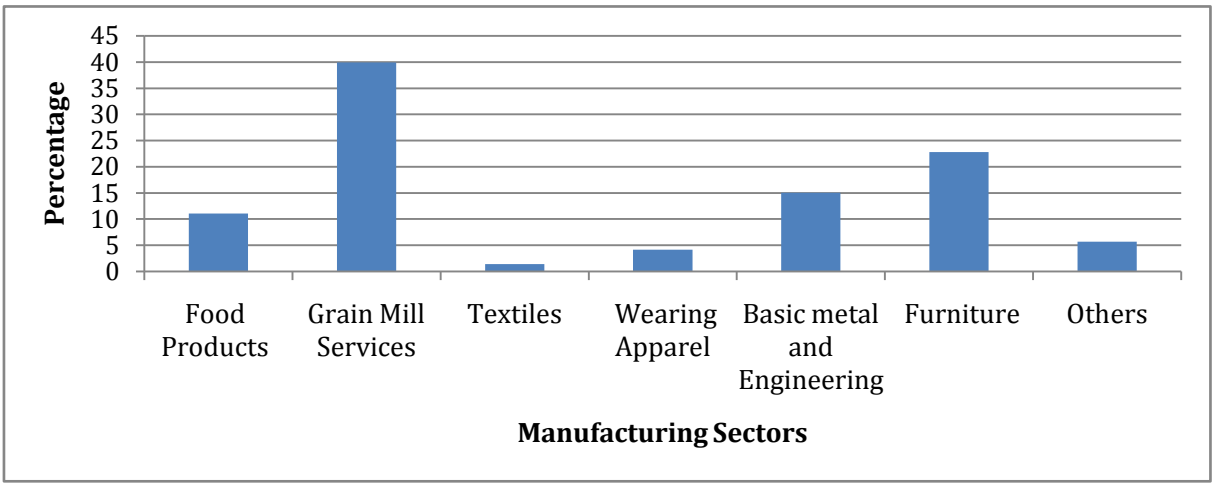

Figure 3.2. Comparisons of small scale manufacturing sectors in gross value of production

The medium and large manufacturing of basic metal and engineering enterprises are engaged in the production of machinery, equipment, motor vehicles, trailers and semitrailers. Table 3.1 shows the medium and large manufacture of basic metal and engineering sector by numbers of establishments and job creation in 2010.

Table 3.1. Number of medium and large basic metal and engineering establishments and their number of employees in 2010 (Source: CSA, 2011)

	Sub-Sector	2009/2010	
		No of Firms	No of employees
1	Manufacture of Basic Iron and Steel	39	4016
2	Manufacture of Fabricated Metal Products	154	9977
3	Manufacture of Machinery and Equipment	15	859
4	Assembly of Motor Vehicles, Trailers and Semi-Trailers	11	1671
	Total	219	16,523

From table 3.1 the number of firms engaged in the manufacture of machinery, equipments, motor vehicles, trailers and semitrailers constitute 12 % of the total metal and engineering sector. However, most of the firms are engaged in the fabrication of metal products which account 70%. While analyzing the sector growth in terms of number of establishment, it shows a higher level of growth starting from 2006/2007. Similarly, the employment level is increasing in line with the number of establishments.

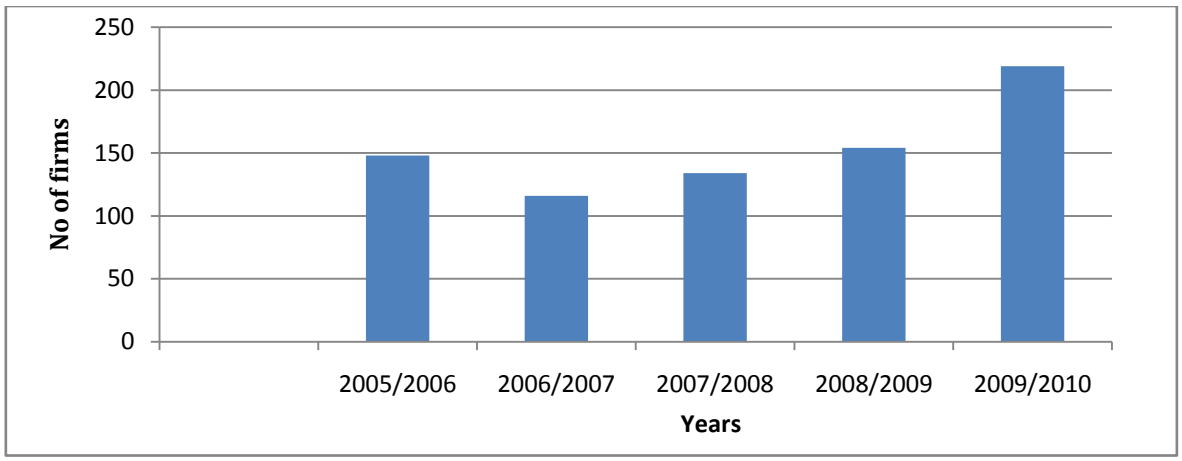

Figure 3.3. Trends of basic metal and engineering establishments

The following chart can be developed while analyzing the sector in terms of job creation in comparisons with other manufacturing sectors from 2005-2010.

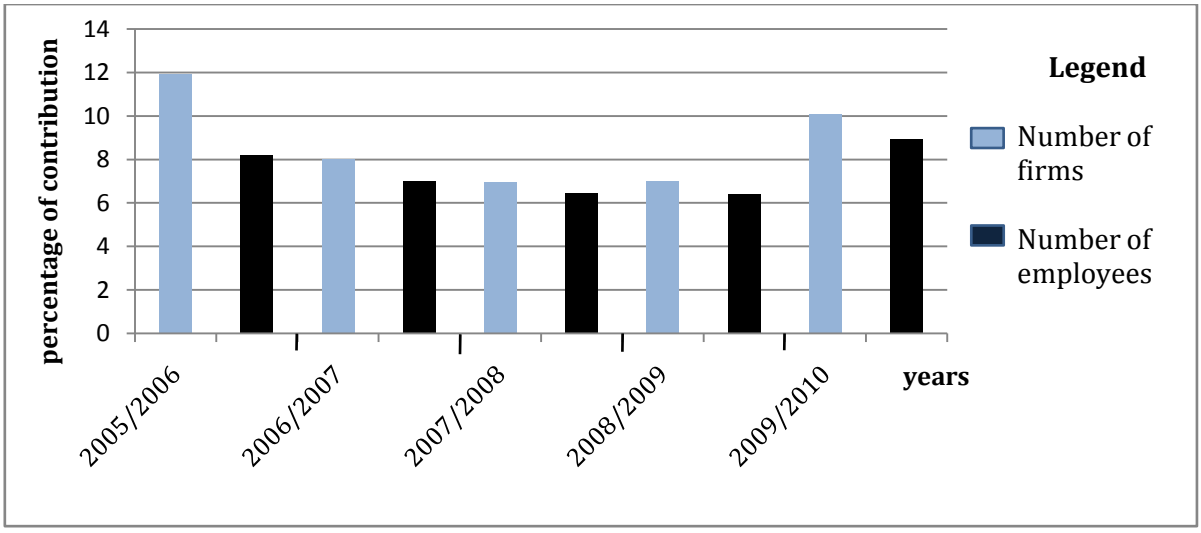

Figure 3.4 Contribution of the sector in terms of job creation and number of establishments

From figure 3.4, the contribution of the sector in terms of number of establishment and job creation shows a decreasing trend from 2005-2008; however, starting from 2008 onwards, it is on increasing trend. Currently the contribution of the sector in both parameters is around 10%. In line with the fast national economic development, the contribution of the sectors in job creation is also expected to increase. Further analyzing the contribution of the sector to gross value of production, it is around 15%.

Table 3.2. Gross value of production of the sector in thousands of birr (Source: CSA, 2011)

	Sub-Sector	2009/2010
1	Manufacture of Basic Iron and Steel	1,699,510
2	Manufacture of Fabricated Metal Products	3,402,348
3	Manufacture of Machinery and Equipment	222,265
4	Assembly of Motor Vehicles, Trailers and Semi-Trailers	800,166
	Total	6,124,289
	Its proportion from the total manufacturing industries	14.58 %

From the above analysis the growth of the sector has a tremendous economic impact on the country from the perspective of job creation and gross value production. However, from the research by access capital, Ethiopia expends 37 % of the money in 2010 that used to purchase imported items on basic metals and engineering products. Machinery, metals and related materials, vehicles and electrical materials constitute 11 %, 11 %, 8 % and 7 % of the total imports respectively. The figure is even greater than the percentage of money used for the purchase of petroleum and chemical products which is 17 %.

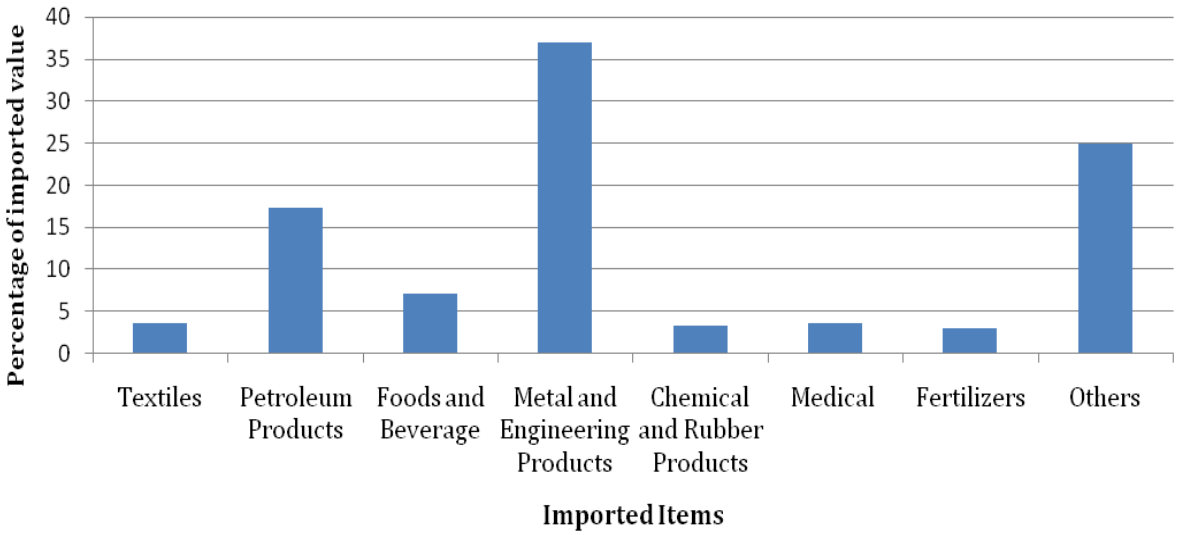

Figure 3.5. Comparisons of value of imported products

In terms of product variety, the sector's major products include low-value engineering products such as iron bars, wires, nails, iron sheets, crown cork, motor vehicle spring, metallic door and metallic window. This reveals that there is huge demand for the products of the sector. Therefore, the growth of the sector can assist the process of import substitution products and saves foreign exchange. Generally, supporting the sector to be technologically competent brings a significant economic benefit.

3.2 Business Start-up and Technology Related Problems in the Sector

Whether they are small or medium to large scale, the enterprises in the sector has a number of problems during their establishment and operation. Under this title, the problems associated with firms engaged in small scale while starting their business and the problems of medium to large scale firms associated with their low technological advancement are discussed. Because, mostly such kind of problems that are calling for the need of establishment of TBI. The data used in this analysis are obtained from the survey of CSA of 2008 and 2010 on nationwide manufacturing enterprises.

Table 3.3 shows the first major problems of small scale enterprises in the sector at the time of establishment.

Table 3.3. Problems of small scale metal and engineering enterprises during establishments

Problems	No. of Responses	Percentage of Responses	Cumulative Percentage
Lack of sufficient initial capital	2360	2360/4266=55.32	55.32
Lack of smooth supply of raw material	221	221/4266=5.18	60.5
Obstacles from government regulation	216	216/4266=5.06	65.56
Lack of information	94	94/4266=2.2	67.76
Lack of foreign exchange	88	88/4266=2.06	69.82
Access to credit facilities	64	64/4266=1.5	71.32
Absence of adequate skills	51	51/4266=1.2	72.52
Others	545	545/4266=12.78	85.3
No problems faced	627	627/4266=14.7	100
Total number of respondents	4266	100	

From table 3.3, lack of sufficient initial capital is the most significant problems of the sector. Moreover, lack of smooth supply of raw material, obstacles from government regulation and lack of information is the next major problems cited by the participants of the sector. These problems constitute almost 70 % of the total problems facing the industry. Only 15 % of the respondents said they have no problems. Further analyzing the sector for reasons of not working at full capacity, table 3.4 is developed.

Table 3.4. Problems of small scale basic metal and engineering enterprises during operation

Problems	No. of Responses	Percentage of Responses	Cumulative Percentage
Absence of market demand	1661	1661/3812=43.57	43.57
Shortage of supply of raw materials	848	848/3812=22.25	65.82
Lack of working premises	423	423/3812=11.1	76.92
Absence of credit facility	240	240/3812=6.3	83.22
Shortage of supply of spare parts	52	52/3812=1.36	84.58
Lack of adequate skills	23	23/3812=0.6	85.15
Others	565	565/3812=14.82	100
Total number of respondents	3812	100	

Absence of market demand, shortage of supply of raw materials, lack of working premises, absence of credit facility are the top major problems. These constitute 83.22 % of the total problems. The survey also shows there is an information problem such as where to get appropriate training, about market and appropriate machinery.

Based on the research conducted by Asmamaw and Zelalem on Engineering and technology challenges, the factors that contribute for slow progress of the medium to large enterprises in the sector are the quality of products are not competent, new technology transferring system is very limited, innovation trends are very low. Limited types of products are produced repeatedly in a particular industry, which indicates that there is a stagnant technology. Accordingly, insufficient competence level of employee and skilled man power shortage, insufficient trends on research and development, lack of relations with Ministry of Science and Technology, limitation in product variety, limitation of innovation trend, lack of sub contracting culture, lack of loan from banks, lack of support from capacity building organizations, lack of recent information on the sector, short coming in product acceptance, compliance to local & international standards, and intellectual property protection issues are problems observed in the sector (Asmamaw and Zelalem, 2010).

It is clear that the prevailing problems and challenges should be improved, in order to bring the competitiveness of the sector. Therefore, adoption of new and appropriate technology, improvement of current technology, research and development, partnership and strategic alliance with academy and government, foreign technology partnership and technology transfer are among the priority solutions to achieve the desired objective. These will call for the establishment of technology business incubation focusing on the sector.

3.3 Significance of TBI Establishment for Metal & Engineering Sector

Basic metals engineering plays a great role in enhancing the economic development of Ethiopia. It is at forefront in the realization of the agricultural development lead industrialization strategy of the country. This is because of its economic and technological contribution in supplying inputs such as raw materials, machinery, hand tools, spare parts, components, construction materials as well as in expanding infrastructure and providing material for agriculture, and other economic sectors. One of the main indicators of socio-economic and technological development of a country is the level of the progress scored in this sector. However, in Ethiopia industries that might help accumulate technological

capabilities and create dynamic inter industry linkages such as metal processing and engineering industries are few in numbers. Overall, the technological level of firms is very low.

Since technology is an essential precondition for improving productivity, attaining industrial development and promoting export growth; innovative entrepreneurs focusing on the sector should be supported with conducive environment to bring technological development of the sector and the country at large. Moreover, it is a key element for Ethiopia to integrate into and compete in the global economy as well as to meet its development goals.

The main role of technology business incubation for metal and engineering sector is through creating new innovation and technologies and serving as a technology transfer mechanism. Innovative entrepreneurs increase the technological development and competitiveness of the sector by broadening the number of business establishment in the sector. The establishment is also used to promote technology innovation through interaction with universities and research centers, introduce new ventures to functioning clusters of high technology enterprises and provide advisory services for enterprises initiating innovative products and services. Consequently, they promote technological product export, create job, increase revenue and tax base.

Generally, the establishment of technology business incubation for this specific sector enables the country to diversify the non-existent technology based products, improved productivity and quality. Moreover, existing medium and large enterprises can be benefited from the TBI through developing new sources for components by subcontracting, acquiring for innovations and opportunities for investment of funds in new ventures. The overall effects of TBI center establishment bring industrial development for the country. For these reasons the establishment of TBI for metal and engineering sector is indispensable.

3.4 Policy Environment toward TBI Establishment for the Sector

Based on the draft policy document of Ministry of Science and Technology (MOST), there is currently lack of systematic transfer of foreign technologies based on the demands of the various social and economic sectors. Additionally, the existing financial system of the country is not designed to address the needs of innovative activities in the enterprises. As a result, the ministry has adopted the National Science, Technology and Innovation Policy. The policy is

adopted under the vision to see Ethiopia undertaking coherent STI initiatives which eventually lead the country to begin exporting its own technologies by the year 2025. Table 3.5 shows some of the indicators in technological capabilities at base line and the milestone to be achieved in 2025.

Table 3.5. Milestone of for technological capability (Source: MOST, 2011)

Objective	**Baseline (2010)**	**Targets (2025)**
Technology transfer & development	No systematic way of technology transfer	Export of Ethiopian technologies
Export promotion	Dominated mainly by primary goods	Export of high technology products
Industrial capability	Huge unmet demand for manufactured products	Adopt international quality standards, innovate new materials and products
GDP (%)	0.2	2
Patents and utility Models (UM) granted for residents	Patent 1	Patent 110
	Utility Model 24	Utility Model 3000

From table 3.5, it is clearly shown that the current technological development level of the country is very low. The budget allocated for the promotion of science and technology is insignificant. The outcomes from patent right and utility model also reflect there is low level of innovation. Hence, it is understood that the country shall build its technological capability by devoting resources to assimilation, adaptation and improvement of foreign technologies.

Consequently, a strategy is devised to alleviate the existing problems and to increase the technological capability of Ethiopia. Some of the strategies are establishing regional centers of excellence to undertake research focused on technology adaptation, promoting the development of domestic technological capabilities for the effective absorption of foreign technologies, creating conducive and supportive environment for nurturing and developing of innovative business enterprises and setting national priority programs for the transfer of major technologies. Similarly, an incentive strategy is devised. Creating national technology and innovation funds, introducing fiscal incentives such as tax exemption and duty free privileges for technological and innovative activities of Ethiopian SMEs, creating a system of special privileges and awards for outstanding innovations/achievements are some of the incentives stated in the policy.

Metals & metal products engineering are categorized as a national priority technology capability programs of Ethiopia based on the immediate needs and the strategic moves of the country. At the same time Science and technology parks or incubators are identified as the innovation support and research system. It is stated that incubators are the major actors which will be engaged in the actual work of technology transfer, diffusion and research.

Based on the interview conducted with the staffs of Ministry of Science and Technology, it is known that a team has formed to study the possibility of developing TBI in the country. Generally, from policy perspective, there is conducive environment for innovative entrepreneurs in basic and metal engineering. Moreover, the policy encourages the establishment of technology incubators.

CHAPTER FOUR

4. BENCHMARKING BEST PRACTICES

4.1 The Importance of Benchmarking and Criteria of Selection

Benchmarking is the process of comparing the quality, the performance and the efficiency of a specific process or method to another that is widely considered to be a standard or best practice (UKBI, 2005). Since there are sufficient experiences worldwide both in developed and developing economies; it is considered appropriate and effective to build on the experience of other countries while developing technology business incubators for Ethiopian context. However, the stage of development, the educational level, the culture of society, the government policy and other situations of Ethiopia are different from other countries. These preconditions should be critically analysed, while adopting others' experiences.

The experiences of China, India, Brazil, Korea, Malaysia, South Africa and USA have taken as bench mark. The selection is mainly based on their rich experience on the topic, availability of bench marking parameters, recommendation from international organization and relevancy with developing nation. United Nations Industrial Development Organization lists china, India and Korea as countries of best practices for the development of technology incubation (Tang et. al., 2010; Dubey et. al., 2005; Lalkaka, 2000; UNIDO, 1999). Similarly, the International Bank for Reconstruction and Development cited Brazil, Malaysia and South Africa as a reference for global good practice in incubation policy development and implementation (InfoDev, 2010; World Bank, 2010). USA is a pioneer that has an extensive and proven experience in technology business incubation as a result it is beneficiary to adopt its successful parameters.

Zablocki lists benchmarking factors while establishing incubation centers. These factors are overall characteristics of incubators**,** nature and scope of support services, key tasks of managers and partners, promotion of services, monitoring and evaluation of business incubator services, financial strategies and performance of assisted projects and regional impacts (Zablocki, 2007).

4.2 Benchmarked Countries

1. CHINA

The technology incubation policies and programmes in China basically evolved from the `Torch' programme initiated in 1988 by the state council and is implemented by the Ministry of Science and Technology (MOST). The Torch programme implements specific projects for the development and commercialization of new technologies in specialized fields. Priority areas include new materials, environmental technologies, biotechnology, and aerospace and information technology. Tenant companies are mostly spin offs from universities, research and development institutions, state owned enterprises but ownership typically remains with the parent institution.

China has been proactive in formulating specific fiscal policies and incentives to encourage both the incubators and their tenants such as providing tax exemption, reduction of income tax, low rentals to attract talented entrepreneurs and start-up companies and also to facilitate international cooperation and financing mechanisms. Besides the national and local governments have also formulated policies and enacted laws for encouraging technological innovation, commercialization of research and development results and promotion of technology intensive SMEs which tacitly support the development of technology business incubation in China. As a result, China is only next to USA in the number of operational technology incubators. This is the result of strong government back up, proactive policies and extensive networking [InfoDev, 2010; World Bank, 2010; UKBI, 2005).

Up to 2008, 670 technology business incubators were set up. These TBI occupied 231.6 million square meters and hosted 44346 ventures which generated 18.662 billion Euros and employed 928000 persons. In all, 31764 ventures in total have been graduated from these TBI by 2008 (Tang et al., 2010). Table 4.1 summarizes the nature of Chinese incubators.

Table 4.1. Characteristics of Chinese technology incubation centers (Source: Tang et al., 2010; InfoDev, 2010; World Bank, 2010)

Chinese Incubators	
1. Management and Operational Policies	
Objective	Creation of technology based new enterprises, facilitating technology transfer, creating jobs and regional economic development
Nature	Non-for-profit organizations , Mostly government-sponsored
Governance/ Structure	Central government gets involved in policy making and monitoring; The board of directors governs TBI. Board members come from local government, university, enterprises and other investors.
Sources of funding of TBI	a) Local government (free land and initial fund) b) Other sponsors such as universities, state-owned enterprises and other investors.
Funding of new ventures	Very complex system with many potential funding institutions at different levels. High proportion of venture capital comes from entrepreneur themselves. Weak venture capital system especially at early stages. Public funding used (as seed) to attract other funds from other sources.
	a) Critical role played by incubator at early stages of firm creation b) Innovation fund is available for new ventures through a project competition c) Local government agencies pool funds, identify investment and channel funds into new ventures
Selection	To hold intellectual property with market potential; to have a qualified entrepreneurial team. Meet the requirement of MOST such as: i) Maximum registration capital, ii) Foundation year, iii) Registration place, iv) Incubation surface, v) Property of high-tech and environment friendly products and vi) Professional entrepreneurs.
Duration	3-5 years depending on the sector
Graduation	A series of formal criteria determined by MOST and TBI
2. Services Provided to Tenant Companies	
Physical resources, business operation support, access to capital and investments, mentoring, coaching, consulting, legal advice, book-keeping, networking services	
3. Performance and Outcomes	
Outcomes (2005-2008 on average)	a) 72 tenant firms per incubator b) 19.75 employees per tenant firms c) 37.85 graduated firms per incubator

2. INDIA

The incubator movement in India took off in the late 1980s as a complementary policy tool aiming at promoting entrepreneurship and stimulating new venture creation. The government has introduced a special scheme in 1998 for providing income tax relief on research and development expenditure and five-year tax holiday for commercial research and development companies to invest in research and development and also to encourage the establishment of research parks. This is essentially to build on India's strong human resources base in science and technology to address its need for modernization and competitiveness in the global market.

It was not until 2000 that India started its TBI programme with clear policy strategy. TBIs under the national science and technology entrepreneurship development board focus on technology areas such as information and communication technology (ICT), biotechnology, new materials including nano materials, instrumentation and maintenance, manufacturing and engineering, design and communication (media & infotainment), health, agriculture and allied fields, and energy and environment. Tenant companies in a TBI may number 10 to 20 and they generally graduate out after 2-3 years of incubation (InfoDev, 2010; World Bank, 2010). Table 4.2 shows the specialization area of Indian mechanical and manufacturing Incubators and their nature.

Table 4.2. Typical profile of TBI in manufacturing domain of India (Source: UKBI 2002)

Parameters	Specification
Total floor area	15000- 25000 sq ft
Number of companies	10-15
Floor area for each company	350-500 sq ft
Number of employees at start up	3-10
Incubation period	3-5 years

By the end of 2009, there were approximately 120 TBIs in India of these, 40 were established in software technology parks (STPs). TBIs were promoted by government departments, banks and financial institutions, and private companies. The incubated enterprises have generated cumulative revenue about US$125m by 2009 (Tang et al., 2010). Table 4.3 summarizes the nature of Indian incubators.

Table 4.3. Characteristics of Indian technology incubation centers (Source: Tang et al., 2010; InfoDev, 2010)

Indian Incubators	
1. Management and Operational Policies	
Objective	Creation of technology based new enterprises, facilitating technology transfer, creating jobs and regional economic development
Nature	Both profit and Non-profit organizations. More than two third TBIs are government promoted and about one third by others such as banks and private companies. Host institutions where the TBIs are located play an instrumental role in management and performance of the TBI
Governance/ Structure	Central government plays a promoting role and has loose control over TBI. The main bodies that govern the TBIs are the governing/ advisory board and the executive management team at the local level. The local or regional governments do not have major control over TBIs, except where they are involved as one of the stakeholders.
Sources of funding of TBI	a) Central government b) Host institutions c) Financial institutions d) Private sector companies
Funding of new ventures	Very complex system with many potential funding institutions at different levels. High proportion of venture capital comes from entrepreneur themselves. Weak venture capital system especially at early stages. Public funding used (as seed) to attract other funds from other sources.
	a) TBI plays a critical facilitating role to obtain funding for start-ups and provide seed capital in some cases b) Weak support from angels and VC, but improved in recent years.
Selection	Generally, the following criteria are applied for selection: Sound idea and business plan, commitment and integrity of promoters, potential for growth, willingness to follow mentoring and advice, capacity to meet targets and willingness to pay for facilities and services.
Duration	2-3 years depending on the sector (duration can be reviewed)
Graduation	A series of formal criteria determined by TBI
2. Services Provided to Tenant Companies	
Physical resources, business operation support, access to capital and investments, mentoring, coaching, consulting, legal advice, book-keeping, networking services	
3. Performance and Outcomes	
Outcomes (2005-2008 on average)	It is estimated that about 500 tenants graduate every year from total TBI in India. 60% of them are considered to be technology based start ups.

3. BRAZIL

The first incubator was established in 1986. Most incubators were located in a university or a research institute and more than 80 per cent of the tenants were spin offs from academia and other companies. Incubators in Brazil are generally linked to universities and financed by various governmental and non governmental sources. These trends of incubators in Brazil are reflections of synergies (a triple helix) among the university, industry, and the government.

Another interesting feature of incubators in Brazil is the innovative approaches to incubation models. Local needs and the attempts to alleviate poverty shaped the emergence of different incubators and incubation models significantly. Many incubators were established as a remedy to unemployment aiming solely at job creation especially in traditional sectors such as agricultural equipment, furniture, and textile. There are even incubators that are specialized to foster entrepreneurship in cultural activities such as music, art, and cinema industry. There are now about 400 incubators operating in Brazil. More than half of these incubators are technology business incubators (Zablocki, 2007; InfoDev, 2010).

There were cases where incubators did not provide business support and consultancy services at all. Moreover some incubators provided very poor physical and operational infrastructure. These problems were exacerbated by institutional constraints to entrepreneurship, such as bureaucracy and insufficient risk capital funding (InfoDev, 2010). Table 4.4 summarizes the nature of Brazilian incubators.

Table 4.4. The Characteristics of Brazil incubation centers (Source: Zablocki, 2007; InfoDev 2010)

Brazilian Incubators	
1. Management and Operational Policies	
Objective	Transfer of technologies generated at the universities and at research centers, creation of new business opportunities for employment and products with high added value, and the development of entrepreneurship in technology-based businesses
Nature	For-profit, non-profit. Incubators in Brazil are reflections of synergies (a triple helix) among the university, industry, and the government
Governance/ Structure	Built in partnerships with government at the city, state and federal levels and with local universities, research institutes and private business. They usually have boards and a senior manager that ensure both strategic input and management in accordance with good corporate conduct.
Sources of funding of TBI	Generally funded by a coalition of partners from the public and private sectors. The majority of incubators are sponsored by universities, linked to the business sector and financed by a variety of government programs. It was determined that public authorities and agencies contribute approximately to 35% of the costs of setting up an incubator. Period of grant funding varies between different funds and schemes but typically for short periods. Funds are given through competitive grants
Funding of new ventures	Gaps in financing, particularly for early stage ventures, can be a major deterrent to new business creation and often lead to the early demise of the most promising start-ups. Direct finance is available from federal agency, which provides 0% interest loans as a seed fund for new start-ups and then loans to stimulate SME growth in the early stages.
Selection	Different, depending on the incubators' goal.
Duration	Mostly between 2-3 years
Graduation	A series of criteria determined by each incubators
2. Services Provided to Tenant Companies	
Offer a range of counseling, help in business plan development, training and support services as well as shared facilities such as use of reception, meeting and exhibition rooms, parking, security, telephone, computer laboratory, technical information center, and mechanical workshop.	
3. Performance and Outcomes	
Outcomes (up to 2004)	Half of them have 6-15 tenant firms per incubator, average number of tenants are 11. 74 % is the average level of occupancy. Average numbers of employees are 5. The average incubator space is 3000 sq m

4. KOREA

The origins of business incubation in Korea traced to the early 1990's. The concept of business incubation was first introduced in Korea in 1991 when the production technology research center was established and operated technology incubators, the predecessor of today's technology business incubators. Although the first Korean incubator was started in 1993, the major expansion has taken place in 2000's. The government reoriented its policies towards high tech and start up companies with the emphasis on promotion of SMEs. The government is further pursuing a wide range of policy measures and programmes such as highly advanced national research and development project to encourage technology innovation and improve industrial research and development capabilities and strengthen the technology incubation systems in the country. Thus Korea in keeping with its global positioning appears to have a well designed and articulated strategy to promote high tech SMEs through the incubation route.

A technology incubator focused on enhanced business services is sponsored by the ministry of science and technology at the Korean advanced institute of science & technology. Support to entrepreneurs came in the form of a three step process: pre-foundation consulting, supervision of the start-up stage, and production of a test-product - from technology development to commercialization. Such support, however, was out-of-wall. In Korea, central government led business incubation is the most prevalent (Sipos and Szabo, 2006). The Ministry of Science and Technology (MOST), Ministry of Commerce, Ministry of Industry and Energy through small and medium business administration and the Ministry of Information and Communication play a pivotal role in promoting SMEs. The business incubation programme of MOST is managed by the high-tech venture centre of Korea Advanced Institute of Science and Technology. Korean Business Incubation Association is actively engaged in evolving programmes for promoting networking and strengthening business support services of TBIs (Suk and Mooweon, 2006; Sipos and Szabo, 2006).

As of 2003, Korea had about 333 technology and business incubators. Among these, 322 centers were non profit incubators (Suk and Mooweon, 2006). Table 4.5 summarizes the nature of Korean incubation centers.

Table 4.5. The Characteristics of Korean incubation centers (Source: Suk and Mooweon, 2006; Sipos and Szabo, 2006)

Korean Incubators	
1. Management and Operational Policies	
Objective	Technology diffusion and regional technological development.
Nature	Mostly non-profit organizations. Mostly promoted and supported by the governments and also privately supported.
Governance/ Structure	Business incubation in the Republic of Korea has been led by the central government.
Sources of funding of TBI	Government provides loan for facilities and operating expenses, tax exemption, investment to high-tech ventures from direct to indirect investment
Funding of new ventures	Besides government grants and loans, venture capital companies and angel investors provides additional liquidity for venture capital and equity injections to support techno-entrepreneurship development
	a) the government is urging venture capitalists and foreign investors to create their own incubation funds to help start-up companies b) special measures initiated to support technology intensive and knowledge based enterprises through pension and other funds from insurance companies
Selection	Generally, the following criteria are applied for selection: i) Idea and business plan, ii) Innovation oriented, iii) Capacity or resources of the firm, iv) Willingness to follow mentoring and advice, iv) Ability to pay for facilities and services.
Duration	1-3 years
Graduation	A series of formal criteria
2. Services Provided to Tenant Companies	
R&D institutions, location, intellectual property/technical consultancy assistance, venture financing, government finance support and tax incentives, entrepreneurship development programmes, and strategic alliances.	
3. Performance and Outcomes	
Outcomes (as of 2002)	a) The average area per incubator is 1,700 Sq.m. b) On average about 14 tenants per incubator. c) the average tenancy period is from 1-2 years d) 1690 firms were graduated

5. MALAYSIA

Malaysia enacted the first national science and technology policy in 1986 and established a number of institutions to stimulate technology oriented programmes. In 1991, the national action plan was launched which outlined the strategies for strengthening science and technology capabilities. The plan provided the framework for the development of hi-tech industries, and strategies for the promotion of knowledge based industries. In Malaysia the technology incubation policies and programmes are essentially derived from this plan.

The business incubation movement began in 1988 with the establishment of a small incubator unit at the standard and industrial research institute of Malaysia (SIRIM). Malaysia has been at the forefront of setting up technology incubations especially aimed at the fostering of neo-technologies. The focus is on selected high-tech sectors, which include information technology, advanced materials, aerospace, biotechnology, advanced manufacturing and other environmentally sound technologies. Thus they are located in university campuses, research and development institutions and in technology parks and actively promote and support commercialization of technologies emerging from these organizations.

As a result of this the technology incubators provide in close proximity a pool of specialists, experts, research and development facilities, venture capital and other business support services. Besides, there are variety of other technology incubation models and concepts being experimented in Malaysia. As of March 2009, Malaysia has more than 106 incubators operating in the country with different types of incubation focus such as ICT, multimedia, advanced engineering, agro-bio, food, etc. Out of 106 incubators, 97 are government sponsored (federal and state), while only nine (9) are privately-owned (InfoDev, 2010). Table 4.6 summarizes the nature of Malaysian incubators.

Table 4.6. The Characteristics of Malaysian incubation centers (Source: InfoDev, 2010)

Malaysian Incubators	
1. Management and Operational Policies	
Objective	Facilitating technology transfer, to help universities and R&D centers commercialize their know-how, to help companies generate spin-off activities, contribute to local competitiveness and job creation, to help disadvantaged communities/individuals with dedicated projects
Nature	Non-for-profit organization. Mostly government sponsored, no examples of mixed private-public sector funding
Governance/ Structure	The federal government is the main and virtually the sole player in incubator development in Malaysia.
Sources of funding of TBI	Government covers 100% both start-up and running costs. The banking system remains the main provider of funds; alternative sources of financing include the development financial institutions and the various special funds established by the government, which are provided in the form of grants and soft loans. However, this support is mainly targeted at established companies and not much is available to start-ups.
Funding of new ventures	Venture capital comes from government under Malaysia technology commercialization centre. The targeted beneficiaries of the pre-seed fund programme are only individuals (existing companies are not eligible).
	a) Conditional funding to develop viable business plans into commercially focused ICT projects. b) It is not a pure grant and recipients will also benefit from mentoring services and access to shared lab facilities
Selection	Most technology-based incubators take into consideration: i) Enterprise profile, ii) Innovation, product/service type, business model, iii) Expansion in business scale and outcomes, iv) Benefits, take-up of specialized services.
Duration	Average duration of the incubation process is 4 years
Focus area	The main business activities tend to be ICT, research and development and advanced manufacturing.
Graduation	A series of formal criteria
2. Services Provided to Tenant Companies	
Include some pre-incubation services, advice on product development, help with raising finance, networking, and professional services, managed workspace and shared utilities.	
3. Performance and Outcomes	
Outcomes (up to 2010)	a) At an average of around 25 tenant companies per incubator b) At an average employment of around 3.5 per company c) Average size of incubators is around 50,000 square feet d) Average occupancy rate 75%

6. SOUTH AFRICA

The concept of incubation in South Africa was first practiced in 1995 when the small business development corporation (SBDC) established the “hives of industry”. The hives are a number of independent workstations that are grouped together to form a cluster of workshops and they were an attempt to bridge the first and third world economies in South Africa. Apart from providing basic accommodation at minimal rates, tenants were also provided with the small business development corporation’s collective support services including loans, business and legal advice, marketing assistance and bulk buying facilities. Prospective tenants were trained after demonstrating their skills. Tools, machinery and other equipment were also available for hire. Services such as bookkeeping, typing and telephone facilities were available to tenants at a small cost.

In 2000, the department of science and technology approved the establishment of the Godisa technology incubator programme in conjunction with the department of trade and industry (Mbewana, 2006). Godisa was established to develop a national incubation framework, experimenting with various models in order to identify the most suitable model/s for the South African environment. The Godisa trust aimed to bring about the enhancement of technological innovation through the creation of technology-intensive SMMEs with the objectives of increased economic growth, employment creation and sustainable development (InfoDev, 2010).

South Africa's has around 28 incubators supporting entrepreneurs in sectors as diverse as horticulture, construction, chemicals, ICT, biotechnology, metal fabrication, furniture manufacturing and platinum beneficiation. While there are a few private sector-led incubators, most are supported by the government. Table 4.7 summarizes the nature of South African incubation centers.

Table 4.7. The Characteristics of South African incubation centers (Source: Mbewana, 2006; InfoDev, 2010)

South African Incubators	
1. Management and Operational Policies	
Objective	Technology transfer and innovation, creation and development of sustainable and competitive SMEs, supporting selected groups (i.e. women entrepreneurship)
Nature	Non-for-profit organizations , mostly government-sponsored
Governance/ Structure	Promoted governmental mechanism favoring public private partnership based incubators a) All the incubators are registered as independent entities, being either not-for-profit companies or trusts, and report to Small Enterprise Development Agency b) The non-executive directors responsible for each incubator are appointed by the members of the Company or Trust, and the executive director manages the incubator.
Sources of funding of TBI	Government grants in successive funding phases (3 years)
Funding of new ventures	Funding shortages are feature of the incubation landscape. There is only one operational venture capitalist organization in the country and none of the incubators have in-house seed funds
Selection	The potential of the actual underlying business idea is crucial, not only the skills and qualifications of the individual submitting a business proposal. Most incubators take into consideration: i) Level of education ii) Product/process feasibility iii) Financial health iv) Previous experience etc
Graduation	A series of formal criteria determined by TBI
2. Services Provided to Tenant Companies	
Shared office environment ,access to science and technology expertise and facilities, availability of low-interest funding, supportive government policies, competent and motivated management and networking	
3. Performance and Outcomes	
Outcomes (As of 2009)	224 SMME's established and 10,628 direct plus indirect jobs created

7. UNITED STATES OF AMERICA

In many ways, the US has been a pioneer in the industry, many practices at developing country incubators have been derived from the American experience. Some of the best US incubators are university affiliated. A trend is towards incubators that are sector specific, or corporation sponsored (Lewis, 2008).

US incubation programs usually start as local initiatives by economic development agencies. Following the initial preparations, federal agencies are approached. Federal funding is usually limited to preparation and construction costs as well as research grants for client companies and is then compounded with other local/private sources (UN, 2004).

Small business clusters are the spontaneous (and at times deliberate) coming together of groups of entrepreneurs in geographic proximity for collective efforts in raising and sustaining competitiveness. The ultimate cluster phenomenon is Silicon Valley. In sixty years, has grown to over 7,000 electronics and software companies. Its 300,000 top scientists include some one-third born abroad. A dozen new firms (and many new millionaires) are created each week. What makes this 'innovation machine' really work is the prevailing culture of risk-taking, competitiveness, the critical mass of professional services from lawyers and accountants, the technical infrastructure and the venture capital (NBIA,2009).

Since 1998, the number of incubators in North America has nearly doubled. There are over 1,100 business incubators presently operating in North America, mostly in USA. 94% operate as non-profits. The general characteristics of USA incubators are summarized in table 4.8.

Table 4.8. The Characteristics of USA incubation (Source: NBIA, 2009; UN, 2004)

USA Incubators	
1. Management and Operational Policies	
Objective	To help small firms exploit and commercialize research results.
Nature	Mostly a nonprofit organizations , there is wide variation in incubator types, funding methods and quality
Governance/ Structure	Each community or institution sponsoring an incubator must develop its own operational plan, mission and goals
Sources of Funding of TBI	Some federal funds are available to help organizations build or renovate facilities into new incubators. The largest source of federal funding for business incubators comes from the U.S. Department of Commerce Economic Development Administration
Selection	A series of formal criteria determined by TBI
Graduation	A series of formal criteria determined by TBI
2. Services Provided to Tenant Companies	
Workspace, shared physical facilities, management support, technical support and networking assistance. Access to other professional services (such as legal and accounting/financial) and access to capital	
3. Key Performance Indicators	
Occupancy rate is 81% (on average) Survival rate is 87% Average number of tenants per incubator is 25 (in-house and affiliates combined) Average number of full time jobs per tenant company is 7.7 Average new jobs created per tenant per year is 2 Average tenancy period is 33 months	
4. Outcomes (as of 2005)	
Assisted more than 27,000 start-up companies that provided full-time employment for more than 100,000 workers and generated annual revenue of more than $17 billion.	

4.3 Success Factors and Lessons Learned

Even though there is a variation between the aforementioned countries in terms of objectives, geographical characteristics and the needs of the incubated companies, there are generic elements that present in the incubation process of all countries' incubator. The following key issues, that should be considered while establishing technology business incubation in Ethiopia, are summarized.

1. The need to have clear objective (business plan) prior to establishment: Well described goals or an objective of the center is the first priority while establishing technology business incubation. The incubator should aim to support businesses in an industry that is structurally and contextually feasible and attractive in the country. Therefore feasibility study has conducted, to design the business incubator and assess whether an incubator might be feasible or not. Consequently, a preliminary business plan which contains incubator's environment, target markets, management plan, operational policies and procedures, the marketing strategy, types of business which will be incubated, forecast of possible internal and external risks should be incorporated.

2. The need to define stakeholders /local alliances of the TBI: It is the responsibility of governments to introduce and expand the establishments of technology incubation centers through various policy directions and supports. The support may include ensuring an effective environment for business growth, reducing unnecessary bureaucracy, creating circumstances where fair competition can flourish, ensuring access to finance and services, access to public and private R&D, incentives for entrepreneurial activity and innovation (tax incentives, intellectual property laws that facilitate the commercialization of ideas.). Though government and its institutions might play the lion's share in promoting TBI, there should be a number of organizations that involved in such endeavors. Therefore these stakeholders should be identified and their role in the process should be defined. The most important stakeholders of the incubators are government agencies, local authorities, academic centers, research/development centers, commercial firms, financial institutions, trade unions, business associations. Each stakeholder has its own input for the TBI and can involve in the governance of the center. Success of the center could largely dependent on the level of involvement of the stakeholders.

3. **The need to develop mechanisms for financing the TBI:** Financing the TBI is required at two different phases of the incubation process. The first phase is at the stage of establishing (creating) the center which is rendered for implementation of training programs, development of infrastructure, development of services. The second phase is at the stage of operational activity which includes staff salary, utility cost, maintenance cost, and loan fund for tenants. These grants could be acquired from government, stakeholders and international donors. Best experiences show that incubators are more likely to succeed when supported by a broadly based partnership of public and private sector sponsors. Particularly in the initial stages, public sector funding is critical to ensure that incubators become operational. Meanwhile revenue could be generated by collecting money from rent and other various services. Financial support does not necessarily mean a support in cash but it could be in kinds. Many financing options exist for entrepreneurs, from private sources through banks to family. Each has its own requirements, both formally and informally, ranging from appropriate loan amounts, application procedures and collateral. Knowing these requirements is the basis for determining financing strategies.

4. **The need to include services provided to the tenant in TBI:** Services that are provided for tenants are different from one incubator to another. There are a number of factors for the variation of services rendered. Generally, technology business incubators provide basic services such as rent of space, workshops, laboratories or halls. Common services may include secretarial support, internet, security services, reception and mailing facilities, access to office equipment, meeting rooms, conference facilities, and exhibition space and catering. Moreover, they provide counseling and advising on business planning, accounting, legal, marketing, production, innovative technologies, access to research specialists, matching with partners from universities and research organizations, improving productivity, quality control and maintenance. Access to financial resources, namely early-stage financing (seed funds, venture capital funds), soft loans and grants is also provided in the center.

5. **The need to have clear entry and exit criteria that in line with the objective:** TBIs should have strict admission and exit criteria and the set of business support services is designed to include those that facilitate technology transfer and commercialization of new technologies.

6. **The need to staff the TBI centers:** Incubator facilities are run by various types of boards with varying degrees of representations. These boards provide overall direction. However, the day to day activities of incubation center is monitored through its permanent staff. The number of administrative and professional staff depends on the size and nature of the incubator.

7. **The need to evaluate the activities of the TBI:** In order to expand and improve the service of incubators, the performance should be evaluated. Efficiency of the incubators is determined through financial measurements, measurements of operational activity, and measurements of the services. Usually exit rates, the growth of graduated companies, taxes paid, average salary/new job created, and the amount of private equity attracted, funds raised by the companies, jobs created and business survival rates are indicators adopted to assess impact regardless of the final goals of the incubation initiative.

CHAPTER FIVE

5. DESIGN OF TBI FOR METAL AND ENGINEERING SECTOR

5.1 General Description of the Center

The proposed technology business incubator is for small scale innovative entrepreneurs or business start up that focus on metal and engineering sector. The term small scale is used to express that the facility is not equipped with hi-tech equipments and it is not intended for practicing of advanced technologies. Instead the proposed facility is equipped with traditional equipments used to perform basic innovative/ technological tasks. It is evident that hi-tech facility has a tremendous impact on technological and innovative economic development efforts. But certain factors should be considered while looking for such facility as an option. The context of our country could not be viable to host hi-tech incubation centers, at least, at this very beginning for a number of reasons. Some of the reasons could be the country's culture toward science and technology is not yet developed, the availability of intellectuals and innovators in hi-tech might not be adequate to call for such centers, the financial capability and option to establish such facility might not be feasible where the idea of technology incubation is at infancy stage and above all its beyond the objective of this study. Generally by considering the possibility of the proposed TBI growing into hi-tech facility, the stage of technology incubation concepts in the country and the immediate need of the country; it is decided to establish a facility used for basic innovative metal and engineering works. Hence in this study conventional mechanical workshop practice is exercised.

The primary mission of the proposed incubator is to contribute to the growth and success of emerging technology businesses in metal and engineering sector. In line with this, the center will bring a number of direct and indirect benefits to the sector, community and the country. The proposed incubator includes facility space, business development assistance and networking to capital and other technical resources. From the benchmarked countries the following general parameters are adopted for the proposed establishment.

Table 5.1. Adopted parameters for the proposed establishment

Parameters	Description	Reason
Objective	To assist the growth and success of technology or innovation based enterprises in metal and engineering sector	The sector has a considerable economic impact and should be assisted with tools of technology transfer in order to bring technological development for Ethiopia
Nature	Not-for-profit	Incubation industries are new to Ethiopian context, and the idea for profit is not viable at this early stage.
Governance	Board of directors who are representative of stakeholders governs the center	From the best practices, the participation of stakeholders in governance of the center brings sustainability to TBI.
Sponsor for establishment	Government and its institution	Since the concept is new; government should take the first initiation and then the participation of private sector might follow.
Duration of tenants	A maximum of three years	From the experience of bench marked countries of manufacturing based incubators
Number of tenants	Twelve	Considering the early stage of TBI concept in Ethiopia and the experience of bench marked countries
Services offered to tenants	Common workshop, individual offices, common facilities, Business development services, Networking services	Considering the basic metal and engineering sector along with the experience of benchmarked countries
Selection criteria	Innovation based	To achieve the objective of the center
Graduation criteria	Meeting the milestones or goals of the TBI	Creating successful technology based businesses is the goal of TBI
External client service	Business development services, consultancy, training	These services are useful for SME and established businesses. Based on the requirements of clients, additional services might be added

The above parameters serve as the general guidelines for the establishment of the center; however, the detailed design parameters are elaborated in the subsequent section.

5.2 Location Area for the Center

The general criteria for selecting location in the establishment of TBI are compatibility with proposed use, location relative to the market served, costs of acquisition or rehabilitation, size of space, lease flexibility, availability of infrastructure and etc. There are a number of potential places or regions that satisfy one or more of the above criteria for the development of TBI in Ethiopia. However, the proposed center is the first of its kind (focuses on basic metal and engineering sector); high consideration is given to its potential to expand throughout the country. By considering all selection criteria and the potential places in Ethiopia, Addis Ababa is selected. The bases for the selection of Addis Ababa are;

1. Most basic metal and engineering industries (47.5 %) are distributed in Addis Ababa city
2. It has a diversified economy like commerce, manufacturing, finance, real estate and insurance.
3. It has numerous private colleges in addition to government's universities and institutions.
4. All the roads interconnecting regional governments are passing through it. Additionally, it has Bole International Airport.

Generally, Addis Ababa is considered to excel all potential towns in the country in terms of communication infrastructure, proximity of knowledge source, business and finance service and availability of entrepreneurs.

Further, the selection of specific site for technology incubator is determined by a number of criteria. Because of its nature and mission the proposed TBI should be near to technical universities. As a result, there are two basic site options for the proposed TBI facility in Addis Ababa. Either it should be near to Addis Ababa Technology Institute in Arada sub-city or near Addis Ababa Science and Technology University which is in Akaki Kality sub-city. However, the latter option is better for a number of reasons such as adequate land to accommodate an incubator facility and possibilities for future expansion, land cost, availability of a large number of industries in the region. Hence, Akaki Kality sub-city is the proposed site and the land is in close proximity to Addis Ababa Science and Technology University.

5.3 Services Offered in the Center

5.3.1 Physical Infrastructure

While considering design parameters, it is widely agreed that there is no standard or one size fits all incubators. Therefore, the subsequent design parameters are adopted from the manuals and feasibility study in the bench marked countries, from NBIA, from conventional machine shop and office facility design principles to Ethiopian context.

5.3.1.1 Foundry and Mechanical Workshop

Since every innovators/ entrepreneurs are coming to the TBI center with their own unique products, the series of processes required for their innovative products could be quite different. As a result in the proposed workshop it is tried to include facilities that required for performing basic metal manufacturing processes. The manufacturing of basic metal and engineering passes through different processes such as; casting and foundry processes, forming and shaping processes, machining processes, joining processes, and finishing processes. The proposed TBI includes basic tools and equipments used to perform the aforementioned processes. The level of the facility can be considered as a medium size workshop.

Casting and Foundry Processes and Equipments: Foundry operation consists of mainly melting, molding, sand preparation and conditioning, core making, pouring, cooling, surface cleaning, fettling, heat treatment, inspection and casting repair. Sand casting is selected for the process because it is an inexpensive method for making a small number of parts and medium to large parts of a range of ferrous and nonferrous alloys. Considering the scale of the proposed TBI; sand casting equipments which are relevant with the objective of the center are proposed. The equipments and materials proposed for the TBI to perform the processes are melting furnaces, sand core shooting, sand mixer (muller), molding machine and hand tools such as hand riddle, shovel, draw spike, lifters, slicks, smoothers and etc.

Forming and Shaping Processes and Equipments: A multitude of operations are classified as bulk forming processes, of which rolling, forging, and extrusion are the most important. On the other hand sheet-metal operations include shearing, bending, stretch forming, spinning, and explosive forming are included under this process. Though there are a number of equipments available for this process, shearing and bending (rolling) machines are proposed.

Machining processes and Equipments: Machining processes also called material removal processes use a sharp tool to remove material from the work piece in the form of chips. For the purpose of performing machining operations saws, lathes, milling machine, drilling machines and grinding machines are proposed.

Joining Processes and Equipments: Joining processes include mechanical fastening, adhesive bonding, and welding processes. For the purpose of such operation arc welding equipments and riveting machine are incorporated.

Finishing Processes and Equipments: There are a number of finishing operations that can be applied to metal products. In most cases, the finishes will protect the product from corrosion**.** Finishing processes include polishing, sand blasting, cladding and electroplating, and coating and painting. Compressor with spray gun is the machine proposed for the finishing process.

Metrology equipments: These are equipments that used for measurement tasks. Scales, vernier scales, micrometer scales, dial indicators, calipers and transfer gauges are included. Moreover metal layout equipments like scribers, dividers, trammel, hermaphrodite caliper, surface gauge and surface plate are considered.

Miscellaneous equipments: Apart from the above equipments, simple material handling equipment (hand trucks or trolleys) , some safety materials (include welding aprons, gloves, face shields, respirators and fire extinguishers and comprehensive first aid equipment) and simple electrical testing equipments are included.

The abovementioned machines and tools are general purpose equipments; however, the tenant might need special equipment and testing apparatus that are not available in the TBI. In this case the manger of the center can facilitate the access of such equipments and apparatus through networking with universities or other organizations.

The raw materials used in the center are mainly sheet metals and various sizes of metal rods. It is assumed that there is no need for larger storage area as space allocated for tenants are adequate to accommodate their own raw materials. Therefore, a small common storage area is designed with in the workshop. By considering the proposed machines and equipments, the

size of tenant companies and experience of benchmarked countries, the following area requirement is proposed for the design of foundry and mechanical workshop facilities.

Table 5.2. Space requirement for common workshop area

Facility	**Area requirement**
Workshop area	460m^2
Storage	50 m^2
Total area	**510m^2**

As traditional mechanical workshop facility design practices, a high ceiling clearance of 4.5 m and long clear span distances of 10 m with high bay lighting fixtures is considered. The machines are laid with a minimum aisle distance of 1.5m between two machines. Moreover, an office of size 9m^2 for technical assistants with in the workshop and an open loading dock are proposed. The facility is equipped with basic utilities such as electric power, water and fire emergency equipments.

5.3.1.2 Individual Tenant Rooms

Offices that are offered for tenants can vary depending on specific factors. The space requirements for tenants of manufacturing sectors are larger than any sector specific TBI. Therefore, the proposed individual tenant rooms are also based on industries experience. Based on their stage of development tenants are classified into early stage, mid level stage and near graduation stage. The resource capacities of near graduation tenant companies are higher than the new entrants. As a result, near graduation stage companies require larger area than others; similarly, the mid level stage tenants require larger area than early stage companies. Such allocation of space allows tenants to move within the building and provides flexibility to accommodate tenants as they grow.

By taking the size, sector and stage of development of the tenant being targeted, the following office configuration is proposed for the twelve tenants' office.

Table 5.3. Office area requirements and configurations for tenants

Type of Tenant	**Number of Units**	**Size of Units**	**Total size**
Early stage	6 (50%)	50 m^2	300 m^2
Mid level stage	4 (30%)	90 m^2	360 m^2
Near graduation stage	2 (20%)	120 m^2	240 m^2
Total Space			900 m^2

Additionally, a separate toilet with an area of 6m^2 and two shower rooms with an area of 10.5m^2 for tenants are designed. The flexibility of each tenant's office sizes is introduced by creating moveable office partitioning. Each individual office units designed to have roll-up doors that are 2m wide. Moreover, they have equipped with office furniture. However, it is the right of tenant companies to change their interior office space based on their needs and requirements.

5.3.1.3 Offices and Common Facilities

While considering administrative and support functions included in the center, it is mainly adopted from the bench marked countries. However, based on the context of our country additional secretary rooms, security rooms and first aid room are included. The design parameters for facilities are based on the anticipated organization structure, administrative function, and expected number of persons. In addition to these factors, the general practice of incubation centers' office configuration is incorporated. Table 5.4 shows the designed office and common facilities space requirements.

Table 5.4. Area requirement for offices and common facilities

Offices and common facilities	**Proposed Area in m^2**	**Description**
Offices		
General manager office	17	Adequately sized to accommodate private meeting with 7 people.
Executive secretary	12	Can accommodate up to 4 guests
Administrative	12	Can accommodate private meeting with 5 persons
Technology advisor	12	Can accommodate private meeting with 5 persons
Reception	14	To provide information to guests
Common Secretary	9	
General service	9	Private office with 2 guest seats
IT officer	9	Private office with 2 guest seats
Common facilities		
Product display	50	To showcase innovative products of tenants for
Secretarial service	12	To provide clients with secretarial services
Conference hall	80	Can handle 50 individuals
Training hall	50	Can handle 20 individuals
Computer lab	24	Can handle 10 individuals at a time
First aid room	13	
Resource Center	40	Provides tenants with information and resources
Material store	11	To store materials such as stationery, sanitary
Cafeteria	60	Provides seating for more than 25 customers
Janitorial	4	
Toilets	10	For management staffs alone
Lobby area	15	
Total Area in m^2	**433**	

Moreover networking spaces through which people have to pass or corridor at 1.8m wide is proposed. Therefore, including corridor space, the built area for offices and common facilities is 590 m^2. The total built up area for the proposed TBI is summarized in table 5.5.

Table 5.5. The total built up area of the center

Facility	**Land allocation in m^2**
Offices and common facilities	590
Foundry and mechanical workshop	510
Tenant offices with common toilets and showers	920.8
Total built up area	2020.8

Additional Facilities:

Car parking: A parking area which accommodates 20 cars at a time is proposed. It is assumed that most vehicles that come to the facility are external clients' (guests) and tenants' cars. Therefore, based on parking standards, 2.4m x 4.8m parking space for each car is proposed. Though it might not frequent, rigid vehicles can come to the center to load and unload raw materials, products, machines and etc. For this purpose 3.06m x 6.12m parking area is considered.

Road: Assuming the frequent types of cars coming into the center are small, a road of 5 m wide is designed.

Security room: Security or guard room is designed at the gate which has an area of $6m^2$.

Green area: An area of 100 m^2 is allocated for green area.

Expansion region: An area 17 % of the total which is 660 m^2 for future expansion is anticipated.

Electrical system: A 3-phase electrical supply is connected to the TBI. The foundry and mechanical workshop uses different electrical meters from the administrative and common office areas.

Telephone and Internet: Each administrative office unit has a fixed line telephone and broadband internet connection. Moreover, each office unit is networked with each other.

Generally, the total land requirement for the proposed facility is ***4565 m^2***, of which ***2020.8 m^2*** is a built-up area. The remaining land is used for pass way, green area, parking and future expansion.

5.3.2 Business Development Services

Business development services (BDS) include the types of expertise required by businesses in order to be successful. BDS are offered to both the tenants and external customers. Through such services that the center is able to provide an integrated coaching and training program for small and micro enterprise at very affordable prices. Apart from this, BDS enable the facility to be financially independent by generating incomes. A number of business development services are provided based on the need and requirements of the clients. However, the major services included in the center are:

Business planning and skills development: In order to help both internal and external clients to overcome the common barriers to start-up, survival and growth, the center provide a range of business planning advice, support and basic business skills training. These include; preparation of business plans, financial documentation, market research, feasibility studies for business development, management skills training and etc.

Consulting Services: The center provides consultants to the established or yet to be established organizations that in need of such services on charge bases.

Educational programs: Based on recommendation from the general manager, an education program that is relevant with the client companies is provided on regular basis. Such services include; courses on production process, new manufacturing technology, quality, maintenance engineering and etc.

Seminars: Seminars emphasizing topics of special interest to emerging technology businesses are provided on a regular basis. The general manager identifies topics based on an understanding of incubator client needs and invite guest speakers with expertise in the topic area.

Resource Library: The center builds and maintains up to date information resources for technology start ups including resource directories, business form templates, and checklists.

5.3.3 Networking Services

Networking services are the major responsibility of the general manger and mainly delivered to the tenant companies. Since they are new and their business knowledge is low,

entrepreneurs are unable to connect themselves to the financial and business network easily. Therefore, in order to overcome such barriers of start up companies the TBI center provides the following services to its tenant companies.

Financial network: The incubator establishes and maintains relationships with a network of banks, creditors, associations and investors to acquire seed and venture capital for tenant companies. The incubator provides introductions between incubator clients and appropriate investment resources. Such networking can be made with Commercial Bank of Ethiopia, Development Bank of Ethiopia, Construction and Business Bank of Ethiopia, Addis Ababa Credit Associations, private and cooperative banks.

Professional network: The incubator develops a high-quality professionals, technologists and business owners that have the technical and business skills needed to support client businesses. It screens such professionals and facilitates the interaction between them and the client. Addis Ababa is a home of many international and national organizations. Moreover, a number of professionals and scholars are dwelling in the city. As a result, it is possible to identify and networking them with the center.

Educational institutions network: Educational institutions provide a talented, affordable work pool to support incubator and incubator client projects. Moreover, they provide library, technology and research resources for start up companies. Apart from Addis Ababa University and Addis Ababa Science and Technology University; many private colleges, training institutions, technical and vocational institutions are available in the city.

Networks of suppliers, customers, investors: The TBI facilitates interaction between its clients and key industry participants including raw material, accessory and machinery suppliers, potential users and buyers of technology products and investors who are willing to invest as business partner. Most of metal and engineering companies, technology product suppliers and big investors are in the city and around the city. Hence, the task of networking the center with suppliers, customers and investors can be smooth.

The aforementioned networking services alone might not be adequate; governmental organizations, technology institutions, policy makers can also be contacted and networked with the center. Generally, it is the responsibility of the general manger to identify individuals, organizations and institutions with which networking are important.

5.4 Facility (Layout) Design

While designing the layout of the proposed center, it is tried to allocate each facility in convenient places for its intended function. Moreover, special consideration is given for efficient use of space. The minimum distance between parking and building as well as between road and building is considered. The parking is designed in a way to accommodate large number of cars with available space. Each building side is accessible except for workshop building which is aligned with the fence in order to save construction cost. Green area and future expansion region are also placed for their intended purposes. The cafeteria and product display facilities are easily accessible by external visitors. Generally, the layout of all facilities is depicted in Appendix E.

5.5 Governance of the TBI Center

Apart from making policy document and monitoring the progress, in this model of TBI the task of establishing and funding the center lays on the government and governmental organizations. The TBI center is sponsored by government and it serve as a non-profit entity. The non-profit establishment enables the tenants to acquire the supports at minimum charge. The following institutions are identified as the potential stakeholders of the TBI. The organizations, which are regarded as the owners, provide the required support during and after the establishment.

1. Addis Ababa Science and Technology University
2. Addis Ababa Technology Institute
3. Ministry of Science and Technology
4. Addis Ababa City Government
5. Ministry of Education
6. Addis Ababa Credit and Saving Institution
7. Development Bank of Ethiopia
8. Ministry of Industry
9. Ethiopian Association of Basic Metal and Engineering

The reasons behind the selection of the above organizations as stakeholders are mainly related to their importance and direct relation with TBI establishment. Addis Ababa Science and Technology University, Addis Ababa Technology Institute, Ministry of Education and

Ministry of Science and Technology provide coaching, training, technology related materials, research and innovation documents to the center. Addis Ababa Credit and Saving Institution and Development Bank of Ethiopia serve as the financial source for TBI clients. Ministry of Industry provides the required support for graduated companies in order to sustain them in business. The established TBI center is located in Addis Ababa; hence, Addis Ababa city government plays an indispensable role by providing the necessary infrastructures such as land, water and electricity. The established TBI model is sector specific; as a result, the involvement of Ethiopian Association of Basic Metal and Engineering assist the incubated companies in creating links and integration with the big and already established metal and engineering firms.

Through their restless effort the board of directors and the general manager can attract a number of stakeholders. Other institutions, private organizations, donors, NGOs and governments could be stakeholders. Increasing the number of stakeholders broaden the supports that the facility is receiving in kind and quantity.

5.5.1 Organizational Structure

The TBI center is run as an autonomous business entity and report to the board of directors. The following organizational structure is customized in order to administer the activity of the center. The structure enables to implement the incubator program with a minimum of administrative and bureaucratic effort.

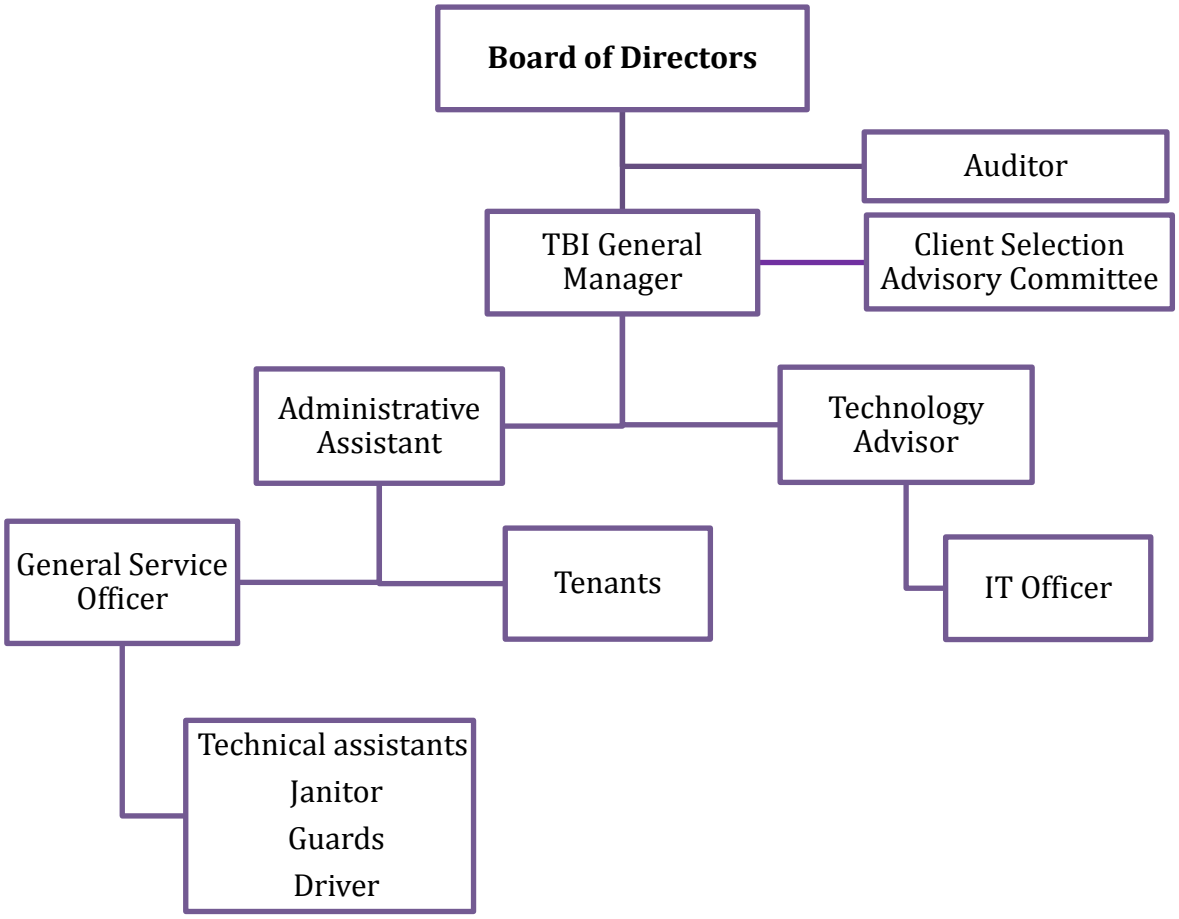

Figure 5.1. The organizational structure of the TBI

5.5.2 The Components of the TBI's Organization Structure

Board of directors: The board of directors is comprised of 9 members. The members are the representative of the stakeholders (owners) of the TBI center. Board members are nominated by stakeholders. Planning and formulating policy (strategic planning), hiring the general manager position, managing external relations and promoting the incubator are some of their roles and responsibilities.

Client Selection Advisory Committee: Client selection advisory committee members are chosen for their experience and understanding of business development issues, interest in technology development, and adequate academic knowledge. Their numbers is greater than five and serve the incubation center on temporary basis. They are drawn from the universities, professional association, metal industry and other agencies, to advise on the selection of tenant businesses, and their exit.

Auditor: An independent, external auditor is nominated and hired by executive committee of the board. The Auditor audits the financial operations of the incubator on an annual basis and report to the board of directors.

General Manager: The general manager is hired by the board of directors and reports to them. The general manager should have an entrepreneurial capacities and experience, excellent communication, sales, negotiating, decision-making and networking skills. Experienced in technology start-ups and understanding of business management are crucial criteria. A person with master's degree in technology affiliated and business administration fields such as industrial engineering, business administration or operation management suit the position. Some of the major duties of the general manager are managing the overall operations, identification of constraints to tenant success followed by corrective actions and establishing network of venture capitalists.

Administrative Assistant: An administrative assistant is the first contact that people have with the incubator and tenants. Administrative Assistant supports to manager on public relations, computer systems, administration, and maintain equipment and supplies.

Technology advisor: Technology advisor is responsible to the manager for technology support, counseling and information programs focused on tech-venture creation. While not necessarily technologist or engineer, a technology orientation is essential for the position. A person with a strong interest and experience with issues of technology venture creation and familiarity and contacts with the local technology establishment are some of the qualification required for technology advisor.

Technical assistants: Technical assistants are hired to support tenant companies on technical matters. Some innovative products may require complicated processes; hence, technical assistants should have extensive work experience on the sector. Additionally their educational level should be competent with the requirement of the facility. A diploma level education and an experience of machine maintenance are some of the criteria.

IT officer: IT officer is an expert in IT field and has some experience in office equipment maintenances. He/ she assist the center in IT related tasks.

General Service Officer: General service officer oversight the overall facilities in the center and reports to the administrative assistants.

Other staffs: Additionally three secretaries, four guards, one driver and two janitors are proposed for the center.

Generally, at the initial stage the incubation might not have adequate capital to hire the required number of staffs. Therefore, the existing staffs are likely to perform multiple tasks. All management and staff are employed by the TBI general manager. All decisions related to staff are made by the general manager, including selection, hiring and dismissal.

5.6 Financial Analysis

The financial analysis presented in this sub topic includes a facility development budget that considers a new construction of the TBI facility located within the Akaki-Kality sub city, an estimate of capital expenditures for start-up, and operating costs for the first year. The estimated costs are based on the data obtained from Ethiopian investment Agency, Addis Ababa city administration investment authority, and from the field survey of suppliers of furniture and office accessories.

5.6.1 Facility Development Budget

The facility development budget includes land and construction related costs for the TBI facility. Although the land required for the TBI facility can be acquired free of lease, the lease cost of the land is included in the estimation. The minimum lease price in Addis Ababa administration is varying based on the grade of land. Table 5.6 shows the minimum lease price of land in expansion zone of Addis Ababa.

Table 5.6. Minimum lease price for expansion zone in Addis Ababa city administration (Source: EIA, 2008)

Land zone	Grade of lease land	Minimum price in birr/m^2
Expansion zone	1	273
	2	230
	3	167
	4	147

The lease holding of urban land is on auction or negotiation basis. Assuming the land in expansion zone of Akaki-Kality sub city, the city administration can provide it with birr 273 per square meter on negotiation.

Regarding cost of building, it generally differs by type of the construction materials used, the type of foundation, wall height, and location. The data from Ethiopian investment agency shows the average cost for simple storage building is from birr 1500 to birr 2500 per square meter.

Table 5.7. Building cost in Addis Ababa (Source: EIA, 2008)

Building type	**Price in birr per m^2**
Simple storage building	1500-2500
Apartment building up to four stories	2500-3800
Tower building with elevator facilities	2800-4500
Residential G+1 building (normal)	2400-2800
Residential villa type building (bricks)	2500-3000
Residential villa type building (HCB)	2000-2600

However, for the proposed TBI birr 3000 per m^2 is taken by considering the complexity or height of the building and the current construction materials cost increment. The total budget for facility development is summarized in table 5.8.

Table 5.8. Facility development budget estimation

Facility cost	**Units in m^2**	**Unit cost**	**Total cost in birr**
Land lease cost	4565	273 birr per m^2	1,246,245
Construction cost	2020.8	3000 birr per m^2	6,062,400
Roads and parking area	800		130,000
External areas, fence, landscaping etc			220,000
Total facility development budget			**7,658,645**

5.6.2 Capital Expense Costs

Capital expenses are related to start-up costs such as furnishing for foundry and mechanical workshop, administrative offices, computer lab, training and conference rooms, etc. Costs for furnishing the cafeteria are not included in this estimation, because it is desired to lease or rent it for service providers.

Though there are simple machineries and hand tools which are available in local markets, most machineries required for the center are to be imported from abroad. The valuation for locally available machines and tools are based on market survey. But, the costs for other machineries are calculated based on the fact that they are imported from China. The cost is assumed to cover the shipping of all the machineries to the port of Djibouti. After the port, a road freight transport mode is used. Dry bulk traffic from port Djibouti to Addis Ababa charges birr 75 per quintal and this rate used in calculation. The weight and other specification of the machines are shown in Appendix D. Since the TBI is sponsored and established by the government, custom duty charges and clearance charges are neglected. The individual and total estimated costs for capital expenditure are presented below.

Table 5.9. Foundry equipments and costs

Foundry Equipments	**Unit**	**Price in birr**	**Description**
Foundry Electric Induction Furnace	1	103462.5	Imported
Sand Core Shooting Machine	1	86300	Imported
Foundry Sand Mixer	1	43675	Imported
Sand molding machine	1	95275	Imported
Hand Tools (hand riddle, shovel, draw spike, lifters, slicks, smoothers etc)		20,000	Local Market
Sub total		348712.5	
Contingency 5 %		17435.63	
Total		**366,150**	

Table 5.10. Imported machineries cost for mechanical workshop

Imported machineries for mechanical workshop	**Unit**	**Price in Birr**
Heavy duty lathe machine	1	349850
Universal lathe machine	1	175007.5
Universal milling machine	1	139250
Power hacksaw machine	1	14270
Vertical drilling machine	1	17950
Metal cutting band sawing machine	1	45470
Mechanical eccentric press	1	116105
Hydraulic shearing machine	1	173725
Rolling machine	1	104925
Tool grinder	1	13289
Radial drilling machine	1	86825
Sub total		1236667
Contingency 5%		61833.33
Total Cost		**1,298,500**

Table 5.11. Locally available machineries and tools cost for mechanical workshop

Locally available machineries and tools for mechanical workshop	Unit	Unit cost in birr	Total cost in birr
Hand drilling machine	2	2700	5400
Circular saw	2	5500	11000
Hand grinding	2	3500	7000
Bench grinder	2	1500	3000
Bench drilling	2	7500	15000
Riveting gun	3	1200	3600
Bench vice	4	3840	15360
Welding machine	2	17000	34000
Compressor with spray gun (270L)	1	22800	22800
Hand tools and accessories		30000	30000
Metrology Equipments		10000	10000
Miscellaneous equipments		45000	45000
Sub Total			202160
Contingency 5 %			10108
Total			**212,268**

Table 5.12. Capital costs for office furniture and accessories

Capital Expense	Unit cost	Unit	Estimated costs
Administrative Office Equipments			
Desk top Computers (including all accessories	9000	11	99000
Lap top computers	12500	2	25000
Printers	6500	3	19500
Photocopier	11000	3	33000
Scan print and copy machine	4000	2	8000
Fax with installation	8000	2	16000
Tables	different types	10	41546
Chairs	different types	10	23774
Guest chairs	different types	26	34390
File cabinets		13	24700
Shelving		4	10400
Fixed line telephone and internet supply			10000
Contingency			15000
Computer lab equipments			
Computers (including all accessories and	9000	10	90000
Computer tables	1010	10	10100
Chairs	1000	10	10000
Conference room			
Desks	2300	66	151800
Tables		1	3164
Audio visual equipments and white board			39000
Digital camera		1	4500

Training room			
Desks	1800	25	45000
Tables	different sizes	10	36200
Whiteboard and other accessories			10000
Resource Center			
Tables	1100	4	4400
Chairs	1000	4	4000
Shelves	2400	6	14400
Books, softwares	Estimated		15000
Furnishing Tenant offices			
Chairs	1840	12	22080
Tables	3103	12	37236
Cabinets	1900	12	22800
Pick up truck		1	300000
Miscellaneous			45000
Total costs in birr			**1,224,990**

From tables 5.9, 5.10, 5.11 and 5.12, the capital cost for machineries and office equipments is 366,150 +1,298,500+212,268+1,224,990 = **birr 3,101,908**.

The estimated cost of erection including consulting mechanical engineers, preparing special foundations and physical erection of machineries is birr 75,000. Similarly, the cost of electrical equipments such as electric motors, starters, switches, cables & other electrical items are assumed to be birr 150,000.

Therefore, the total capital cost is 3,101,908 +75,000+150,000= **birr 3,326,908**

5.6.3 Operating Budget

The operating budget estimates expenses associated with the first year of TBI operation including salaries. But some expenses such as utility costs for foundry and mechanical workshop should be paid by tenants. The administration or management of the center will propose mode of payments for each tenant. Table 5.13 shows an annual salary of the employee based on the current minimum salaries of civil servants.

Table 5.13. Estimated salaries for the employees of the TBI

No	**Description**	**Required number**	**Salary in birr**	
			Monthly	**Annually**
1	General Manager	1	6530	78360
2	Technology advisor	1	4500	54000
3	Administrative Assistant	1	3000	36000
4	General service officer	1	2500	30000
5	IT officer	1	3000	36000
6	Secretaries	3	3300	39600
7	Technical assistants	2	2000	24000
8	Janitor	2	970	11640
9	Driver	1	800	9600
10	Guard	4	2200	26400
11	Gardener	1	450	5400
	Total	18	29250	**351000**

Like wise the remaining operating budget is shown in table 5.14.

Table 5.14. Estimated annual operational costs for the first year

Operational Expense	**Description**	**Annual estimated costs in birr**
Salaries		351000
Employee reimbursement	Travel, parking etc	36000
Meeting refreshment		6000
Employee training		8800
Professional services for TBI		90000
Utilities	Electric, water, internet etc.	41000
Simple Equipments		15000
General Supplies		50000
Maintenance		25000
Miscellaneous expenses		25000
Contingency	2% of the total	12956
Total annual operational costs		**660,756**

Based on the above estimations the total budget for establishing and operating the first year of the technology business incubation is 7,658,645 + 3,326,908 + 660,756= **birr 11,646,309.**

5.7 Incubate Selection Process

Applicants might learn about the incubation program (notice for application) through web site, telephone, mail, personal contact or an incubator visit. Therefore, if they are interested all prospective candidates complete a brief application form. The brief application form includes description of the applicant's current business (personal) status and a very preliminary sense of the applicant's service and facility needs.

Then the manager evaluates the application against the predetermined criteria. If the business description or business plan adequately addresses screening criteria, the potential candidate is informed for further interview or presentation in the presence of selection panels. Meanwhile, applicants that fail to fulfill the criteria are informed by the manager.

Applicants who meet the incubator's basic qualifications (pre-screening) are invited for a formal interview or presentation with the manager and selection panels. Based on the panel's input, the general manager makes a decision regarding acceptance and inform the Board. Then after the decision of the board of directors; the selected clients sign contractual agreement with the center. The contractual agreement include, understanding of the TBI center objectives, graduation criteria and possible reasons for a client's termination from the program and the time they have to quit.

After the clients enter into the program, all the efforts of the incubator is toward offering services and programs which strengthen the company for its future entry to market. Moreover, continuous monitoring of the client companies is carried out.

Finally, after going through all the process of incubator, the management evaluates the performance of the clients. If the clients satisfy the graduation criteria, clients leave the incubator, setting up an independent room and consolidating itself to the market of its choice. Meanwhile, the clients that fail to satisfy the objective of the incubator or fail to perform according to the agreement are forced to leave the program. Generally, the devised incubation process is depicted in figure 5.2.

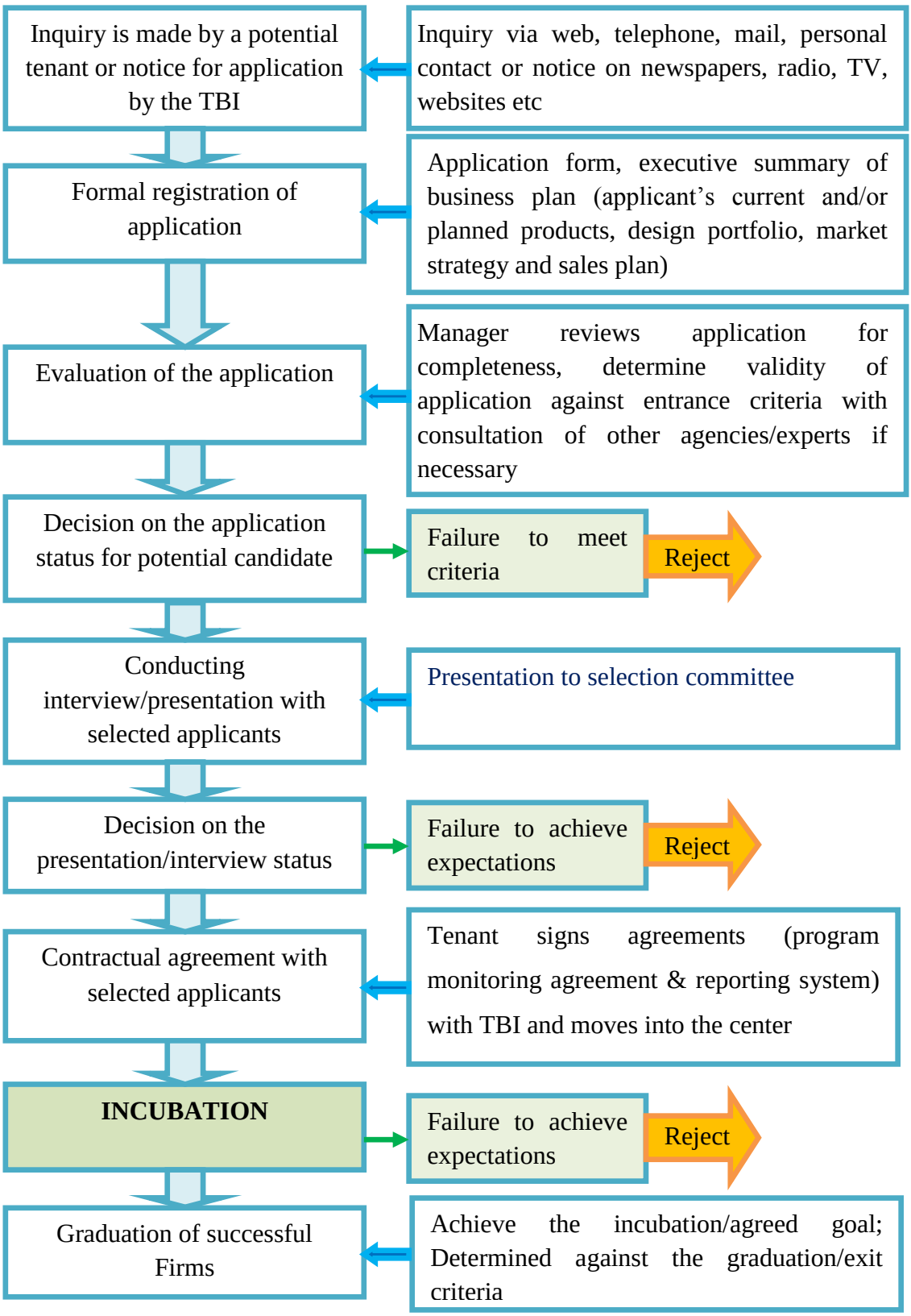

Figure 5.2. The incubate selection process

5.7.1 Selection Procedures

The selection committee which is a panel of six to eight people (comprise of representative of stakeholders and experts in the field of technology and manufacturing backgrounds) assist the general manager in understanding the business case and determining if the applicant should be approved for acceptance into the incubator.

5.7.2 Entry Criteria

In order to ensure clients benefit from the services provided and to achieve the goal of the incubator, all applicants are evaluated against a predetermined set of criteria. In this particular case the following entrance criteria have been adopted for use at the TBI center.

Table 5.15. Entry criteria for the proposed TBI

Applicants should have a certain level of academic competence
Applicants have an innovative business idea with a technology related character. • It should be an idea of innovating new products related to basic metal and engineering. • It should introduce a new skills or technical knowledge to the country; • There should be the existence of a definable market for the potential product • The product should be commercialized within shortest possible time. • With potential to replace currently imported products to the local economy
Applicants shows sufficient evidence of interest to become techno entrepreneur • They should provide a written business plan including a market strategy • The applicant business must have the capacity to provide economic benefits including high employment potential and opportunities,
Applicants business must comply with local and state legislation.
Applicants are able and willing to pay a subsidized fee when it is proved to be necessary. • ability to pay incubator rents while they develop positive cash flow
Applicants should aim to start trading within one year.
Applicants should agree to work with the incubator management. • To identify their business development needs in order to deliver the required support/service • To ensure milestones for successful graduation from the program.
Applicants agree to participate in confidential/non confidential surveys while in the program and for certain years after graduation from the program. • They should provide baseline business data as requested by incubator management. • They should inform the center for changes related to business plan, financial status and internal operations

5.7.3 Exit Criteria

In order to leave the incubator program, set up their independent room and consolidate themselves on the market of their choice; the clients should graduate successfully. The graduation stages of the clients are determined against certain criteria of exit. In this particular case the following graduation or exit criteria is adopted/designed.

Table 5.16. Exit and graduation criteria for the proposed TBI

Clients who have progressed beyond the incubator's ability to provide sufficient value. • When the business needs more space than the TBI can accommodate. • Firm no longer requires incubation (when the pre-agreed milestones are reached)
Clients who developed the capability of being competitively marketed on local and international market.
Clients who own the rights to intellectual property (IP) of a product that has been developed
Clients who failed to meet the terms of the contractual agreement, to comply with centers regulations, to accept professional mentoring and/or achieve agreed upon milestones can result in early termination of the tenants.
Clients who change their company emphasis from that originally planned in the business plan.

Occupancy is determined by the incubator management. The manager reviews the performance of the client on each successive three months after the commencement of tenancy, but expected to last no more than three years. Extensions beyond three years are at the judgment of the board of directors.

Though the tenant company is graduated and leaves the program, it should be in close contact with the center. The information obtained from the graduated companies enables to measure the effectiveness of the program.

5.8 Financial Strategy for the TBI

Financing is one of the crucial issues for the success and sustainability of any technology business incubation. TBI requires funding for three main purposes; these are capital cost,

operating cost and seed money. The designed TBI model is for not-profit organization. Hence, taking this into consideration the following financial strategy is devised.

5.8.1 Financial Strategy for Capital Cost

The direct capital budget is come from governmental organization in different forms. Addis Ababa City Administration can provide land free of lease for setup. Since TBI strengths the technological capability of the country and result in industrial development; the city administration is a strong partner in providing suitable land free of lease.

Addis Ababa Science and Technology University, Addis Ababa Institute of Technology, Ministry of Education and Ministry of Science and Technology provide the required capital budget for the establishment of TBI. The proportion of contribution of each institution is decided after negotiating on the program. If the negotiation agreed on the primary stakeholder of the program, then it is the responsibility of that stakeholder to cover most of the capital cost. However, if all stakeholders agreed on equitable involvement then the financial contribution is formulated as to reflect the situation. It is understood that the contributions might be in kind like furnishing the offices.

Since private investors can be interested in profit making businesses alone and they perceive the TBI as government projects, their support is less likely. However, they might contribute if they are convinced about the indirect benefits they are going to achieve. The starting point is recognition of the kinds of assets and benefits that may attract private investors. Therefore, the incubator manager works to mobilize private sector involvement, in mutual interest. Private investors can participate in the program through foundations, purchases of know-how and supplies. Moreover, grants can be obtained from international donor agencies such as the United Nations Industrial Development Organization (UNIDO), European Union, Non-Governmental Organizations, and foreign governments with economic cooperation agencies (such as Japan, Germany, USA etc.). Generally, doing a research on the sources of grants and securing the required financial budget is the responsibility of the TBI project team and management.

5.8.2 Financial Strategy for Operating Cost

Income like rent for use of the incubator facility, service charge from internal and external clients, fees from special projects and community activities can be generated from the TBI program. The revenues received from the tenants usually cover only a part of the total operation costs. Moreover, the remaining sources of income might not generate the required amount of money to fund the operation cost at least until the activities and services of the program is well known by the public. So, it is required to secure a constant fund from a definite source till the program become stable to operate independently.

The operating cost of the TBI is covered by the government until the cash flow of the center demonstrates a positive trend. The boards of directors approve an annual budget that contributed from the stakeholders. Each stakeholder contributes their share for the operational cost of the program. Apart from the stakeholders other possible sources of operating cost can be assessed.

5.8.3 Financial Strategy for Seed Money

Access to finance is one of the services provided by the TBI for clients. It might be difficult to find a precise source of seed capital for clients, as the knowledge of financial institution of the country in this aspect is uncertain. However, there are a number of option to acquire seed capital such as financing from own resources, contacts with investors/business, normal bank loans and etc.

Bank finance is a viable option for financing the business of tenants. To facilitate bank financing, the TBI develop a special financial advisory unit to assist tenant companies prepare loan applications and service bank debts. Therefore, clients are helped in preparation of their business plan before soliciting banks for seed capital financing.

In this regard, Addis Credit and Saving Institution and Development Bank of Ethiopia could be the main stake holders of the program. Moreover, royalty financing based on future returns from innovations is one way of helping the program to obtain seed capital. The private sector can also be involved in providing seed capital for the clients and can own a proportion of tenant business.

5.9 Strategy for Sustainability

The achievement of sustainability for the TBI center is one of the crucial responsibilities of each stakeholder. Rental and provision of space are not sufficient to cover all the costs of the incubator. Therefore, mode of raising additional revenues should be devised. Providing consultation and advisory service, technology and technology sources, training and rented conference hall for external clients could be a viable source of income for the center. Sometimes it might be happened that machines could be idle; in this case the foundry and mechanical shop are used by external clients through negotiation or contract.

Moreover, the sustainability of the center is guaranteed when it tries to achieve the objective of establishment. The center should prove its impact on the sector and bring innovation or technological development. In other words the efficiency of the center should be measured.

5.9.1 Operational Cost and Revenue Structure

Revenues are expected to be generated from rent, tenant client service fees, external client service fees and cafeteria rent. Though it is difficult to estimate; grants and donations are also included in the revenue structure. As the service of the TBI center is expanding, more revenue sources can be added. While analyzing the operational costs, it is assumed that the expense will grow at 8 percent for the consecutive 4 years and will remain the same for the next years.

It is found that rental rates for office space in Addis Ababa vary significantly from location to location or from building to building depending on the quality of the building and distance from the center of the town. However, the minimum bid prices set by the administration for rented houses are from birr 45.5 to 60 per m^2 (EIA, 2008). Hence, birr 55 per square meter is taken as rental rate for tenant offices. By considering yearly occupancy rate and a 6 percent annual inflation, the following rental income is generated.

Table 5.17. Estimation of occupancy rate and rental income

Rental Revenues						
Operational years	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
Percentage of space leased	10	30	50	75	80	80
Space leased in square meter	90	270	450	675	720	720
Rental rate in birr/m^2	55	58.3	61.8	65.5	69.4	73.6
Rental revenue in birr	59400	188892	333720	530550	599616	635904

Additionally, the service of cafeteria will be rented at 60 birr per square meter for the first operational year and will grow at the rate of 6 percent annually. Likewise, the revenues generated from the service rendered to tenants assumed to grow by 6 percent and revenues from outside customers are estimated to grow by 15 percent annually. Generally, the following revenue and cost structure is developed.

Table 5.18. Operational cost and revenue structure

Revenue						
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**
From rent	59,400	188,892	333,720	530,550	599,616	635904
From tenant services	50,000	53,000	56,180	59,551	63,124	66,912
From external services	70,000	80,500	92,575	106,462	122,431	140,795
From cafeteria	43,200	45,792	48,540	51,452	54,540	57,812
From grants / donations	-	-	-	-	-	-
Total Expected Revenue	222,600	368,184	531,015	748,015	839,711	901,423
Operational costs						
Annual Expenses	660,756	713,617	770,706	832,363	898,952	898,952
Operational Results						
	-438,156	-345,433	-239,691	-84,348	-59,241	2471

Looking into the cost and revenue structure, it is estimated that the center able to cover its operational costs at 6th year after commencement of operation. Therefore, there is a need to constantly financing the center and it is the responsibility of the government to provide funds until the center is self-sufficient. The board of directors warrants the availability of yearly operational costs on their budget plan.

After the first 6 year, the center is capable to generate adequate revenue to run its programs. At this junction the center should look for an expansion or additional program. It can be transformed into hi-tech facility with introduction of non traditional machines such as computer numerical control (CNC) and robotics. But, the feasibility study should be conducted for the project prior to implementation.

5.9.2 Performance Measurement

At the very beginning it is difficult to quantify the expected outcomes of the center in numerical value. It might take a certain number of years to gain the anticipated results;

however, industry practitioners suggest performance indicators to measure the outcomes of technology incubators. Hence, these indicators which are relevant with the proposed TBI are adapted. They are:

1. The number of tenant clients within the center
2. The number of technologies/innovations produced
3. The number of patents applied for and received by incubator clients
4. The number of owner equity deals between tenants and existing companies in the metal and engineering sector.
5. The number of patent transfer (sell, rent) to the firms in the metal and engineering sector.
6. The number of companies that successfully graduate from the center
7. The number of jobs created on an annual basis within the incubator and by graduated companies.
8. The number of incubator graduates that stay (operational) in the community
9. Tax revenues generated by technology incubator clients and graduates
10. Number of technologies exported
11. Number of technologies that substitute imported items and etc.

5.10 Implementation Plan

The incubation program is developed in three phases.

Phase 1: Initiation: This first phase of TBI development plan is assumed to take one year. The first major action under initiation phase is to hire the incubator project manager. The detailed activities of project manager include;

- ✓ Work with the identified stakeholders
- ✓ Create the legal structure
- ✓ Identify supporters for the program
- ✓ Review and file legal documents
- ✓ Create incubator advisory committee
- ✓ Create board of directors
- ✓ Identify funding sources for incubator build-out
- ✓ Identify funding for first year operations and initiate fund raising program.

Phase 2: Implementation: This second phase of an incubation program is takes the duration to establish the facility with the required support services and commence the incubation program. The detailed activities under this phase include;

- ✓ Hire an incubator general manager
- ✓ Identify and lease commercial space
- ✓ Accept resident client companies
- ✓ Continue working with affiliate companies and solidify the incubator program and services

Phase 3: Expansion: After the incubation program is implemented and lays its foundation in the community, the next phase is to look for an expansion project. The major activities under this phase include;

- ✓ Conduct formal six-month review and explore feasibility of developing affiliate client program,
- ✓ Increase the program offerings to attract a greater number of incubator companies
- ✓ Secure stable and diverse revenue streams toward a long-term facilities solution.

TBI Project Implementation Schedule: It is assumed that the first phase (initiation of the incubation program) takes one year. Therefore an implementation program for the facility development is assumed to begin on September 2012 after the first phase is accomplished. Based on the above assumptions the project schedule for the establishment of the facility is developed below.

Table 5.19. Project schedule for the establishment of the facility

Activity Name (ID)	Description	Duration (days)	Precedence
1	Licensing and registration	10	-
2	Acquisition of land	20	1
3	Land development and Building	180	2
4	Electrification and Utility	10	3
5	Purchasing machines and equipments	110	2
6	Machine installation	30	4,5
7	Hiring Staff	20	4,5
8	Launch facility	15	6,7

The starting and finishing time for each task is scheduled and depicted in the following Gantt chart. From the graph it is found that 255 working days are required to finish the project. Activity 1, 2, 3, 4, 7 and 8 are considered as a critical activities and need due considerations during project execution.

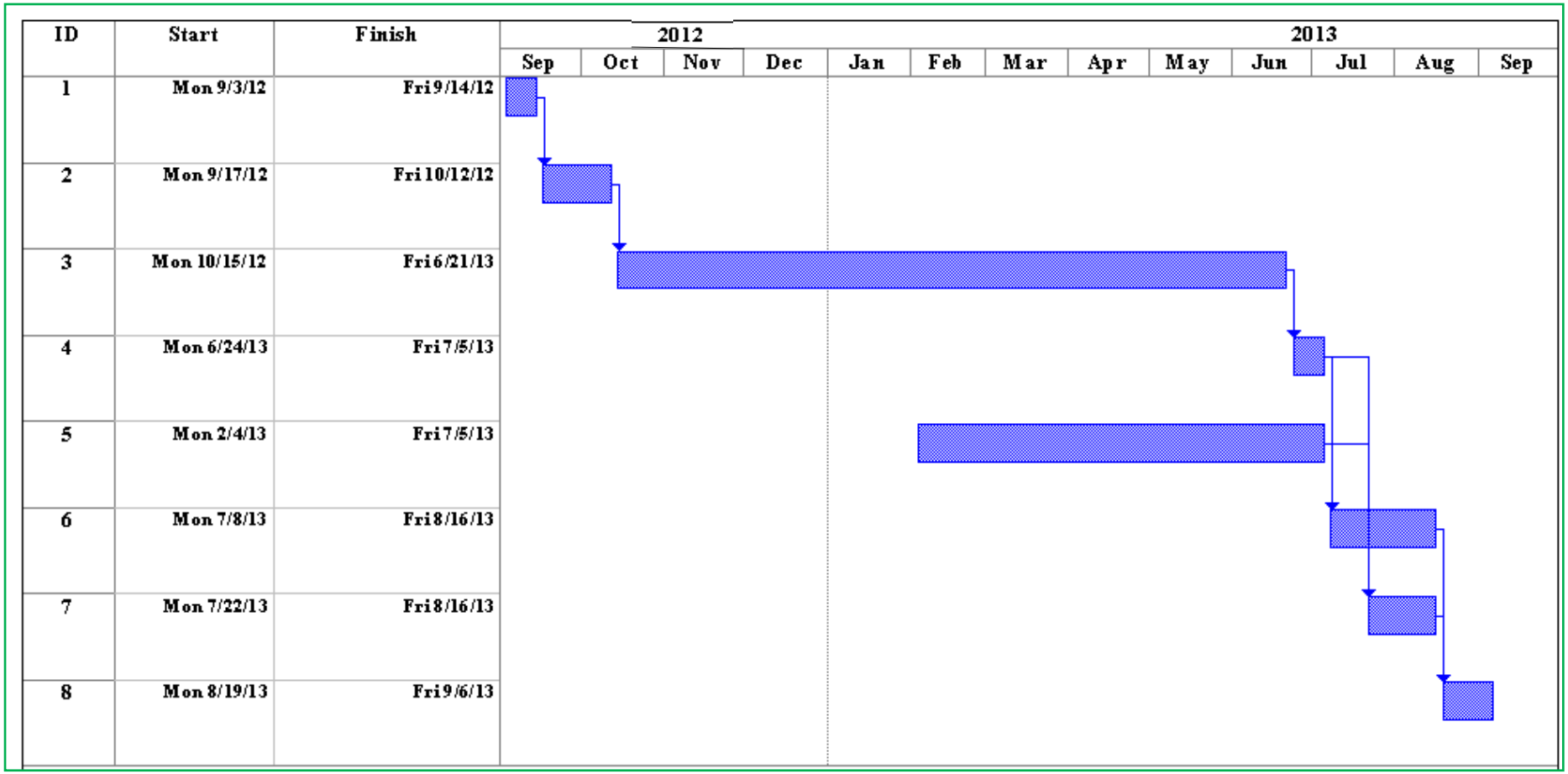

Figure 5.3. Gantt chart for the project Schedule

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Technology business incubators have become an increasingly widespread tool for technological, industrial, and overall development endeavors in many developed as well as developing nations. Their direct and indirect effects on economy urge Ethiopia to look for technology incubators as a viable tool for technology or industrial advancement. However, core sectors such as basic and metal engineering has not any technology incubation centers yet. The basic and metal engineering sector has a tremendous impact on the overall economic development activities especially on industrial development. Considering the government's move toward industrial lead economy the sector is at the core to assist the transition. It is most capable to produce new jobs, enterprises, technological/innovation based products and foster economic growth than any other sectors. Therefore, it is crucial to support basic metal and engineering sector directly or indirectly through the establishment of technology incubation.

Adapting incubation concepts, models and practices of successful countries to Ethiopian case is useful to take actions in clear or success route. Consequently, best practices of China, India, Korea, Brazil, Malaysia, South Africa and USA is bench marked or upgraded to our socio-economic environments to establish technology business incubation. Aiming to assist innovators or technology entrepreneurs, technology business incubation with basic technology facility is designed. The proposed TBI is laid on 4565 m^2 of land in Addis Ababa and comprises of facilities such as foundry and mechanical workshop, administrative offices, common areas and tenant offices. The center is proposed to provide business development and networking services. The budget for the establishment of the center is estimated to be birr 11,646,309. Generally, the TBI supports basic innovators, small enterprises and established firms on the sector; moreover, it can be a model for technology business incubations on basic metal and engineering and other sectors.

6.2 Recommendations

- Since technology incubators create innovative enterprises and bring technological development, all communities and stakeholders should strive for the development of technology incubators.

- The role of government should be irreplaceable for supporting technology business incubation as a tool of a technology driven economic development strategy with necessary policy actions and uninterrupted funding.

- It should be clear that not all of the sectors have the potential to utilize an incubator; as a result, priority areas should be identified prior to establishing business incubators. In this case the proposed TBI center can serve as a model for other sectors in order to adapt some of its parameters.

- Universities and technical institutes in the country should look for the development of technology incubation centers with in their premises. They should assist technological development of regions based on their respective regional governments' priority.

- Technology incubator should be registered as members (develop strategic alliances) with international associations of business incubators. They should also network with the technology incubators of other countries to gain experiences; if not grants.

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Appendix A: Small Scale Manufacturing Industries in 2008

Industrial Group	No of establishments	Gross value of production	Value added	No of employees
Manufacture of Food Products Except Grain Mill services	1541	308,346,153	57,255,451	2471
Grain Mill Services	23047	1,113,873,376	479,699,504	39815
Manufacture of Textiles	1366	39,110,832	19,621,876	868
Manufacture of Wearing Apparel, Dressing and Dyeing of Fur	3097	115,655,245	60,584,805	2326
Manufacture of Luggage, Handbags and Footwear	46	4,370,821	1,482,397	97
Manufacture of Wood and Products of Wood and Cork, Except Furniture	90	7,819,873	3,072,214	220
Manufacture of Paper and Paper Products	3	103,635	56,424	7
Publishing, Printing and Reproduction of Recording Media	755	29,055,792	7,486,315	786
Manufacture of Chemicals and Chemical Products	6	636,322	198,287	31
Manufacture of Other Non-Metallic Mineral Products	457	116,877,481	56,288,440	1765
Manufacture of Fabricated Metal Products, Except Machinery and Equipment	4355	419,600,595	178,086,816	7411
Manufacture of Machinery and Equipment N.E.C.	0	0		
Manufacture of Parts and Accessories for Motor Vehicles and their Engines	0	0		
Manufacture of Furniture; Manufacturing N.E.C.	8575	635,850,091	277,872,921	18527
TOTAL	43338	2,791,300,216	1,141,705,450	74324

Appendix B: Large and Medium Manufacturing Industries Establishments

Sector		2006/2007		2007/2008		2008/2009		2009/2010	
		No of firms	No of employees	No of firms	No of employees	No of firms	No of employees	No of firms	No of employees
1	Manufacture of Food Products and Beverages	381	35,686	485	41,265	562	44,957	572	60,110
2	Manufacture of Tobacco Products	1	799	1	1,254	1	1122	1	986
3	Manufacture of Textiles &Wearing Apparel	73	29,306	61	18,223	84	24,259	91	30,724
4	Tanning and Dressing of Leather	72	8,351	83	8,586	89	8,750	114	10,707
5	Manufacture of Wood and Products of Wood and Cork	41	2,010	70	3,166	48	2,111	54	3,261
6	Manufacture of Paper and Paper Products	117	8,161	143	8,917	127	8,822	123	9,998
7	Manufacture of Chemicals , Chemical Products, rubber & plastic products	128	14,649	162	16,489	162	19,989	235	25,044
8	Manufacture of other Non-Metallic Mineral Products	284	11,137	488	16,853	608	19,790	482	19,482
9	Manufacture of Basic metal and engineering	116	8,742	134	8,418	154	9,448	219	16,523
10	Manufacture of Furniture	229	5,713	299	7,134	363	7,945	281	8,251
	TOTAL	1442	124,554	1926	130,305	2198	147,193	2172	185,086
	Gross value of production	18,579,125,000		22,946,588,000		28,787,699,000		42,008,056,000	

Appendix C: Price of Some Office Furniture

Furniture	Price in Birrs
L shape	6740
Guest chair	1000
Writing table	3103
L shape office	4760
Table with out drawer	1800
Manager chair	4193
Large table	3164
Medium table	1765
Computer table	1010
Secretarial chair	1839
Cabinet	1900
Desk top computer	9000
Lap top computer	12500
Digital camera	4500
Photocopier	11000
Printer	6500
Scan, print and copy machine	4000
Projector	12500

Appendix D: Specification for Foundry and Mechanical Workshop Machines

Foundry Machines

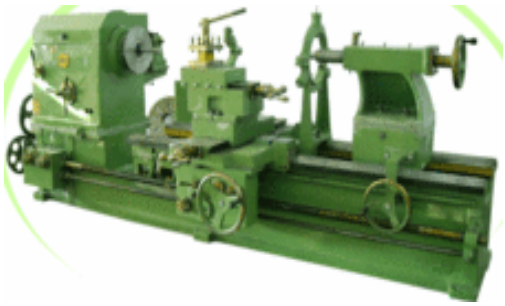
Foundry Induction Furnace	Technical Specification		
	*Item*	*Unit*	*Specification*
	Rated capacity	kg	10-50
	Rated power	kw	50
	Input voltage	v	380
	Transformer capacity	kva	60
	Out voltage	v	750
	Output frequency	khz	2.5
	Melting time	min	20-60
	Power consumption (steel)	kw.h/t	900
	Water cooling	t/h	3
	Input water pressure	mpa	0.2
	Volume	m^3	1.2
	Weight	kg	350
	***Supplier**: Qingdao Tongfeng Casting Machine Co. Ltd., China*		

Sand Core Shooting Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Core box of size	mm	450x400x300
	Max. weight of shoot sand	kg	15
	Template's size, max. /min.	mm	500/190
	Core boxes to force	kg	1300
	Productivity	h	60S
	Working pressure	mpa	0.65
	Shoot sand pressure	mpa	0.4
	Power supply	ac	380V
	Heating method	electrical	electrical
	Heating power	kw	20
	Sand-up way		Air slide
	***Supplier**: Qingdao Tongfeng Casting Machine Co. Ltd., China*		

Foundry Sand Mixer	Technical Specification		
	*Item*	*Unit*	*Specification*
	Disc diameter	mm	1000
	Feeding capacity	Kg/s	110
	Productivity	t/h	1.5-2.5
	Power	Kw	4
	Spindle speed	rpm	45
	Single-round pressure		0-1100
	Machine weight	kg	900
	***Supplier**: Qingdao Tongfeng Casting Machine Co. Ltd., China*		

Sand Molding Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Foundry flask max. dimension	mm	500x450x200
	Worktable size	mm	600X550
	Jolting load	kgf	300
	Compressive stress	kgf	5000
	Molding process	mm	180
	Productivity	box/h	40-60
	Jolting cylinder diameter	mm	150
	Compress press		160
	Consumption of free air	m^3/box	0.4
	Overall dimension(LxWxH)	mm	1300x800x1700
	***Supplier**: Qingdao Tongfeng Casting Machine Co. Ltd., China*		

Mechanical Workshop Machines

Lathe Machine (Heavy Duty)	Technical Specification		
	*Item*	*Unit*	*Specification*
	Max. swing over bed	mm	800
	Max. swing over carriage	mm	520
	Center distance	mm	1000
	Width of gap	mm	320
	Swing over gap	mm	1000
	Width of guide way	mm	550
	Spindle bore diameter	mm	105
	Rapid traverse speed	m/min	3.8
	Max. travel of cross slide	mm	493
	Travel of top slide	mm	200
	Main motor power	kw	11
	Rapid traverse motor power	kw	1.1
	Coolant pump motor power	kw	0.09
	Gross/Net weight 4000mm	kg	7800/6100
	***Supplier:** Tengzhou Xili Machine Tool Co. Ltd., China*		

Lathe Machine (Universal)	Technical Specification		
	*Item*	*Unit*	*Specification*
	Max. swing over bed	mm	400
	Max. swing over carriage	mm	230
	Max. swing over gap	mm	700
	Width of gap	mm	250
	Max. length of work piece	mm	1000
	Width of guide way	mm	394
	Spindle speed	rpm	26-2000
	Dia. of spindle bore	mm	82
	Max. travel of cross slide	mm	348
	Travel of top slide	mm	150
	Travel of tailstock quill	mm	150
	Diameter of tailstock quill	mm	75
	Main motor power	kw	7.5
	Gross/Net weight 2000mm	kg	4010/3030
	***Supplier**: Tengzhou Xili Machine Tool Co. Ltd., China*		

Universal Milling Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Table size	mm	360x1250
	Longitudinal travel	mm	700/680
	Max. transverse travel	mm	255/240
	Max. vertical travel	mm	410/390
	Table size	mm	1250x360
	Distance from horizontal spindle to supporting	mm	175
	Spindle speed range	rpm	60-1800
	Vertical up-down speed table	mm/min	590
	Range of table travel	mm	18
	Main motor power	kw	4
	Motor of lifted table	kw	1.1
	Overall size (LxWxH)	mm	1880x1700x1700
	Net weight/Gross weight	kg	2000/2200
	***Supplier**: Tengzhou Xili Machine Tool Co. Ltd., China*		

Power Hacksaw Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Max. sawing size for Round steel	mm	250
	Max. sawing size for shape bar	mm	250x250
	Saw blade width	mm	450×35×2
	Stroke of sawing bow reciprocation	no/ min	91
	Length of saw blade strokes	mm	152
	Motor	kw	1.5
	Net weight	kg	680
	Overall dimensions (LxWxH)	mm	1550x700x1000
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

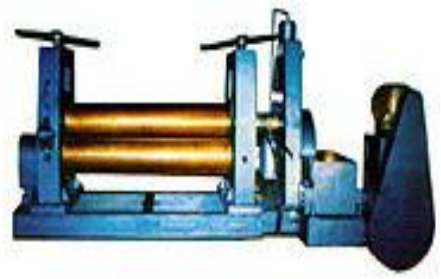
Vertical Drilling Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Max. Drilling capacity	mm	32
	Max. feed resistance	N	9000
	Max. Permissible spindle torque	N.m	160
	Throat distance	mm	280
	Spindle travel	mm	200
	Spindle box travel	mm	200
	Spindle speeds range	r/min	50-2000
	Feed rates	r/min	0.056-1.8
	Max. travel of table	mm	310
	Working surface of worktable	mm	400×530
	power of main motor	kw	2.2
	Flow of cooling pump	l/min	25
	Overall dimensions (LxWxH)	mm	962x847x2340
	Net weight of machine	kg	1000
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

Bench Drill Press	Technical Specification		
	*Item*	*Unit*	*Specification*
	Drilling capacity	mm	16
	Chuck size	mm	16
	Table travel	mm	190
	Table size	mm	200×190
	Spindle travel	mm	55
	Distance spindle axis to column	mm	125
	Column diameter	mm	60
	Spindle speeds range	r/min	300-3190
	Spindle speeds series		12
	Motor power	hp	1/2
	Overall height	mm	860
	Net weight./Gross weight	kg	40/43
	Packing case dimensions	mm	680×440×255

Metal Cutting Band Sawing Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Cutting capacity round	mm	280
	Cutting capacity rectangle	mm	280x350
	Oil pump Motor power	kw	0.42
	Main motor output	kw	2.2
	Voltage	v	380V
	Frequency	hz	50
	Band saw dimensions	mm	0.9x27x3505
	Process Speed	m/min	20/45/80
	Overall size	mm	2095x1095x1445
	Machine weight	kg	1000
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

Mechanical Eccentric Press	Technical Specification		
	*Item*	*Unit*	*Specification*
	Nominal capacity	KN	250
	Nominal pressure stroke	mm	6
	Stroke of slide	mm	80
	Strokes per minute	mm^{-1}	100
	Max. die height	mm	180
	Die height adjustment	mm	45
	Distance between slide center and frame	mm	500
	Thickness of bolster	mm	50
	Distance between columns	mm	250
	Bench size	mm	400x600
	Hole dimensions in bed	mm	ø160
	Bottom size of slide	mm	180x200
	Size of the handle hole	mm	ø40x60
	Main motor power	kw	3
	Overall dimension	mm	1600x1100
	Height above floor	mm	2180
	Total weight	kg	2300
	***Supplier**: Anhui Laifu NC Machine Tool Co., Ltd., China*		

Hydraulic Shearing Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Max. shearing thickness	mm	4
	Max. shearing width	mm	2500
	Stroke times	Per min	18
	Back gauge range	mm	20-600
	Shearing angle	$(^0)$	0.5-1.5
	Throat depth	mm	100
	Motor power	Kw	4
	Overall dimensions (LxWxH)	mm	3000x2000x1850
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

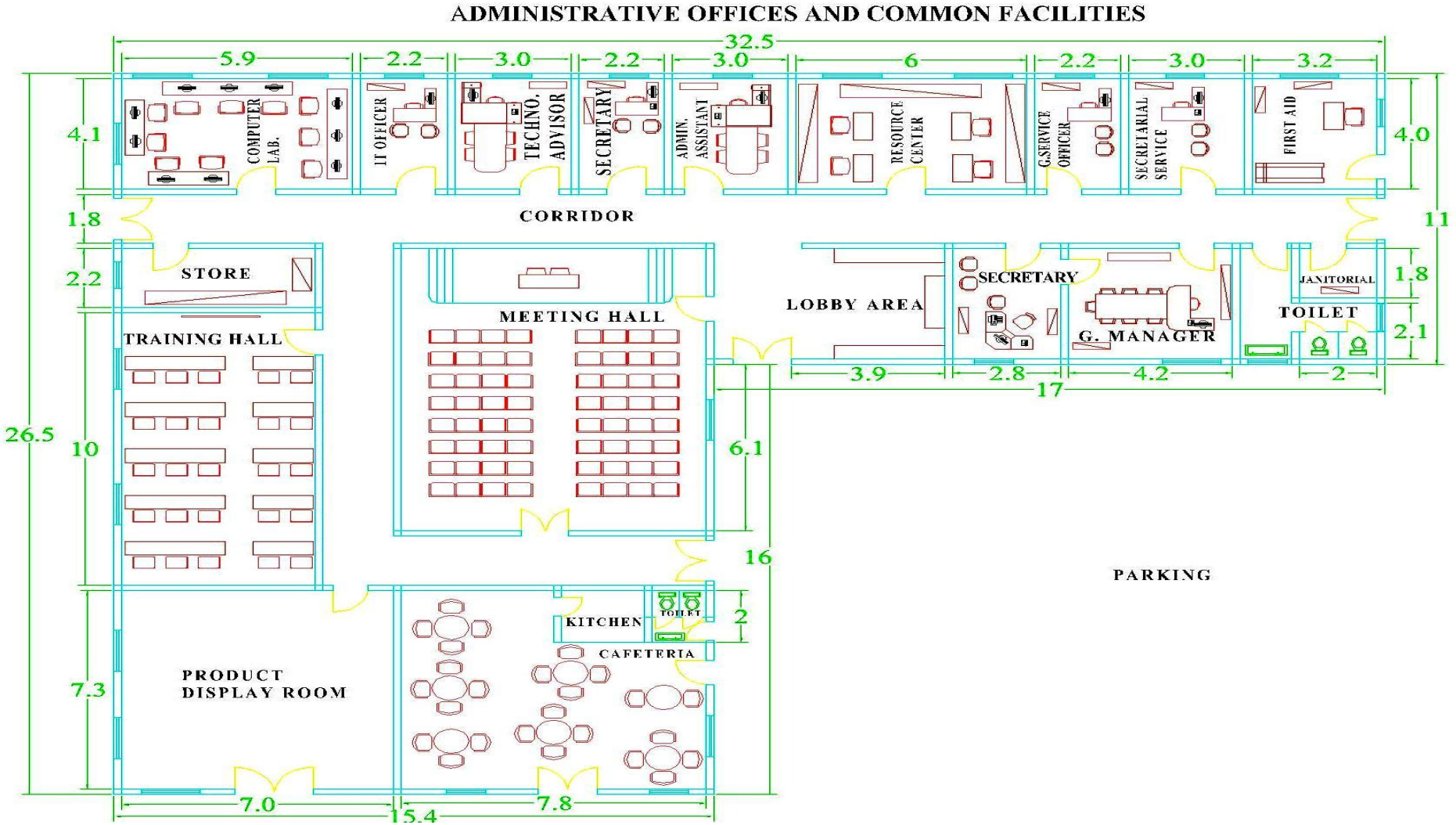
Rolling Machine	Technical Specification		
	*Item*	*Unit*	*Specification*
	Plate yield limit	Mpa	245
	Max. plate thickness	mm	8
	Max. plate width	mm	2500
	Min. diameter	mm	500
	Diameter of upper roller	mm	240
	Diameter of lower roller	mm	200
	Central distance	mm	310
	Main motor power	Kw	11
	Overall dimension	mm	4550x1350x1610
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

Radial Drilling Machine	Technical Specifications		
	*Item*	*Unit*	*Specification*
	Drilling depth	mm	140
	No. of spindle: speeds/range	r/min	6(72-1000)
	No. of spindle: feeds/range	mm/rev	2(0.1 a 0.2)
	Drill power	kw	1.5
	Drilling radius, max/min	mm	750/350
	Drilling head: traverse	mm	400
	Distance base plate to spindle ,Max/Min	mm	835/ 275
	Diameter of column sleeve	mm	190
	Working surface of the base plate	mm	750x650
	Length x Width x Height	mm	1170x670x160
	Arm elevator motor	KW	0.75
	Standard box table (XxYxZ)	mm	400x350x350
	Weight of machine	Kg	1100
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

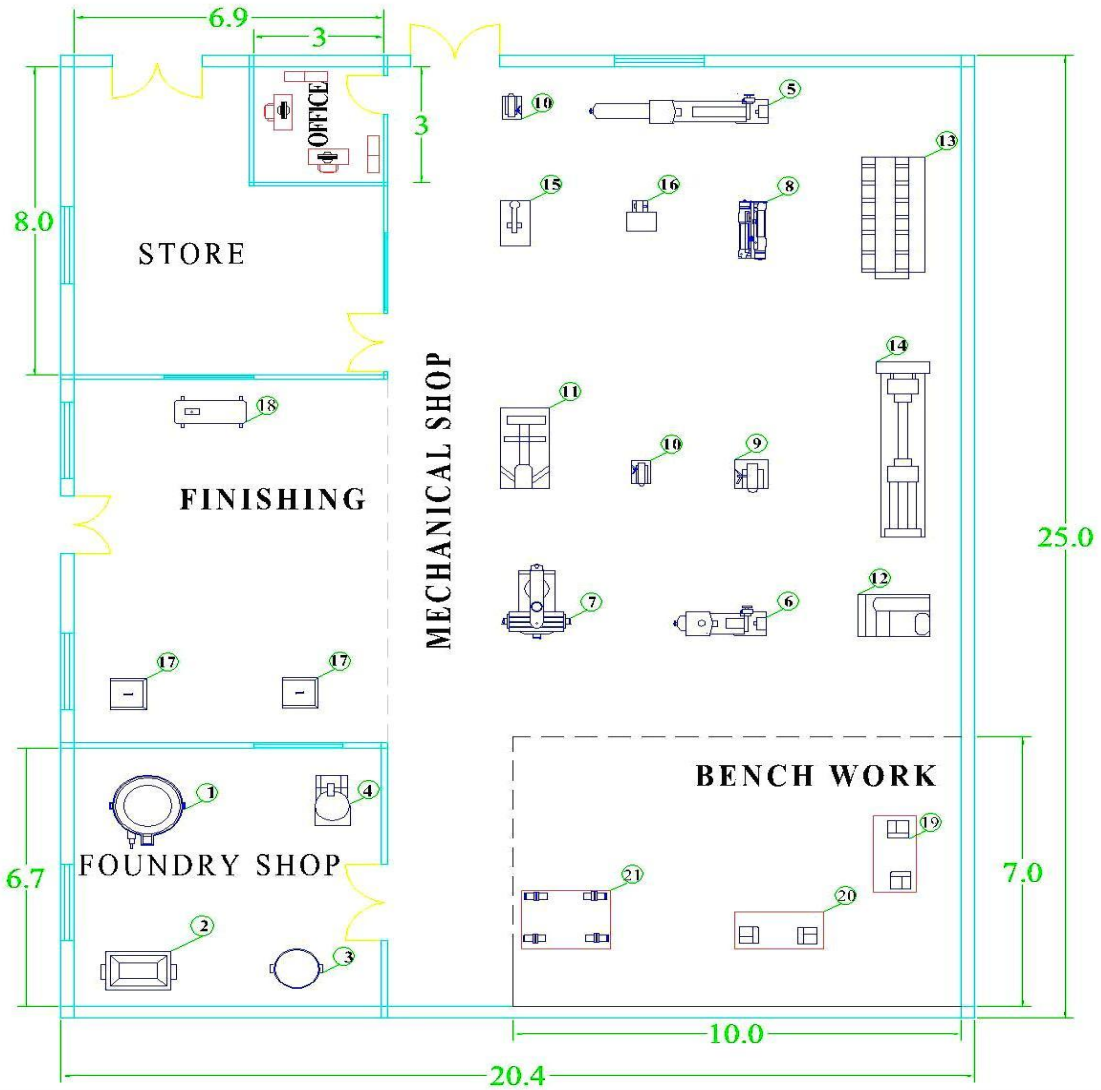
Tool Grinder	Technical Specification		
	*Item*	*Unit*	*Specification*
	Diameter of edge mill	mm	90-630
	Max. diameter (mill cutter thickness)	mm	φ200x150
	Max. length (straight cutter)	mm	250
	Carving cutter	mm	φ13
	Sand wheel specifications	mm	φ125x180
	Spindle speed	r/min	2860
	Motor power	W	370
	Water pump power	W	40
	Overall dimensions	mm	650x800x1580
	***Supplier**: Qingdao Prosper Machinery Co. Ltd. , China*		

Arc Welding Machine	Technical Specifications		
	*Item*	*Unit*	*Specification*
	Input power voltage	v	AC380 ±10%
	Frequency	Hz	50/60
	Rated welding current	A	400
	Welding current range	A	5~400
	Rated duty cycle		60%
	Rated input capacity	kva	13
	Phase		3 phase
	Weight	kg	35

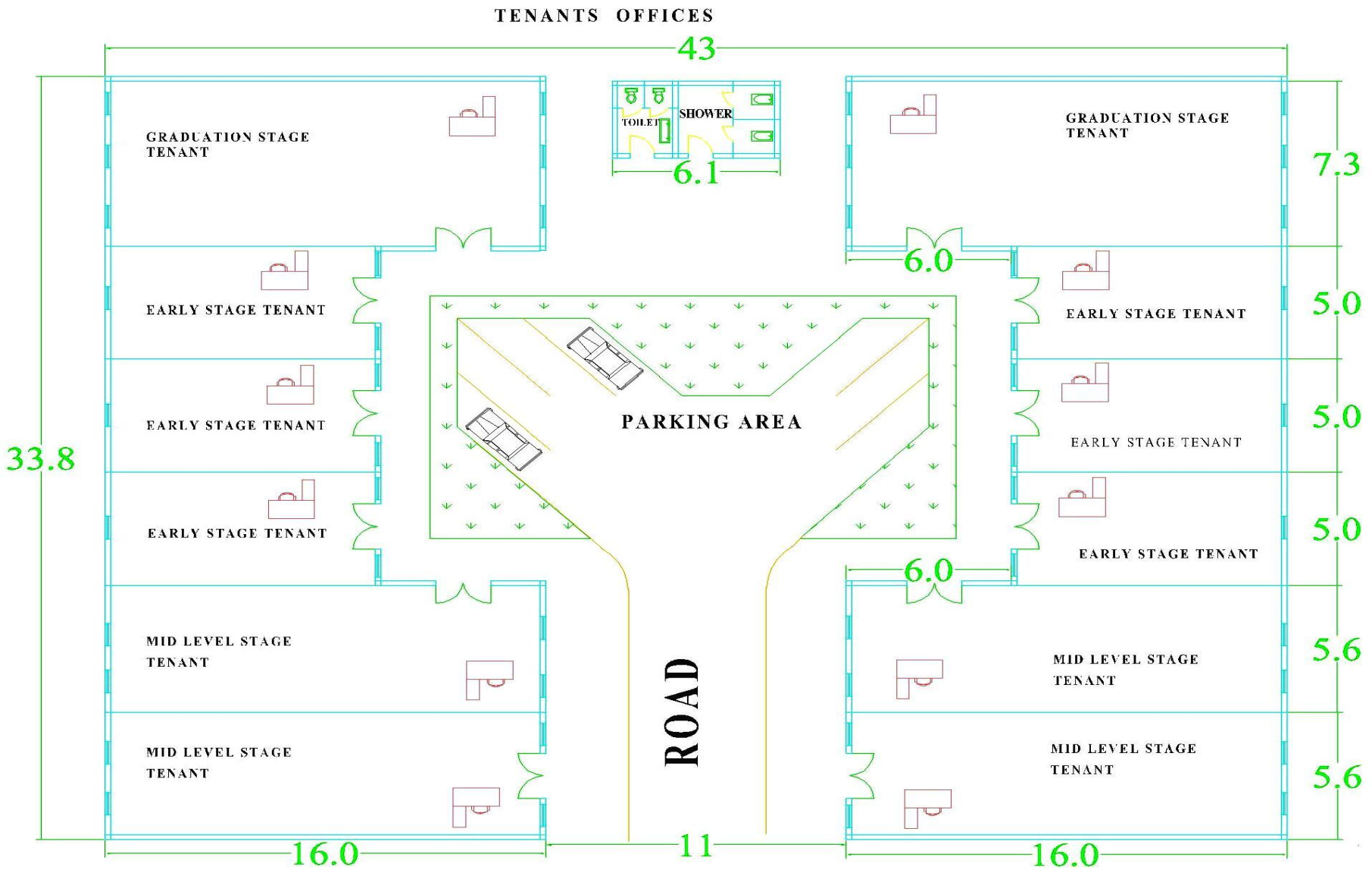
Appendix E: Detailed Layout of the Proposed Facilities



FOUNDRY AND MECHANICAL SHOP



21	4	Bench vice
20	2	Circular saw
19	2	Bench grinder
18	1	Compressor
17	2	Arc welding
16	1	Radial drilling
15	1	Tool grinder
14	1	Rolling
13	1	Hydraulic shearing
12	1	Mechanical eccentric press
11	1	Band Sawing
10	2	Bench Drill Press
9	1	Vertical drilling
8	1	Power Hacksaw
7	1	Universal Milling
6	1	Universal Lathe
5	1	Heavy duty Lathe
4	1	Sand molding
3	1	Sand Mixer
2	1	Sand Core Shooting
1	1	Electric Furnace
Item Ref	Quantity	Designation


TENANTS OFFICES
43
33.8
GRADUATION STAGE TENANT
TOILET
SHOWER
6.1
GRADUATION STAGE TENANT
7.3
6.0
EARLY STAGE TENANT
EARLY STAGE TENANT
EARLY STAGE TENANT
PARKING AREA
EARLY STAGE TENANT
EARLY STAGE TENANT
5.0
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5.0
6.0
EARLY STAGE TENANT
MID LEVEL STAGE TENANT
MID LEVEL STAGE TENANT
ROAD
MID LEVEL STAGE TENANT
MID LEVEL STAGE TENANT
5.6
5.6
16.0
11
16.0

LAYOUT OF THE TBI FACILITIES

DECLARATION

This thesis entitled “Promoting industrial development in Ethiopia through the establishment of technology business incubation” is my original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged.

_____ _____

Aberham Genetu Date

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

_____ _____

Dr.-Ing Daniel Kitaw (Advisor) Date

_____ _____

Mr. Gulilat Gatew (Co-advisor) Date