JOURNAL OF APPLIED COMPUTER SCIENCE & TECHNOLOGY

THE INSTITUTION OF ENGINEERS, BANGLADESH

VOL. CSE 2, NO. 2, AUGUST 2020

ISSN 2663-4775 (PRINT)
ISSN 2665-4783 (ONLINE)

JOURNAL OF
APPLIED COMPUTER SCIENCE & TECHNOLOGY

THE INSTITUTION OF ENGINEERS, BANGLADESH

VOL. CSE 2, NO. 2, AUGUST 2020

Published by

COMPUTER ENGINEERING DIVISION

THE INSTITUTION OF ENGINEERS, BANGLADESH

Shaheed Prokaushali Bhaban, IEB Headquarters : Ramna, Dhaka-1000

JOURNAL OF APPLIED COMPUTER SCIENCE & TECHNOLOGY
The Institution of Engineers, Bangladesh (IEB)

Vol. CSE 2, No. 2, AUGUST 2020

EDITORIAL BOARD

ISSN Registration Information (Print)
ISSN 2663-4775 Key Title: Journal of Applied Computer Science & Tecnology (Dhaka, Print)
Abbreviated Key Title: J.acst.eng. (Dhaka, Print)
Variant Title: Journal of Applied Computer Science & Technology Division,
The Institute of Engineers, Bangladesh Variant Title: JACST (IEB)

ISSN Registration Information (Online)
ISSN 2665-4783
Key Title: Journal of Applied Computer Science & Technology (Dhaka, Online)
Abbreviated Key Title: J.acst.eng. (Dhaka, Online)
URL: http://www.iebbd.org/jcse

Price is BDT 150.00 per copy (for non-member) Annual Subscription: Tk. 150/- (US$ 20)

A Theoretical Strategy Based Framework of Business Incubation Process for Disruptive Innovations: The Double Staircase Model

Authors:

Engr. Md. Ranak Ahsan
Secretary, Computer Engineering Division, IEB

Ashikur Rahman Rupok
Coordinator, Student to Startup

TABLE OF CONTENTS

Abstract-

An incubator is anything that performs or facilitates through various forms of incubation Process. The basic definition and methodologies of the process differ from basis of Business, Startups, Science & Technology, Arts, Culture and other perspectives. The U.S.-based International Business Innovation Association estimates that there are more than 9,000 incubators worldwide. In Bangladesh there are around 20-25 Incubators and Accelerators. Moreover only a few are active alongside issues which are aplenty regarding the definition of the process and methodologies they offer through each of their facilitation models. Although 90-95% of idea stage startups die before even entering the market, the number of startups operating globally is 305 Million driven by 472 Entrepreneurs. Moreover, most of the large and well-established companies are at risk regarding their future existence due to an unseen phenomenon called disruptive innovation. This research illuminates a systematic look at the process in order to create a framework of business incubation process for disruptive innovations through a strategic approach based on relevant situation and ecosystem based requirements. The purpose of this paper is preliminary attempt to deal with the phenomenon of business incubation process from theoretical and thought experiment based analysis. The authors intend to address the major catalysts behind the limitations of existing models and process methodologies. An intensive analytical study on the history, evolution and terminology of existing Incubation models laid the basis of this research with theoretical case study on existing frameworks and methodologies providing the potential structure of the process. Finally a few thought experiments conducted to paint possible scenarios and circumstances for general case described the framework through step by step approach. The compiled Findings show the possibilities that can transform the rather unsynchronized ecosystem into an effective machine to take the idea stage failures and turn them into go-to-market players as well as help the large companies to stay in the market through in-house incubation of disruptive innovations. The main focus of the research is to seek a solution for the millions of idea stage startups to at least enter the market and have an opportunity to do business so that they could learn from practical market based experience to develop entrepreneurial skills even if for potential pivots as well as provide a solution to the large companies who are often pushed out of the market through introduction of various disruptive innovations.

1.0 Introduction

Innovation has been widely recognized in the industrial sector for providing the competitive advantage and creates the economic value for countries around the world. Many countries are continuously searching for innovative frameworks which are best suited to their country's economic environment. Many new start-ups use innovation create the opportunities for their business, but not all of them survived.

"The value of an idea lies in the using of it."
- Thomas Alva Edison

INCUBATION IS THE HARD PART BETWEEN INNOVATION AND SUCCESS. Currently more than 305 Million Startups are operating around the world driven by 472 Million Entrepreneurs. Globally around 100 Million startups are created each year with 1.35 Million Tech Startups. But only 186+ Startups managed to exit through selling out their startup while others couldn't survive through the previous stages. The Startup Genome 2019 Report Claimed those 11 out of 12 Startups are failed mostly in the idea stage before even entering the market. And those who enter, 25% of Startups shuts down in their first year and 34% in their 2nd Year of operation due to lack of Venture Fund while only 50% reaches up to fifth year, 33% till 10th year and only 25% till 15th Year. 82% of startups that fail do so because of cash flow problems. 75% of Venture Backed Startups never return cash to their investors while in 30-40% cases investors lose their whole initial investment. Countries and Economies require entrepreneurs of Digital age to march forward into the era of 4th industrial revolution.

Moreover, Disruptive innovations have created immense chaos in the market over the last couple of decades. 88% of the Fortune 500 firms that existed in 1955 are gone. These companies have either gone bankrupt, merged, or still exist but have fallen from the top Fortune 500 companies. Most of the companies on the list in 1955

are unrecognizable, forgotten companies today. As the life expectancies of companies continue to shrink, organizations must be more vigilant than ever in remaining innovative and future-proofing their businesses. This includes Big Giants like: Nokia, Blockbuster, Compaq, General Motors, Kodak, Motorola, Blackberry, IBM, and many more. Companies that experience innovation success grab onto it and believe that it is their secret to Sustainability. But unfortunately, this is not the case, as disruptive innovations are always causing chaos and pushing established sustainable innovations out of the market. This Phenomenon is also known as THE INNOVATOR's DILEMMA.

The business landscape is littered with cautionary tales of huge companies that failed due to lack of innovation. An unwillingness to innovate puts any company at risk of failure, but refusing to evolve with the market can be even more devastating. Large companies need to become good at incubation now more than ever. They need Intrapreneurs now more than ever. It is their path to achieve the organic growth they desire through strategic innovation. But the problem rises in the processes, methods and tools used for New Product Development (NPD) are insufficient for strategic innovation and strategic innovation is necessary for the accelerated growth that companies demand. The most promising approaches of Incubation Process are designed for the startup ecosystem. But an issue is that in most of the Developing or Least Developed Countries elements of their Ecosystems are not synchronized at all and most of the startups find it very challenging to adapt this eco-system based approach.

Incubation is a way for disruptive innovations with large potential to succeed in creating strategic innovations, but incubation is currently an ill-defined system. Basically there are two types of use needed for Incubation Process,

-Taking the large number of Startups with decent potential from Idea Stage failures into the market to operate as a business.

-Ensuring the supply of disruptive innovations from large companies so that they don't get pushed out of the market because of the upcoming idea stage startups.

Although there are many ways that incubation in large companies and startups are similar, there are some significant differences that have bedeviled those that have tried to apply startup approaches to large companies. Even the labels used -

"entrepreneurs" in a startup and "Intrapreneurs" in a company - indicate there is a meaningful difference. Large companies suffer from the legacy forces of culture, context and commitment that slow decision making, cause them to shy away from uncertainty, and that set expectations of guaranteed success.

A framework for incubation in large companies must take these differences

Sustaining Innovation	Disruptive Innovation
•Satisfies customer's current needs.	•Evolved to meet Customer's Future Need.
•Makes sense in short term targets.	•A niche & unproven opportunity can be the Future of the Industry.

Table-1: Key Differences between sustainable and Disruptive Innovation

into account and take advantage of a large company's strengths to mitigate its weaknesses. To do this, a framework needs to be supported by the appropriate organizational structures. This usually involves a separate an distinct corporate innovation group (cig) that can operate independently of existing business units. The objective of this research is to address and mitigate these differences in terms of strategic planning Clayton Christensen demonstrates how successful, outstanding companies can do everything "right" and still lose their market leadership - or even fail - as new, unexpected competitors rise and take over the market. There are two key parts to this dilemma.

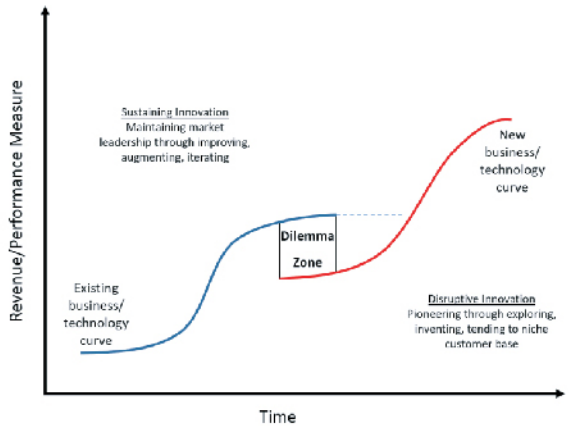
through both theoretical and systematic approach. The research also aims to design a framework of incubation for both idea-stage startups and large companies to adapt in-house irrelevant to any incubator or facilitation based company.

2.0 Theoretical and Terminological Analysis

The Innovator's Dilemma; When New Technologies Cause Great Firms to Fail, generally referred to as The Innovator's Dilemma, first published in 1997, is the best-known work of the Harvard professor and businessman Clayton Christensen. It expands on the concept of disruptive technologies, a term he coined in a 1995 article Disruptive Technologies: Catching the Wave.

The term disruptive technologies was first described in depth with this book by Christensen; but the term was later changed to disruptive innovation in a later book (The Innovator's Solution). A disruptive innovation is an innovation that creates a new market and value network that will eventually disrupt an already existing market and replace an existing product. The Key differences addressed by this theory of Dilemma between Sustainable Innovation and Disruptive innovation are as follow,

1. Value to innovation is an S-curve: Improving a product takes time and much iteration. The first of these iterations provide minimal value to the customer but in time the base is created and the value increases exponentially. Once the base is created then each iteration is dramatically better than the last. At some point the most valuable improvements are complete and the value per iteration is minimal again. So in the middle is the most value, at the beginning and end the value is minimal.



Figue-1: The S-Curve of Value to Innovation

think about innovation.

Christensen then argues that the following are common principles that incumbents must address:

- Resource dependence: Current customers drive a company's use of resources
- Small markets struggle to impact an incumbent's large market
- Disruptive technologies have fluid futures, as in, it is impossible to know what they will disrupt once matured
- Incumbent Organizations' value is more than simply their workers, it includes their

processes and core capabilities which drive their efforts

- Technology supply may not equal market demand. The attributes that make disruptive technologies unattractive in established markets are often the ones that have the greatest value in emerging markets. He also argues the following strategies assist incumbents in succeeding against the disruptive technology:

- They develop the disruptive technology with the 'right' customers. Not necessarily their current customer set

- They place the disruptive technology into an autonomous organization that can be rewarded with small wins and small customer sets

- They fail early and often to find the correct disruptive technology

- They allow the disruption organization to utilize all of the company's resources when needed but are careful to make sure the processes and values were not those of the company

A significant thought story is the evolution of Modern day computer Keyboard through the legends of QWERTY Keyboard vs. Old School Typewriting Machines. Marketers often divide any new market into three major Layers,

I. Easy Users: People who are not satisfied with the existing solutions and eagerly seeking for new ones in need. (Level of effort for Acquisition : Easy, 1% of the total market)

II. Medium Users: People who often tend to follow the trends using existing solutions and flow of mainstreams or would accept new solutions only after easy users are completely satisfied. (Level of Effort for Acquisition:
Medium, 10-20% of the total Market)

III. Hard Users: People who are absolutely fan of existing solutions and won't even heard about anything new in the first attempt but would try only after easy and medium users are all completely fascinated about it. (Level of Effort for Acquisition: Hard, 80% or above of the total market)

A typewriter is a mechanical or electromechanical machine for typing characters similar to those produced by a printer's movable type. Typically, a typewriter has an array of keys, and each one causes a different single character to be produced on the paper, by means of a ribbon with dried ink struck against the paper by a type element similar to the sorts used in movable type letterpress printing. On some typewriters, a separate type element (called a type bar) corresponds to each key; others use a single type element (such as a type ball or disc) with a different portion of it used for each character. At the end of the nineteenth century, the term typewriter was also applied to a person who used a typing machine.

The first commercial typewriters were introduced in 1874, but did not become common in offices until after the mid-1880s. The typewriter quickly became an indispensable tool for practically all writing other than personal handwritten correspondence. It was widely used by professional writers, in offices, and for business correspondence in private homes. Typewriters were a standard fixture in most offices up to the 1980s when computers and modern keyboards started to disrupt the market. The major difference between modern day computer key boards and old school typewriting machine was the Backspace Button!! The problem with old school type writers were that they didn't

had any delete or removal system for mistakes. Even mistakenly writing a single alphabet would cause the whole page completely into waste. But with the computer keyboard there was this option for correction before printing any document. Offering of a virtual copy alongside before hard print copy was the main game. In the beginning, professional typists were mocking of computer keyboard saying first you make mistake then you buy a new device to avoid the mistake instead of making no mistakes at all in the first place. But there was a niche market even back then. People who are entering the profession and want to learn how to type. Making mistakes and learn from them was the main point why these entry level typists adopted the computer keyboard as easy users. This is point where the disruption began. Based on various NPD frameworks the manufacturers collected and incorporated feedbacks from early users to develop the product and introduce features like: modern day layout, Shortcut keys, etc. and soon Computer keyboards started becoming trend acquiring medium users as well.

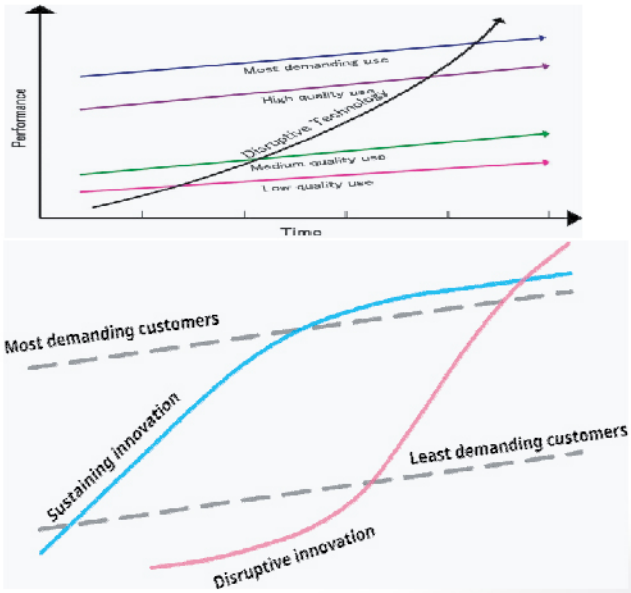


Figure-2: Disruptive Innovations Pushing Sustainable Innovations out of Market

When computer keyboards covered the easy and medium users, the entry level users were able to type a document with two times speed and perfection than a professional typist who uses old school typewriting machines. That's when even the hard users realized that this is the future and it calls for change. So Modern day computer keyboards received market dominance status while Old School Typewriting machines, now a day, are hard to find other than museum.

This is how generally the process of Disruption or Disruptive Innovation works. It starts as a negligible thought with a tiny niche market but ends up driving even the monopolies out of the market over time.

What Innovator's Dilemma has taught us are,
- Listen to the customers for sustainable innovations and Seek to identify potential Disruptions at the same time.
- Disruptive innovation to improve rapidly through proper incubation process.
- Small Niche Market gives more time to FineTune without worrying about larger competitors

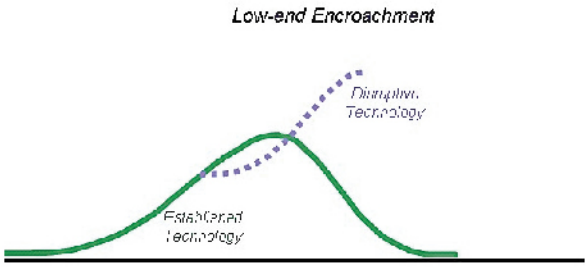


Figure-3: Disruptive Technology born out of existing technology

Most of the experts believe this dilemma to be a positive encouragement for small idea stage startups and bears a warning message for all the established businesses. But the most important fact that it shows is that "both the idea stage startups and established large businesses need to figure out how to manifest

The terminology of Incubation differs from sector to sector based on the use. The One proper definition is, Provide Aid to the slow development without outward or perceptible signs. Moreover from psychological perspective Incubation is the process of thinking about a problem subconsciously while being involved in other activities. In Religion and Culture, Dream incubation is practiced as a technique of learning to "plant a seed" in one's mind for a specific dream topic to occur. It also indicates to an Islamic

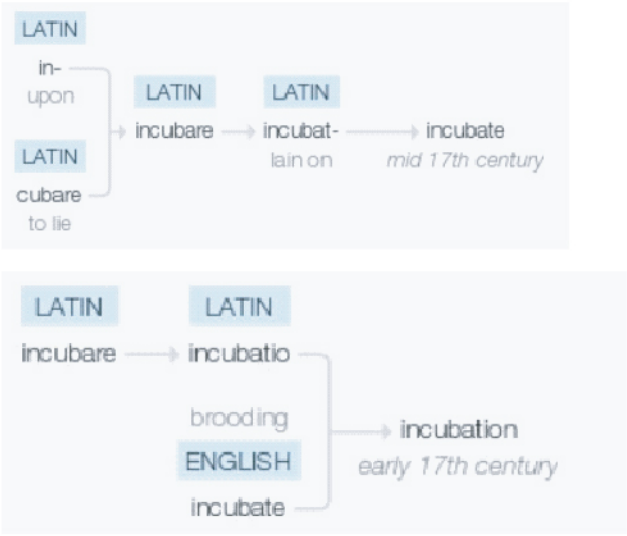


Figure-4: History of the word "Incubation"

the maximum in the market from any disruptive innovations." And that's why it's important for any framework on NPD to be aligned with the process of Disruptions at every step.

prayer with the intention of searching for guidance for a decision or issue commonly known as Salaat-ul-Istikhaarah. The National Business Incubation Association (NBIA) defines business incubators as a catalyst tool for either regional or national economic development. NBIA categorizes their members' incubators by the following five incubator types: academic institutions; non-profit development corporations; for-profit property development ventures; venture capital firms, and combination of the above.

Ideas, Startups and Innovations are often compared to seeds while the Seed Fund works as the water for the seedling to grow and turn into a big tree in future.

The Complete timeline consists of three major Processes known as IDEATION, INCUBATION and ACCELERATION, however Incubation and Accelerations combinedly also known as corporatization.

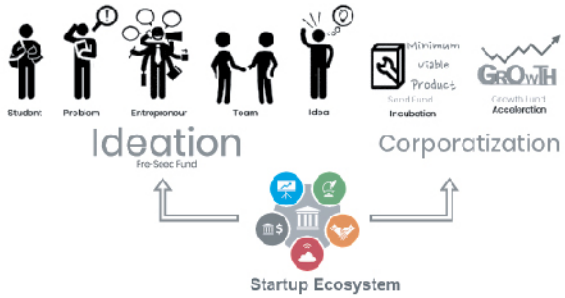


Figure-5: How Ecosystem Facilitates the Processes

As there are lot of theories, definitions, variations and frameworks that exist it's hard to distinguish between these processes. Country's like Australia often refers their Education System as the IDEA generator and thus ignores the Ideation process completely. In Many other countries like Bangladesh often Incubators follows the path of Ideation and accelerators follows the process of incubation due to the lack in quality of entrepreneurs or startups. However, there is a simple way to distinguish and define each of these processes if considered like a system each as shown below,

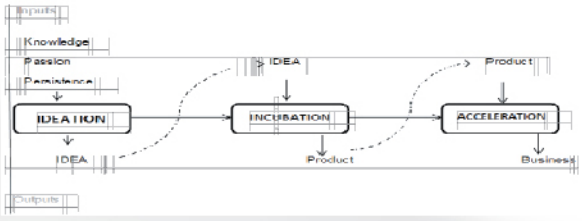


Figure-6: Definition of Processes in terms of System

Systematically, Incubation is the process where disruptive Ideas (input) are facilitated through an experience in order to build a complete product (output)

3.0 Study on History & Evolution of Business Incubation

Business incubators differ from research and technology parks in their dedication to startup and early-stage companies. Research and technology parks, on the other hand, tend to be large-scale projects that house everything from corporate, government or university labs to very small companies. Most research and technology parks do not offer business assistance services, which are the hallmark of a business incubation program. However, many research and technology parks house incubation programs.

Incubators also differ from the U.S. Small Business Administration's Small Business Development Centers (and similar business support programs) in that they serve only selected clients. Congress created the Small Business Administration in the Small Business Act of July 30, 1953. Its purpose is to "aid, counsel, assist and protect, insofar as is possible, the interests of small business concerns." In addition, the charter ensures that small businesses receive a "fair proportion" of any government contracts and sales of surplus property. SBDCs work with any small business at any stage of development, not only startup companies. Many business incubation programs partner with their local SBDC to create a "one-stop shop" for entrepreneurial support.

Within European Union countries there are different EU and state funded programs that offer support in form of consulting, mentoring, prototype creation and other services and co-funding for them. TecHub is one of examples for IT companies and ideas.

In India, the business incubators are promoted in a varied fashion: as Technology Business Incubators (TBI) and as Startup Incubators-the first deals with technology business (mostly, consultancy and promoting technology related businesses) and the later deals with promoting startups (with more emphasis on establishing new companies, scaling the businesses, prototyping, patenting, and so forth). The mission on creating specific innovations among the young minds of researchers via. 101 specialized incubators have been boosted in various parts of India through AIM-India. For instance, AIC-IIITKottayam, a Startup-based Incubator, specializes in IoT Cloud research jointly with world class incubators from Germany, US, Austria, and so forth.

The formal concept of business incubation began in the US in 1959 when Joseph L. Mancuso opened the Batavia Industrial Center in a Batavia, New York, warehouse. Incubation expanded in the U.S. in the 1980s and spread to the UK and Europe through various related forms (e.g. innovation centres, pépinières d'entreprises, technopoles/science parks).
The U.S.-based International Business Innovation Association estimates that there are about 9,000 incubators worldwide. A study funded by the European Commission in 2002 identified around 900 incubation environments in Western Europe. As of October 2006, there were more than 1,400 incubators in North America, up from only 12 in 1980. Her Majesty's Treasury identified around 25 incubation environments in the UK in 1997; by 2005, UKBI identified around 270 incubation environments across the country. In 2005 alone, North American incubation programs assisted more than

27,000 companies that provided employment for more than 100,000 workers and generated annual revenues of $17 billion.

Incubation activity has not been limited to developed countries; incubation environments are now being implemented in developing countries and raising interest for financial support from organizations such as UNIDO and the World Bank.

Bangladesh launched it's first ever Incubator jointly with BHTPA, The Banglalink IT Incubator at Janata Tower in 2016 through the Gala Day of Connecting Startups Bangladesh, also the first National Startup based Competition. Since then few other known incubators have entered the scene such as: Startup Dhaka Incubator, YY Goshti Incubator with support from The EMK Center, Daffodil International University Business Incubator and many more.

An analytical study of existing Incubation models that has come and evolved throughout the history was prepared as the basis of this research based modeling. Key Characteristics, Certain Specialties, Advantages and disadvantages of these models was taken into account in order to provide an in-depth analytical report. (In Appendix-I)

4.0 Catalysts Behind Limitations

Recently, a multi-billion dollar, international company looked at their innovation portfolio and realized that all it contained were opportunities totally aligned with (and supported by) its existing business units.

There were virtually no active projects for strategic opportunities that would expand their business beyond the area close to their core, and consequently no new offerings that they could rely on for accelerated future growth. When they examined the reasons why this was so, they determined that the only way to create new offerings was their tried-andtrue New Product Development (NPD) process based on the stage-gate methodology introduced by Cooper in 1986. In digging further, they came to the realization that it was the stage-gate process itself (even with the new agile stage-gate modifications) that was the limiting factor. The linear nature of the process (even with constant customer iterations), the lack of system-level iteration and feedback, and the deterministic control mechanisms all conspired to make it difficult for any opportunity that wasn't well within, or at least very close to the core, to even make it into the NPD process - much less succeed if it did. It was clear that a new methodology was needed.

For a company to successfully implement opportunities that stretch its strategic boundaries there needs to be room to experiment in a nondeterministic, non-linear way. There needs to be a way, not only to tweak the design of a new opportunity, but also to challenge and reshape its underlying value proposition and business case throughout the process. For strategic innovations to be successfully pursued by a company there needs to be an iterative cycle of experimentation - testing, learning, adapting, and testing again - until you get it right (or abandon it!). This period of experimentation requires a certain mindset, specific behaviors, a methodology that includes the appropriate tools, and a guide that can be used to check if you are on the right path. This is what is called 'incubation'.

Incubation is the period between having a wellreasoned concept and an actual artifact (product, service, platform, business model, etc.) that can thrive in the world.

The reason for having an incubation period (during which you are incubating a new opportunity) is to design and conduct experiments (and use the results) to get as close to a true, valuable manifestation of a new artifact as possible.

Sometimes new product development (NPD) is relatively straightforward, although it may be extremely costly and difficult. If uncertainty is low and the new artifact is relatively close to the company's core, the NPD processes that companies use (such as stage-gate) are pretty good at producing a continuous stream of sustaining innovations. Incubation isn't even an issue - just develop it! Today, however, sticking close to the core is just table stakes. Doing so will keep you alive, but it will also keep you penned into an increasingly smaller corner of the universe of possibilities.

So throughout the history with inputs from various experts and researchers, Incubators have been evolved and even produced facilitation based Startups like WeWork who broke the valuation records through the roof with $47 Billion on January, 2019 and fell down at the same speed to below $10 Billion in September, 2019 less than the $12.8 billion it had raised since 2010. However, the process for general incubation of disruptive innovations still remains unclear. However, many incubators approaches to address the circumstantial requirements and issues which causes major shift form the actual process and thus in developing and Least developed countries incubators often turns into Ideators in terms of activities and facilitations provided.

Another main reason for this is most of the models are aligned with the ecosystem which causes more ecosystem dependency for the model to actually work. This results into a much bigger issue for the Developing or least developed countries that are weak in terms of ecosystem to adapt such models. Moreover, not every startup in any country can afford or fit in with an incubator, mentor or facilitation based platform due to lack of definite outcome, financials and opportunities.

Unlike many business assistance programs, business incubators do not serve any and all companies. Entrepreneurs who wish to enter a business incubation program must apply for admission. Acceptance criteria vary from program to program, but in general only those with feasible business ideas and a workable business plan are admitted. It is this factor that makes it difficult to compare the success rates of incubated companies against general business survival statistics.

Although most incubators offer their clients office space and shared administrative services, the heart of a true business incubation program are the services it provides to startup companies. More than half of incubation programs surveyed by the National Business Incubation Association in 2006 reported that they also served affiliate or virtual clients. These companies do not reside in the incubator facility. Affiliate clients may be home-based businesses or early-stage companies that have their own premises but can benefit from incubator services. Virtual clients may be too remote from an incubation facility to participate on site, and so receive counseling and other assistance electronically.

The amount of time a company spends in an incubation program can vary widely depending on a number of factors, including the type of business and the entrepreneur's level of business expertise. Life science and other firms with long research and development cycles require

more time in an incubation program than manufacturing or service companies that can immediately produce and bring a product or service to market. On average, incubator clients spend 33 months in a program. Many incubation programs set graduation requirements by development benchmarks, such as company revenues or staffing levels, rather than time.

i. Eligibility
ii. Admission process
iii. Intellectual property iv. Seed loan
v. Infrastructure
vi. Common Infrastructure
vii. Other services (facilitation, Training, mentoring, etc.)
viii. Periodic assessment
ix. Information Submission
x. Consideration
xi. Tenure in BI
xii. Exit
xiii. Conflicts of interests and confidentiality of information
xiv. Disclaimer
xv. Agreements

Business incubation has been identified as a means of meeting a variety of economic and socioeconomic policy needs, which may include job creation, fostering a community's entrepreneurial climate, technology commercialization, diversifying local economies, building or accelerating growth of local industry clusters, business creation and retention, encouraging minority entrepreneurship, identifying potential spin-in or spin-out business opportunities, or community revitalization. About one-third of business incubation programs are sponsored by economic development organizations. Government entities (such as cities or counties) account for 21% of program sponsors. Another 20% are sponsored by academic institutions, including two- and four-year colleges, universities, and technical colleges. In many countries, incubation programs are funded by regional or national governments as part of an overall economic development strategy. In the United States, however, most incubation programs are independent, community-based and resourced projects. The U.S. Economic Development Administration is a frequent source of funds for developing incubation programs, but once a program is open and operational it typically receives no federal funding; few states offer centralized incubator funding. Rents and/or client fees account for 59% of incubator revenues, followed by service contracts or grants (18%) and cash operating subsidies (15%).
As part of a major effort to address the ongoing economic crisis of the US, legislation was introduced to "reconstitute Project Socrates". The updated version of Socrates supports incubators by enabling users with technology-based facts about the marketplace, competitor maneuvers, potential partners, and technology paths to achieve competitive advantage. Michael Sekora, the original creator and director of Socrates says that a key purpose of Socrates is to assist government economic planners in addressing the economic and socioeconomic issues with unprecedented speed, efficiency and agility.

Many for-profit or "private" incubation programs were launched in the late 1990s by investors and other forprofit operators seeking to hatch businesses quickly and bring in big payoffs. At the time, NBIA estimated that nearly 30% of all incubation programs were for-profit ventures. In the wake of the dot-com bust, however, many of those programs closed. In NBIA's 2002 State of the Business Incubation survey, only 16% of responding incubators were for-profit programs. By the 2006 SOI, just 6% of respondents were for-profit.

Although some incubation programs (regardless of nonprofit or for-profit status) take equity in client companies, most do

not. Only 25% of incubation programs report that they take equity in some or all of their clients.

Incubators often aggregate themselves into networks which are used to share good practices and new methodologies. Europe's European Business and Innovation Centre Network ("EBN") association federates more than 250 European Business and Innovation Centres (EU|BICs) throughout Europe. France has its own national network of technopoles, pre-incubators, and EU|BICs, called RETIS Innovation. This network focuses on internationalizing startups. Of 1000 incubators across Europe, 500 are situated in Germany. Many of them are organized federally within the ADT (Arbeitsgemeinschaft Deutscher Innovations-, Technologie-, und Gründerzentren e.V.).

Profitability and financial sustainability is another reason that incubators face various challenges in meeting the expectations and requirements of each and every participant startups. Designing or offering individual solutions for each startup is an absurd strategy for any business incubation based organization that seeks profitability or financial sustainability.

Sometimes, though, incubation is really hard. When there are high levels of uncertainty in many dimensions - because the new artifact has never been done before and because it will require new competencies and behaviors that are different from the company's current expertise - success is often elusive. It is this latter condition that is of interest. It is a defining aspect of strategic innovations that stretch or transform existing businesses boundaries.

In today's world, VUCA is increasing at an accelerating pace. Within and near the core, that uncertainty can be managed (indeed the company itself may be the cause). Farther from the core, however, the causes are less familiar and the ways to address them are unknown. But the need to identify, define and implement new opportunities that are further from the core is increasing. This is where differential value can be created and where accelerated growth is possible.

On the other hand, the scenario for entry level or Idea Stage Startups is completely different. There's no doubting that entrepreneurship is tough, with a US study of 3,200 high growth technology startups finding that over 92 per cent failed within three years.

Failory carried out a survey on 80+ Failed Startup Founders and CO-founders and resulted in the information below,

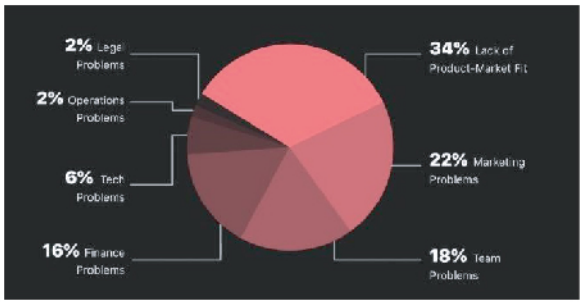


Figure-7: Common Reasons for startup Failure

don-based data analytics firm Autopsy, which has ranging from pre-seed to series A and beyond, the largest database on startup failure globally compiled data exclusively for Wamda.

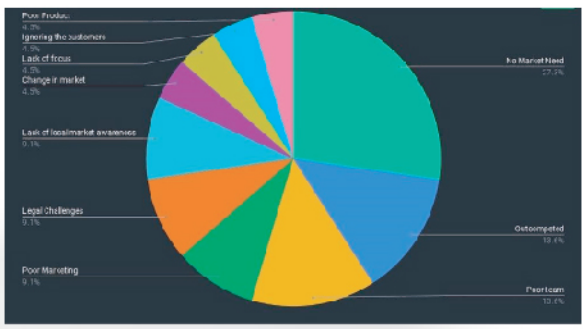


Figure-8: Data Analysis of Autopsy: Top 10 Reasons for Startup Failure in MENA Region

Autopsy analyzed more than 60 failed startups in the Middle East and North Africa (Mena) region - principally from Saudi Arabia, Egypt, the UAE and Iran - to establish the common reasons for failure. No market need (27.3 per cent) was cited as the most common cause, followed by outcompeted and poor team (both 13.6 per cent). Poor marketing, legal challenges and a lack of local market awareness were each cited by 9.1 per cent of companies, while change in market, lack of focus, ignoring customers and poor product were each blamed by 4.5 per cent.

Among the failed companies, the three most represented sectors were e-commerce, advertising and software. The highest funded company included was Dubai-based Zibox Inc. a marketplace for buying and selling used items, which received $1.9 million in seed funding. Autopsy continues to capture and analyses failure data to provide an insight into the reasons why companies fail and what key data and lessons derived from their failure can be useful for future startups and other stakeholders in the space such as Venture Capitalists.

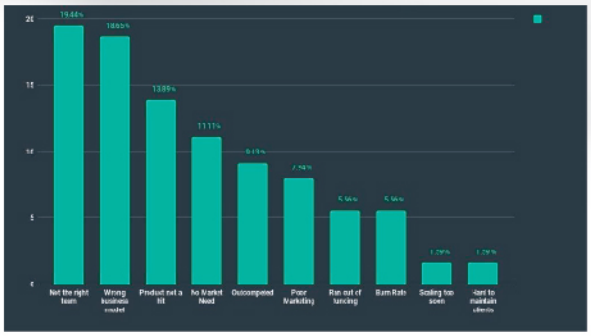
Autopsy ran an analysis on 300 failed startups to understand the common reasons for failure. After a deep dive ofreading and analysis into each submitted story on Autopsy and gathered the top 10 reasons for failure.

Options	knowledge & Strategy Driven Learning (Lack/Need)	High-End Skills (Lack/Need)	Legalization and Licensing Process or Policy Based Challenges (Barrier)	Grant/Equity Funding Sources (Lack/Need)	Other (Lack/Need, Barrier)	Don't Know (Need Mentoring)
Number of Votes (Total 1000)	**317**	**36**	**73**	**235**	**9** **4 – Opportunity (Need/Lack)** **3 – Competition and Recognition (Need/Lack)** **2 – Thinking Capacity (Barrier)**	**330**
Rate	**31.7%**	**3.6%**	**7.3%**	**23.5%**	**0.9%**	**33%**

Table-2: Lack/Need/Barriers voted by Student to Startup Participants (1000 Startups)

Based on these data as primary leads, an online survey was designed with few specific options and conducted through an online poll among a group of 1000 Youth Entrepreneurs of Bangladesh who participated in Student to Startup Program about what they lack/need and see as a barrier for success. Each of them were given one single vote only so that they would choose what they think as a burning requirement and the Results were very much unpredictable than how the facilitation market thinks,

The unexpected result was that 33% of Entrepreneurs who pitched their startup in a national competition and went through an intense process of ideation didn't have any clue about what they need or lack or see as a barrier to their success. Most importantly, these clueless entrepreneurs are the majority and as its proven majority often reflect the whole community. Although this indicates to the trend the youth has been following for last decade, the more concerning issue is the analysis of



the other options they voted for.

Now let's analyze the other popular options, Grant/Equity Funding Sources: According to Small Business Trends, One-third of startups launch with less than $5,000 while 58% of US startups start with less than $25,000. The ceiling of Two Innovation Grants provided by ICT Division and A2i are 25,00,000 BDT which isroughly $30,000. The Pre-seed fund offered by Innovation Design and Entrepreneurship Academy(iDEA) Project of Bangladesh Computer Council is 10,00,000 BDT which is roughly $12,000. Moreover, there are bigger players in the ecosystem for equity funding such as: SBK Tech Venture, Pegasus TechVenture, The Angel Network, IDLC Finance, RVenture and many more. Yet the problem lies in the other side of the picture where only 40% of startups actually turn a profit as 30% of startups break even.

Knowledge & Strategy Driven Learning: Based on areport provided by Failory, No market need is the number one reason why startups fail alongside with Basic Sales and Marketing skills. Team problems are a contributing factor to these failures. Little experience of CEOs and Directors is also a common characteristic of failed startups. According to Preferred CEO, 77% of businesses do not have an appropriate product and/or service prices and 73% of businesses have overly optimistic sales estimates. But the trend knows no bound. As In a survey of Micro Biz Mag among 1,000 adults in the U.K, in January 2020, 65% of them wanted to start their own business. The other 35% were split between those who did not want to start their own business (21%) and those who were unsure (14%) In 2017, Latin America and the Caribbean had the highest rate of startups worldwide, with 11.7% of the working-age population involved in new entrepreneurial activities. (Source: Statista) The region's largest and most populous country, Brazil, is also the most entrepreneurial country in the world, with 13.8% of the adult population engaged in various business enterprises. As of September 2018, around 50% of Indians were likely to start their own business. (Source: Statista)

Nearly a century ago, Henry Ford said that failure was simply the opportunity to begin again, this time more intelligently. Many entrepreneurs have heeded the legendary carmaker's advice, When people become an entrepreneur they almost train themselves to not even consider that failure is possible. It's like the athlete who thinks only of winning. Failure isn't an option. In the real world, though, no matter how hard you work you may still fail. When that happens, the entrepreneur is ill-prepared, and they fail hard. There is a very large personal cost, which usually burns them out in the sense they stop seeing entrepreneurship as a viable careerchoice.

5.0 Framework's Architecture
The major assumptions for the Design of this framework's Architecture are,
1. The Input (participated Entrepreneur/Startup) has completed the overcoming early difficulties before succeeding, but the concept of embracing failure is less accepted in the startup sector increasing the chances of companies going bust. Based on data provided by Startup Heatmap Europe, 38% of European Entrepreneurs wouldn't launch a 2nd

Startup independent of the fact of failure or success. ideation process and has a decent Idea or basic concept of certain product, service, business or technology to start working on.

2. The Input (participated Entrepreneur/ Startup) has a basic Seed Fund to work with while the sources of this fund is irrelevant (FnF, Angel, Grants, etc.)

3. The Duration of the complete process is undefined (as per requirement) although in order to raise growth funds (series A,B, etc.), valuation is a very important but relative factor. There are many methods for valuation but most of them require the business to operate for minimum 6-12 months in order to get a justified valuation.

4. The founder or co-founders of the Input (participated Entrepreneur/Startup) has gained a basic knowledge from the Ideation process on the NPD frameworks available (in Appendix-II) alongside with how and where they can be applied.

5. The Eco-system where the process is hosted has very little to offer and most of the developments would be based on self support.

6. The Input (participated Entrepreneur/ Startup) can't jump from one stair to another without covering up the previous stair completely. Moreover, it's important to stairway through the both staircases parallelly in an efficient way.

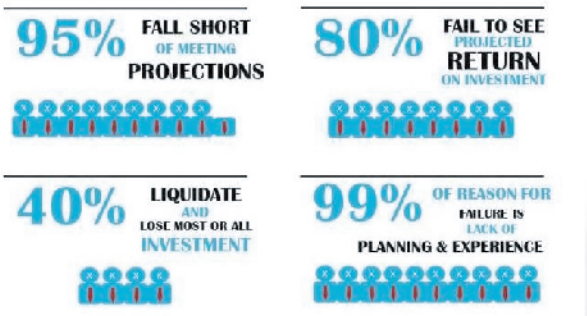


Figure-10: Top 4 Startup Failure Data from EU (Statista)

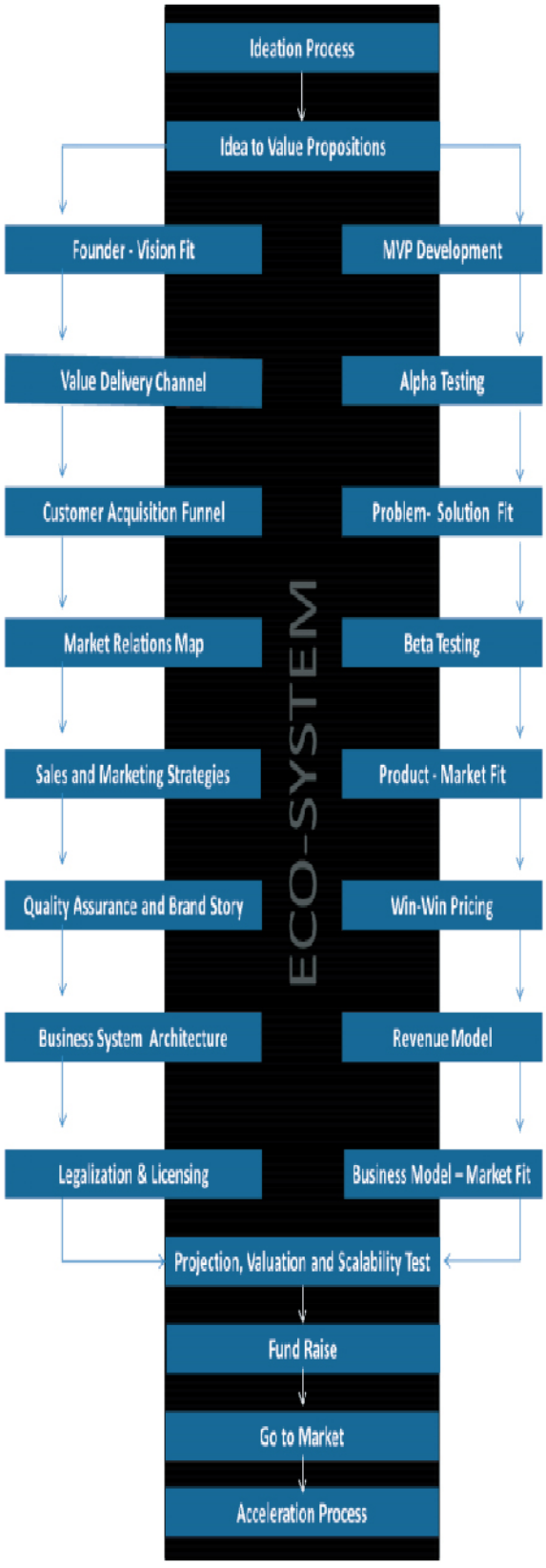


Figure-11: The Double Staircase Model, Framework Architecture (Ashikur R. Rupok, 2020)

The first Step of the process is to convert the idea or basic concept into value propositions. It's very important distinguish between Features and Benefits in order to understand value propositions properly. The most simpler way to understand this difference is to know that Feature shows 'what it is' and benefit tells 'what it can do'.

The next important thing is the core team. The common problem most of the entrepreneurs around the world face are that they always have to eat more than they can digest and assume that they would learn how to digest the rest while eating. That's why it's very important to have a team that fulfills all the roles required and backs each other up for the sake of a common vision. There are lots of theories about finding a soul mate. Some of the theoretical one's consist of a challenger, a gatekeeper and a leader while practical ones consist of a Technician/ engineer, one manager and one finance/ accountant.

Once the work Breakdown Structure and the team are ready the right staircase development starts with a Minimum Viable Product. There are lots of important things regarding building a MVP such as: Gall's Law of System Development. But what's important is to ensure that the MVP is minimum in terms of four factors: Time, Money, effort and Features.

The alpha testing will be conducted by having the inhouse team as consumer of the MVP to use the product or service from a customer's point of view and make sure that the problem-solution fit is gained.

The beta testing can be conducted through a general diversified liquid network in order to achieve best results and feedbacks. This is kind of a shortcut to identify the targeted market. Although many prefer to have feedbacks from real customers/consumers or even a niche market. It's a justified strategy although any pivotal move in terms of targeted users can harm the efficiency. However, the main goal of beta testing would be to achieve the product-market fit.

The important thing after gaining product-market fit is to figure out a win-win pricing. Large companies make these types of decisions through market survey or other methodological approaches while idea stage startups usually follow their instincts. Both cases it's important to make the customer/consumer feel that he/she/they are wining. After figuring out the pricing the next step would be to design a revenue model. There are many types of business or revenue model with distinct differences between them. More or less the idea is to figure out who has your money and how you should take it. Many startups prefer to work on the revenue or business model first before fixing the price although for efficient approach it's better to know exactly how much money there is to take. However in both cases the ultimate target is to achieve the business model-market fit. The left staircase starting with the Founder-vision fit focuses on mapping and strategically plan for the business to operate. Before figuring out how to sell a product it's important to figure out how the value would be delivered to the targeted consumer/customer. Startups like: Ali express, Amazon, etc. capitalizes on over fulfilling customer expectations in terms of value delivery. Skills on supply chain management are a bonus to have in this type of work.

After figuring out the value delivery channels the sales and marketing section starts with designing the customer acquisition funnel. Frameworks and strategies like: AIDA Model, AIDCAS Model, CAB Model, Growth Hacking, AAARR

metric, Digital Marketing, etc. can be used in this stair. The other thing required to operate a business is to have circumstantial sales and marketing strategies. Usually these strategies are often designed based on the features, market or the nature of the business. Hook Model, IKEA Effect, Carrot-Stick Theory, Snow Ball Sales System, one page marketing plan, etc. are some of the strategies adapted by companies now a days. The basic idea is to list down the messages that are to be thrown towards the customers/consumers.

The most important part of this section is to work on the market relations mapping. Market Analysis, Market Evaluation, Market Segmentations, Market Targeting and product positioning are the few names of this type of work. The Market Relation Map also consists targeting potential stakeholders and how the feedback based relation with the market will work.

The final part of the left staircase focuses on building a company. It starts will figuring out methodologies for quality assurance of the product or service in order to establish as a Brand and every Brand has its own story to tell that actually affects it's sales figures.

The final two stairs focuses on the structure of the business. It's important to build a system dependent business of maturity stage right from the beginning. This includes figuring out the different departments, sections or teams behind the business who'll operate chosen with 'must have' characteristics. The final stair of left staircase is legalization or registration of the business with licensing like: trade mark, patent, copyright, IP, etc.

The Right Staircase shows the things an input must go through during the incubation while the left staircase indicates preparatory ground work for the upcoming growth and acceleration process in order to build a justified business plan.

Both of the staircases merges at the point where startups calculates the projections, financial models with breakeven analysis, valuation of the business and test the scalability to make sure it's profitable and won't fall under the pressure of growth at any scale. An input (participated Startup/Entrepreneur) leaves this stair with a well-documented business proposal based on a disruptive innovation that they've already worked on and tested through a systematic approach. Usually any investor, Financial Organization, VC or angel would jump into this type of well-prepared plan if the numbers shown in the valuation and projection are satisfying.

The input (participated startup/ entrepreneur) that entered the process with a basic concept or idea comes out in shape of a product in the market as output.

6.0 Conclusion

"If you are not embarrassed by the first version of your product, you've launched too late."
- Reid Hoffman, LinkedIn Co-Founder and Venture Capitalist

Usually entrepreneurship is a very risky choice of career although similar to the dilemma of innovation the future rests on the shoulders of these risk takers. Innovation is and will cause transition in the job market and skill. It's a phenomenon that snatches the old jobs but also creates and provides the new one. The Double Staircase Model is a common model to be used for business incubation of disruptive innovations from idea stage startups as well as the large companies who needs to keep testing disruptions in order to stay alive in the future market. This model has almost zero dependency on either of the

eco-system, Business Incubator Companies or any facilitation platforms. Startups are defined as businesses with such potential that won't run, but fly. In order to fly in the sky, entrepreneurs must learn how to climb up the stairs accordingly.

Appendix-I

Over the past decades, a number of people have discussed and developed approaches to incubation as a specific and important phase of innovation. Perhaps the most relevant early work on incubation as a distinct and important phase of innovation is the work of Gina O'Connor as described in her book Grabbing Lightning.

Analysis of Methodological Models for Business Incubation that evolved throughout the history,

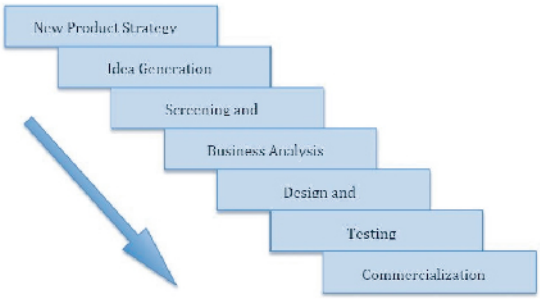


Figure-12: The BAH model (Booz, Allen and Hamilton, 1982)

Researchers, who have tried to develop a model that simulates the different stages of the NPD process, have made many attempts.

A multitude of allied NPD models have been planned over the years. The best known is the Booz, Allen and Hamilton (1982) model also known as the BAH model, which set the standards for most other NPD models that have been developed. This widely used model appears to enclose all of the realizable stages of models that have been developed. It is based on extensive research in several companies, in depth interviews of the specialists, and case studies that correspond to reality and, therefore, seems to be a fairly good sequence of substantiated practice in industry.

The stages of the model are as follows: New Product Strategy: Connects the NPD process to company goals and provides objectives for new ideas generation and instructions in determining selection criteria.

The BAH model (Booz, Allen and Hamilton, 1982)

Idea generation: Searches for product ideas that correspond to company objectives.

Screening and evaluation: Consists of a first infiltration to determine which ideas are relevant and worth more detailed research.

Business Analysis: Further assessment of the ideas based on quantitative research, such as economic gains, Return-oninvestment (ROI), and volume of sales.

Design and Development: Converts an idea from drawing into a product that is demonstrable and producible.

Testing: Performs commercial tests necessary to check earlier business decisions.

Commercialization : Schedules the production. The results Booz, Allen and Hamilton found, demonstrates that companies that have successfully produced new products are more likely to follow the model of NPD process and that the product generally follow all of the above stages.

The model stresses on process functions of incubator as main business development tool that can transform idea into a real

business. The main outcome of the model: Incubation process is of key importance

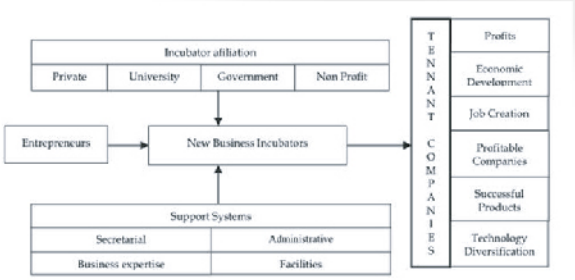


Figure-14: Smilor model (1987)

This model was developed by Smilor in 1987 by refining Campbell's model (1985). Smilor created structure model via describing main incubator affiliates, support systems and description of main outcomes of the incubation process. He considers an incubator as a transformation mechanism that assist entrepreneur in building a venture. Even though the representation of the model doesn't provide extensive information aboutparticular services that business incubator

- Campbell, Kendrick & Samuelson Model (1985)
- Smilor model (1987)

supplies to tenants, Smilor categorizes the benefits that business incubators provide to their tenants through four dimensions:

I. Credibility development.
II. The shortening of the learning curve.
III. Faster troubleshooting.
IV. Access to the network of entrepreneurs

This model is the combination of two. Firstly, Smilor introduced his model and then it was extended by Nijkamp. Nijkamp's (1988) model is the interpretation of a generic business incubator. He argues that any business incubator acts as a mediator between entrepreneurs and community. Thus, successful implementation of the incubator requires combination of at least these elements:

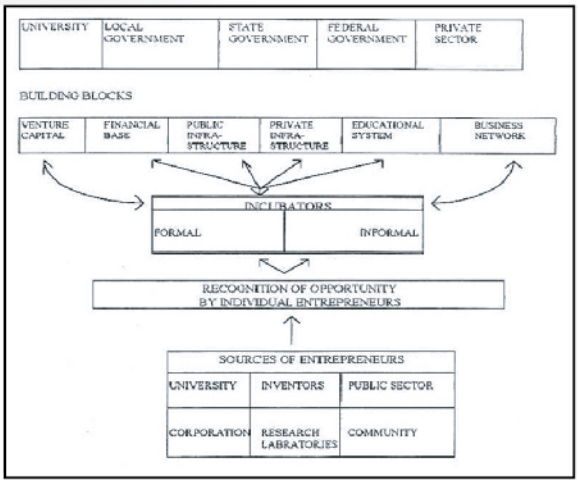


Figure-15: Nijkamp & Smilor Generic Incubator model (1988)

Nijkamp & Smilor Generic Incubator model (1988)

I. Sources of entrepreneurs
II. Recognition of opportunities by entrepreneurs
III. Demand for business incubation services

- Torrance and Safter's Creative Incubation Model (1990)

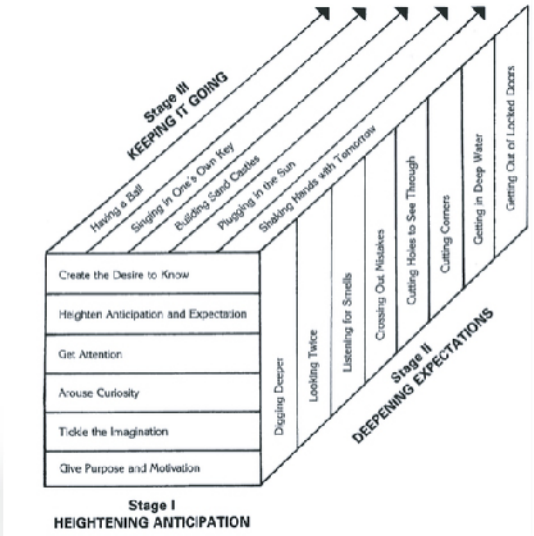


Figure-16: Torrance and Safter's Creative Incubation Model (1990)

Torrance constructed the incubation model of teaching (IMT) to provide educators with a method to deliver academic content while leading students through the creative thinking process (Torrance, 1979; Torrance & Safter, 1990). The model's three stages (Heightening Anticipation, Deepening Expectations, and Keeping It Going), ensure that creativity is taught from start to finish, rather than sprinkled on at the end of lessons. Indeed, creativity becomes the vehicle through which content is delivered and deep learning occurs. Torrance strategically designed the model to encourage students to let ideas "sink in" through incubation, claiming that learning creatively is both effective and intrinsically motivating: "People prefer to learn creatively-by exploring, questioning, manipulating, rearranging things, testing and modifying, listening, looking, feeling-and then thinking about it- incubating" (Torrance & Safter, 1990, p. 13).

Carter & Jones-Evans process model (2000)

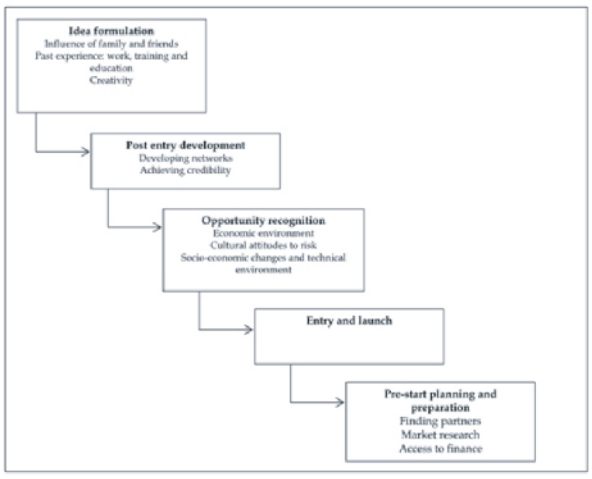


Figure-17: Carter & Jones-Evans process model (2000)

This is a first true process model in a row. Carter & Jones-Evans (2000) proposed a typical five-step incubation process, as shown in the figure above. As it can be seen from Carter & Jones-Evans' (2000) model the process is organized and focused on the needs of the incubate, which will be supported by the services provided by the incubators during the incubation process. The incubation process according to the Carter & Jones-Evans consists of the following stages: idea formulation, post entry development, opportunity recognition, entry and launch, pre-start planning and preparations.

Nowak and Grantham Virtual Incubation Model (2000)

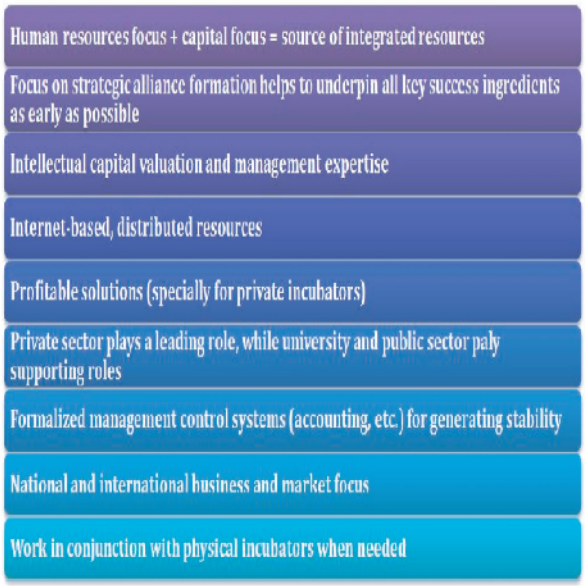


Figure-18: Nowak and Grantham Virtual Incubation Model (2000)

Nowak and Grantham (2000) have established their model on the following premise:

"Traditional business development entrepreneurs face a common challenge: the absence of capital, human resources, and management capabilities." So, the new model needs to provide the small business community with a structure and mechanism to easily access:

- information on "best practices" for business development

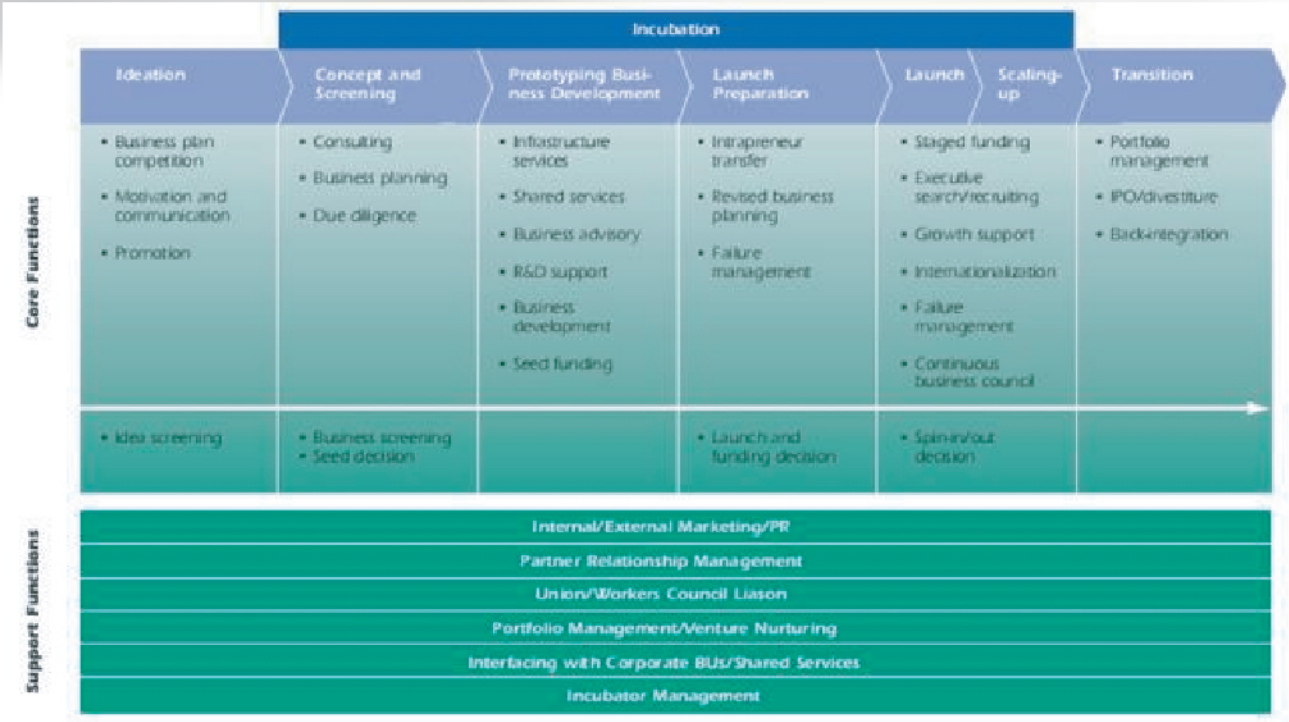


Figure-19: Booz, Allen & Hamilton Corporate Incubator Model (2000)

- industry and management experience
- resources for international marketing, sales and distribution

They proposed the creation of a virtual incubation model, based on networked innovation, which brings together, if only in a virtual sense, centers of technical and business or management excellence

Booz, Allen & Hamilton Corporate Incubator Model (2000)

Main contribution of the model proposed by Gregor Harter, Klaus Hölbling & Steffen Leistner from Booz, Allen and Hamilton (1982, The BAH Model) is conceptualization of business incubation and applying it to a corporation's needs in continuous innovation. The model describes how corporate incubator could reinforce and support innovation practices

Lazarowich & Wojciechowski 'New Economy' Incubator Model (2002)

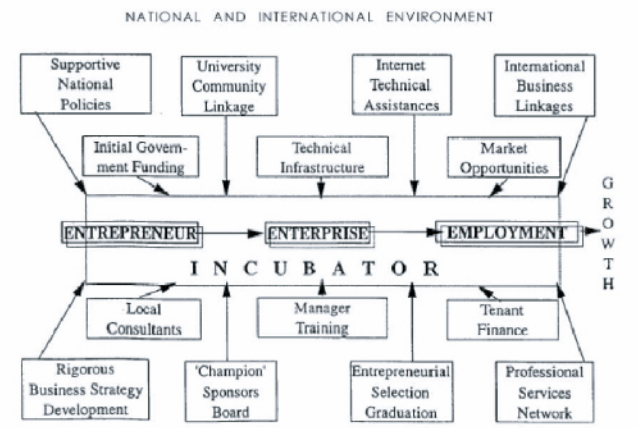


Figure-20: Lazarowich & Wojciechowski ' New Economy' Incubator Model (2002)

The model described by Lazarowich and Wojciechowski explains 'new economy' incubators. They are characterized by the following:

- "Business incubators are private-sector, profit-driven with the pay-back coming from investment in companies rather than from rental income.

- They tend to focus mainly on high-tech and internet-related activities and unlike

'traditional' incubators, do not have job creation as their principal.

- 'New economy' incubators often have an essentially virtual presence with financial and business services at the core of the offering unlike their 'traditional' counterparts that usually center on the provision of physical workspace."

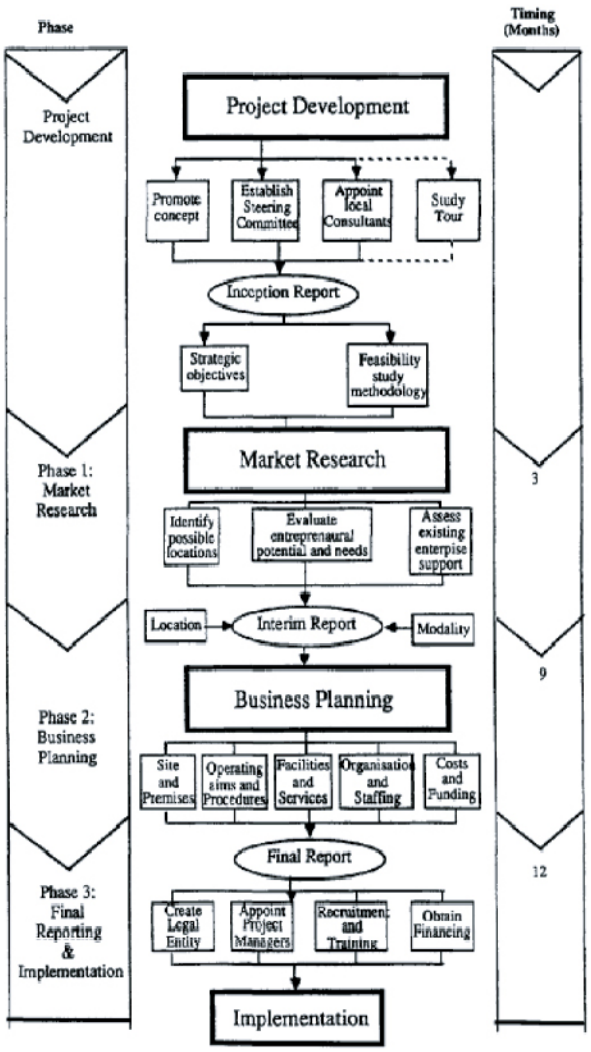


Figure-21: Lalkaka Incubator Development Model (Technology Business Incubator Manual) (2000)

This model is about the development of technology business incubator. The model was presented by Mr. Lalkaka in 2000 and was intended to guide planners, educators, sponsors and management teams in exploring and establishing a successful TBI program.

Costa-David, Malan, Lalkaka, NBIA Model (2002)

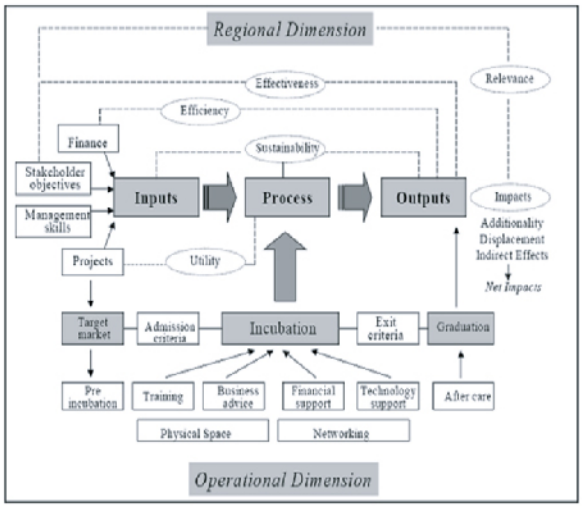


Figure-22: Costa-David, Malan, Lalkaka, NBIA Model (2002)

This model was presented in a 2002 EU incubator benchmarking study as a general 'model of incubation' based on EU-wide survey data. However, it was developed by very knowledgeable authors Costa-David, Malan, Lalkaka for NBIA. Later the Center for Strategy & Evaluation Services (EU) copied this model and used proposed benchmarks that depict incubator efficiency and performance in terms of using inputs, developing and orchestrating processes and ensuring a steady supply of quality outputs.

Gibson & Wiggins Model (2003)

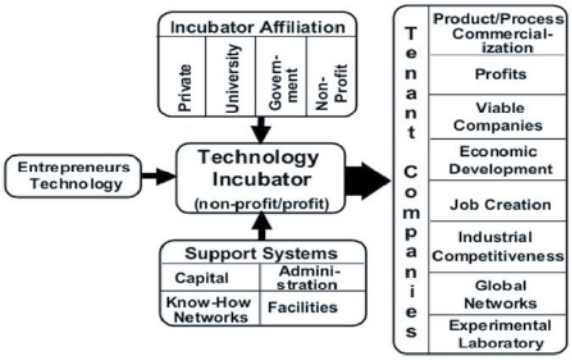


Figure-23: Gibson & Wiggins Model (2003)

This model is basically a copy-paste but redefined version of a Smilor model (1987).

Sahay Model (2004)

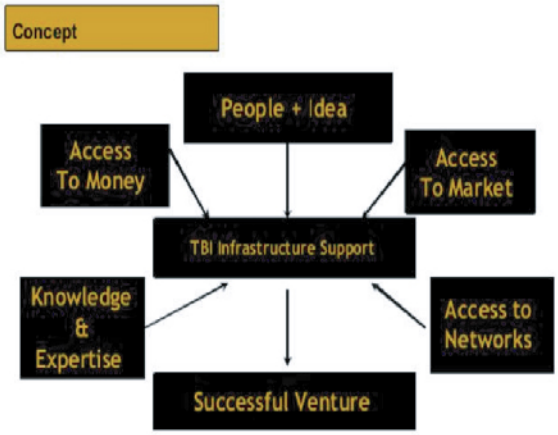


Figure-24: Sahay Model (2004)

The objective of the business incubator is to transform entrepreneurs with ideas into businessmen with successful ventures. Even though this sounds too optimistic and there is no business incubator which has no failures. In the process of incubation BI provide access to knowledge, expertise, technology, networks, money and markets. These are building blocks of technology-based business incubator according to Mr. Sahay.

Hackett & Dilts Generic Business Incubator Model (2004)

The model is a universal business incubation model which can be used both in public and corporate purposes. In short, it is structured as black-box: inputs of the process, process activities, and outputs of the process. Authors also present a formula of Business Incubation Process.

Bergek & Norrman Model (2008)

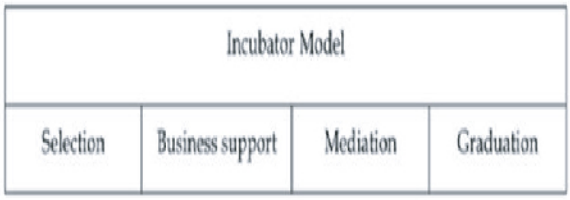
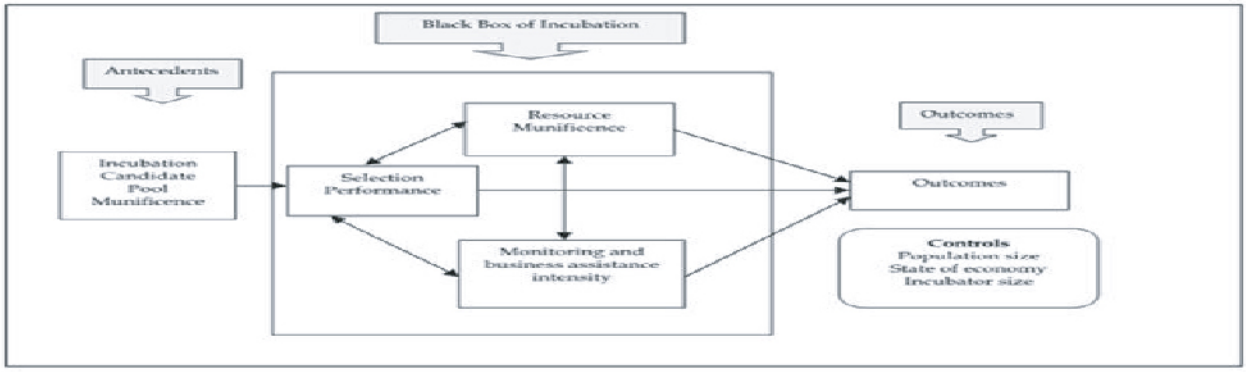


Figure-26: Bergek & Norrman Model (2008)

The model of Bergek & Norrman from 2008 continues the ideas that have been developed by Hackett & Dilts (2004),Smilor in 1987 and Gibson & Wiggins (2003). On the one hand the model is centered on the results of the

(a)



(b)

Figure-25: Hackett & Dilts Generic Business Incubator Model (2004)

business incubation. On the other hand it's still process model which describes different stages of the process. So, it's easy to adapt it in the real life and build your incubator by applying this model.

InfoDev Process Model (2009)

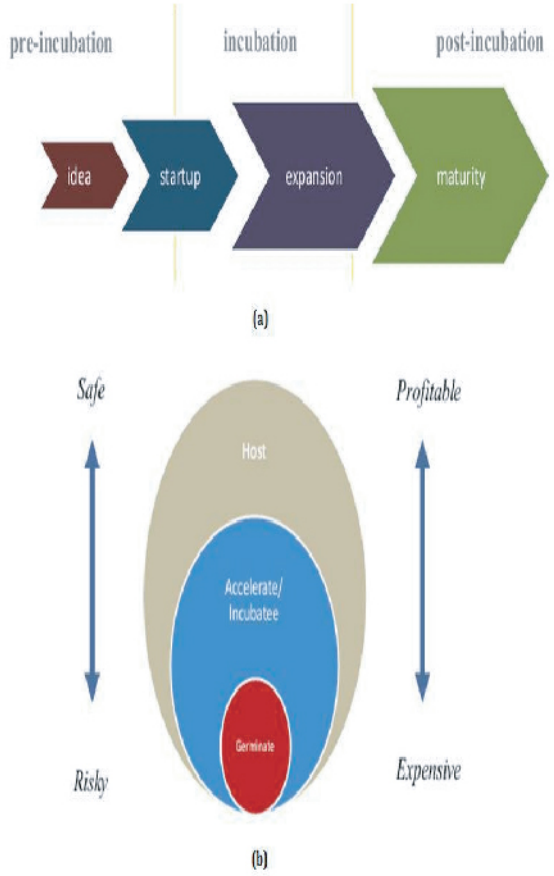


Figure-27: InfoDev Process Model (2009)

infoDev model is the model developed for building business incubators around the World within infoDev network. InfoDev is a powerful and well-known World Bank program that "grows innovation around the world". They work in five different areas: Access to Finance, Agribusiness Entrepreneurship, Climate Technology, Mobile Innovation, Women Entrepreneurs. One of the works they do is helping entrepreneurs by bringing them business coaching, access to early-stage

Jones's Incubation Value Chain Model (2010)

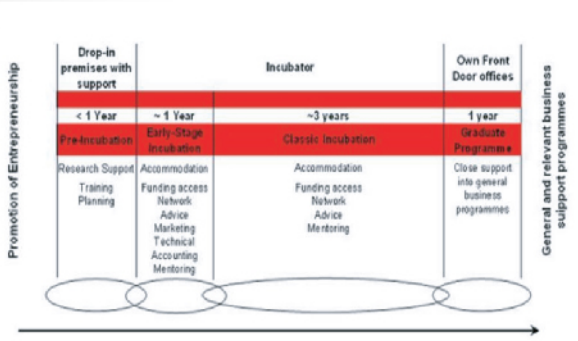


Figure-28: Jones's Incubation Value Chain Model (2010)

The Incubation Value Chain Model is a first comprehensive approach to link incubation process to the processes in the innovation ecosystem and entrepreneur's life cycle. Firstly, Jones separated the process into several stages:

1) Pre-incubation. This stage is not leaded directly by incubator. It is here initial training, planning and research support for would-be entrepreneur is delivered.

2) Early-stage incubation. This is classical stage of any incubator which includes funding access, business support, marketing, mentoring, financial and accounting services, accommodation, etc. This stage is no longer than a year. Most accelerators work in the early-stage incubation stage.

3) Classic incubation. Serious stage that lasts about 2-3 years with the access to services and resources of typical business incubator.

Second and the main point of the model is that Jones considers business incubator as a part of a value chain which allows us to think about long-term goals of the innovation system in the whole.

Important conclusion that should be made from this model is:

" Business incubation or venture development is step-by-step process that should be addressed by different development institutions on each stage: from ideation phase till later stage of the venture.

- Matching venture's development stages with incubation stages helps us understand needs of ventures on the one hand, and propose particular business incubation services on the other hand.

4) Graduate program. After graduation entrepreneurs or companies could get support in special business support programs or get some benefits from government in tax and financial sphere.

Chandra and C.-A. Chao Model (2009);

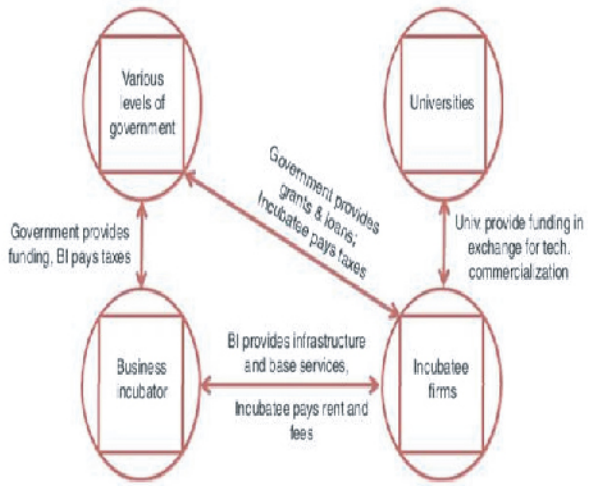


Figure-29: Chandra and C.-A. Chao Model (2009);

The Chandra & Chao model (2011) conceptualize the flow of the resources between key stakeholders in the innovation ecosystem which are connected to business incubators. Authors distinguished 4 key players:

- Public, government
- Business incubator
- Entrepreneurs
- Universities

Public, government, and university support for incubation is generally provided with the expectation of economic growth and job creation or technology transfer and commercialization respectively as illustrated in figure above. Government provides grants & loans and expects that incubatees will pay taxes after reaching mature phase, incubator pays taxes from their income. University sponsor harvests it's return on

investment "by way of technology transfer/commercialization and its attendant benefits to faculty and students." (?handra & Chao model, 2011) Incubators around the world are either affiliated to a university/government or to a local economic development agency that invests public/private resources into incubation to support a new venture at the earliest and most vulnerable stage of its life cycle.

Important feature of this model is conceptualization of resources' (money, knowledge) flow (or cycle) between stakeholders. Business incubators are viewed as moderators of these resources. Thus, efficiency and effectiveness of any business incubator are directly linked to the taxes which government use in order to support entrepreneurs.

Lessons learned and comments about the model:

- The model describes resources flow between stakeholders of business incubators. This is very important aspect that hasn't been discussed before. An attempt to understand the whole environment and a place of business incubator in the innovation value chain is critical to this service organization.

-However, authors failed to identify all stakeholders in this process. Venture funds,

Public, government, and university support for incubation is generally provided with the expectation of economic growth and job creation or technology transfer and commercialization respectively as illustrated in figure above. Government provides grants & loans and expects that incubatees will pay taxes after reaching mature phase, incubator pays taxes from their income. University sponsor harvests it's return on

investment "by way of technology transfer/commercialization and its attendant benefits to faculty and students." (?handra & Chao model, 2011) Incubators around the world are either affiliated to a university/government or to a local economic development agency that invests public/private resources into incubation to support a new venture at the earliest and most vulnerable stage of its life cycle.

Important feature of this model is conceptualization of resources' (money, knowledge) flow (or cycle) between stakeholders. Business incubators are viewed as moderators of these resources. Thus, efficiency and effectiveness of any business incubator are directly linked to the taxes which government use in order to support entrepreneurs.

Lessons learned and comments about the model:

- The model describes resources flow between stakeholders of business incubators. This is very important aspect that hasn't been discussed before. An attempt to understand the whole environment and a place of business incubator in the innovation value chain is critical to this service organization.

-However, authors failed to identify all stakeholders in this process. Venture funds, corporations, and market were not put in the list. Another view could be also proposed.

Becker & Gassmann (2006)

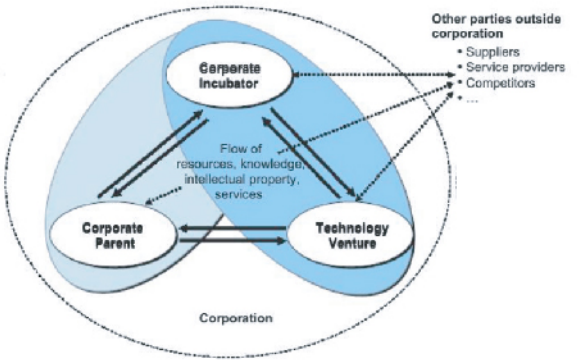


Figure-30: Becker & Gassmann (2006)

The resource-based view offers a valuable framework to analyses how the corporate incubator can optimize scope and interaction of resource flow between

(1) Corporate incubator and technology venture, and

(2) Corporate incubator and Parent Corporation

The quality of the exchange between incubator and technology venture depends on the incubator's resources, its degree of access to and quality of resources available from the parent corporation, as well as the openness of resource flow on the side of the receiving technology venture. The degree the resource's demand by the technology venture can be fulfilled by the incubator is closely linked with the scope of interaction, quality of relationship and trust between incubator manager and technology venture, which further research needs to analyses.

resources which they return in in form of financial profit, but even more importantly

through explicit and tacit knowledge to the corporation. Further research is needed in several areas:

-In-depth longitudinal study on development of corporate incubators in the post new economy; ? Quantitative analysis of phase-dependent resource flow between the incubation stakeholders (early set-up versus harvest phase);

-Survey on success factors of technology ventures regarding type of resource flow, sophistication of management know-how, extent of networking quality and branding impact. This exploratory study provides a first insight into a resource-based view on corporate incubators and invites further development and applications.

Resource flow is a two-fold process. Initially the incubator and technology venture receive

Metibtikar's Incubation Process model (2012)

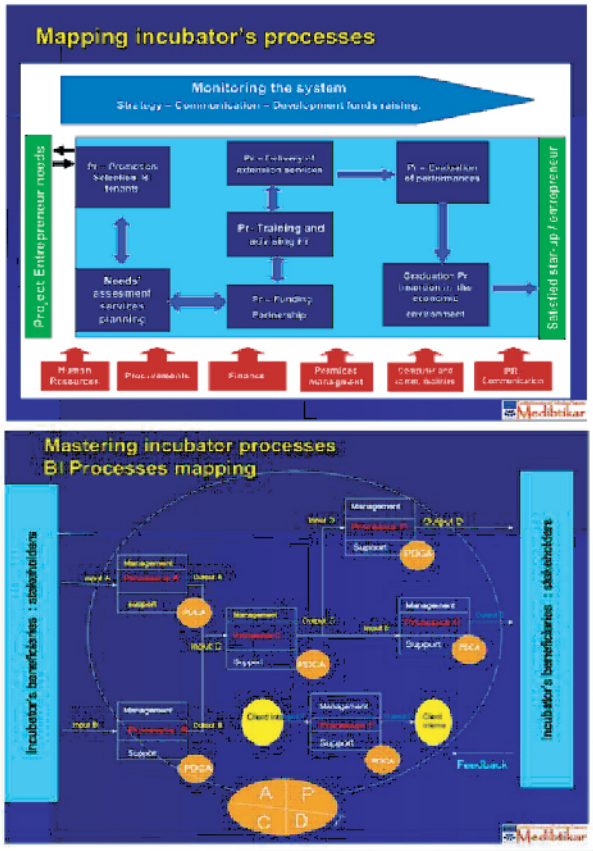


Figure-31: Metibtikar's Incubation Process model (2012)

This model is valuable for analysis because it describes business incubation process. There are several building blocks of the model:

-Entrepreneurs' needs
-Incubation process
-Monitoring & mediation processes
-Support services
-Built-in PDCA cycle.

Let's describe the latter first. Every practice that is delivered in the incubation value chain is a subject for continuous improvement. It is true for both points of views: for the entrepreneur's perspective that is getting results out of it and for the incubator that can't stop delivering certain service after the end of the particular stage of incubation process. On the opposite every service (or practice) that is delivered by an incubator has different intensity along the stages of the incubation process lifecycle. See analogy from the Hump diagram below. As an example we can take team building activity and consider it along the life cycle of the incubation process. In the beginning there is strong need for team building services in order to strengthen the team/venture. On the later stages the intensity of team building is smaller, but still incubator managers should pay

attention to it and guide a team from a "forming stage" of the team to an "excellent performing stage" of the team work (Tuckman model of the group development)

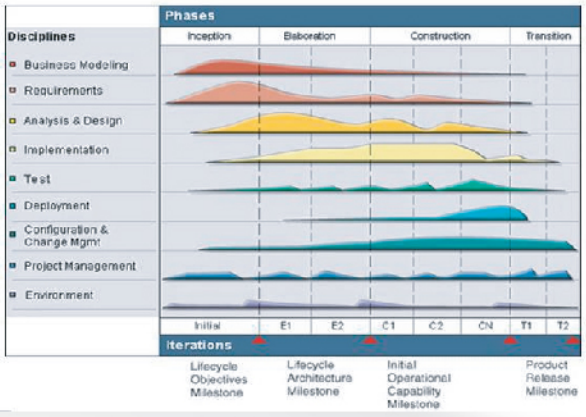


Figure-32: Hump Diagram of System Development (IBM, 2005)

Thus, PDCA cycle applied by incubator managers helps tenants to continually change and tweak what they do in order to:

1. "Achieve higher quality in their results and processes.
2. Gain continual increases in work efficiency.
3. Allows you to clearly see which stage your project is at.
4. Assists you in handling your work logically and systematically." (Bulsuk, 2009)

In general, incubators are understood as a kind of infrastructure to support and promote the creation and development of SMEs, with the principal objective being to provide support infrastructure to make up for perceived shortcomings or imperfections in the market mechanism (Bollingtoft & Ulhoi, 2005) and mitigate highly qualified entrepreneurs' lack of knowledge about management (Chan & Lau, 2005;Hansen et al., 2000;Lyons, 2000). Project promoters' lack of experience and the lack of resources needed in the early stages (Schwartz & Hornych, 2010) are a barrier to new firms achieving success, and so the support services and infrastructure provided by incubators are directed towards accelerating their learning process (Bruneel et al., 2012;Lalkaka & Bishop, 1996)

For Bollingtoft and Ulhoi (2005), one interesting characteristic of an incubator is the capacity to create and exploit synergies through different resources, services and competences. One of the definitions of an incubator considered most relevant is that of the Entrepreneur's Small Business Encyclopedia, which defines a firm incubator as an organization aiming to accelerate the growth and success of firms' entrepreneurship through a variety of resources and business support services that could include physical premises, capital, coaching, common services and network connections (Bruneel et al., 2012;Morant & Soriano, 2016), including external networks.

European Union initiatives allow SMEs to access global markets in the early stages through the Enterprise Europe Network (EEN), that is, a business cooperation network established by the European Union. Incubators using this type of instrument focus principally on new technology-based firms (Bruneel et al., 2012). This case is in line with the priority axis of the EU's government action (Comissão Europeia [EC], 2014), a resource to help SMEs, mainly those directed from the outset to the global market, that is, born globals (Singh, 2017) While some articles borrow management theories to study business incubation (e.g. Aaboen, 2009;Amezcua et al., 2013;Bruneel et al., 2012;Carayannis and von Zedtwitz, 2005), most remain largely atheoretical (Hackett and Dilts, 2004). We note that most articles researching business incubation focus on technology-based ES (8 out of 12).

Carayannis and von Zedtwitz (2005) propose incubators archetypes based on competitive scope and strategic objectives (Carayannis and von Zedtwitz, 2005). Bruneel and colleagues identify three historical generations of incubators differentiated by their service portfolios (Bruneel et al., 2012). Finally, we learned that universities deploy different strategies to incubate new spin-off ventures relying on varied entrance criteria, resources available, infrastructure, and financial support schemes (Clarysse et al., 2005) Business training and learning represents the main support type associated with business incubation. Studies are fairly consistent in operationalizing business training and learning as coaching (Bergek and Norrman, 2008) and workshops (Bruneel et al., 2012) Also to regional innovation studies (Chesbrough et al., 2000). Bruneel et al. (2012) suggested the financial investments received by incubating enterprises usually come from multiple entities such as financial institutions, government and enterprises. Similarly, Wang andZhou (2012, 2013) argue that financial investments are not immediately available for incubating enterprises without stable financing channels, and that regional innovative performance is unlikely to benefit from business incubators.

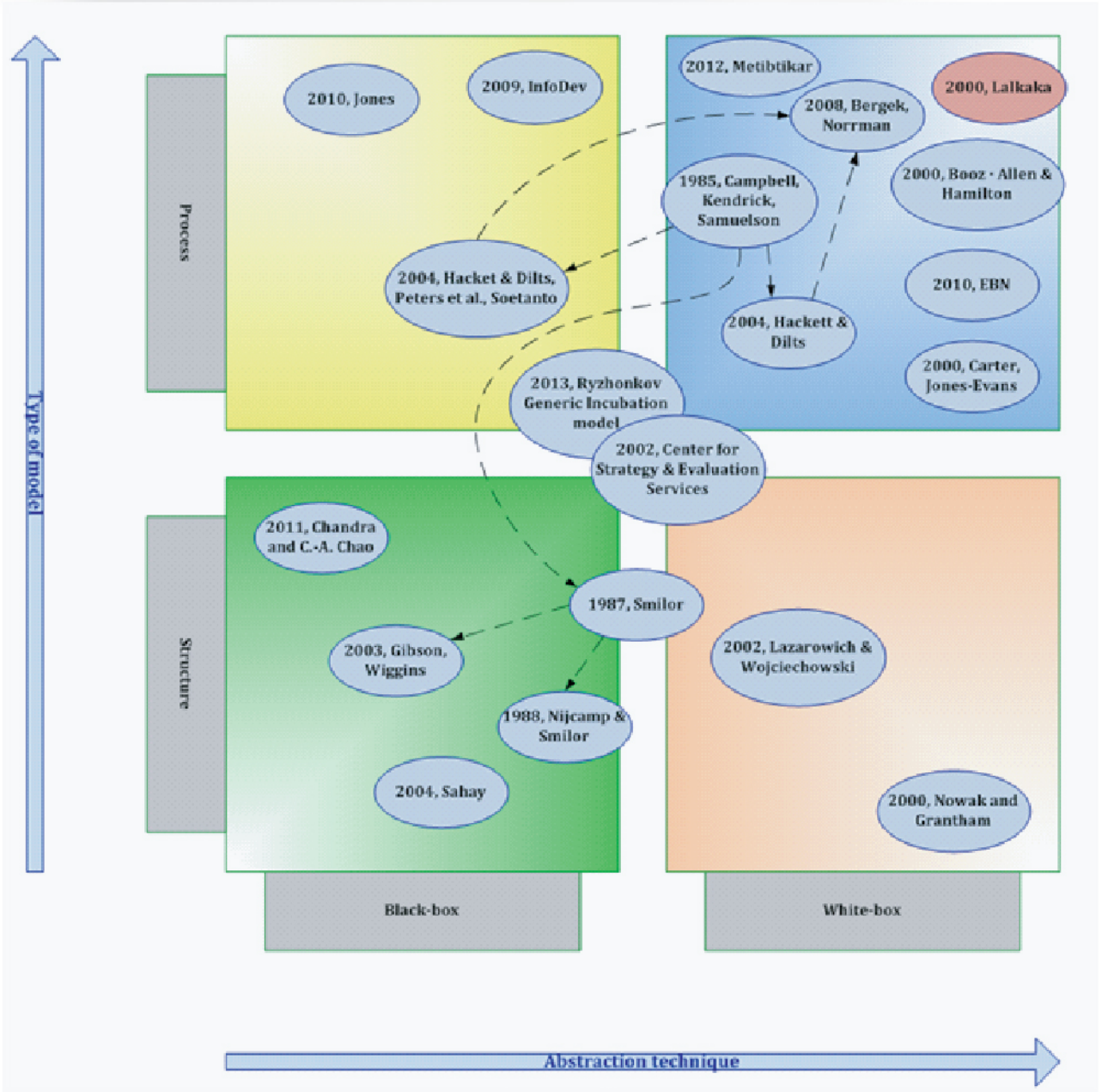


Figure-33: Business Incubation Models' Comparison Matrix

In the beginning it is essential to present several conceptualizations that have been made by Hackett & Dilts (Hackett & Dilts, 2004) (2004). These conceptualizations will help to understand the overall view on a typical business incubator and its operations. Authors used different lenses to formulate these conceptualizations:

theoretical lens for data analysis, such as, social network theory, dyadic theory, real option-driven theory or the resource based view; conceptual constructs linked to specific bodies of literature (such as the new venture creation literature) to develop definitions and / or models; philosophical implications of new theoretical conclusions such as the line of argument a game or rational choice theorist would use.

"These conceptualizations are as follows:
Incubation as a mechanism for new venture

creation- a step-by-step / staged process that awards legitimacy, opens network access and heightens community support for entrepreneurs.

Incubation as a mechanism for resource allocation - a mechanism of awarding a stock of tangible and in-tangible resources to client firms that results in, in addition to other benefits, client firm growth.

Incubation as a socio-political game- a socio-political mechanism of creating an environment and perception of reduced risk and security within a boundaried physical space.

Incubation as a co-product of incubator-incubatee dyads-a process of co-producing developmental assistance in independent incubator-client dyads.

Incubation as an outcome of network behavior - a system of increasing client firms' network density.

Incubatee selection as a predictable and controllable process- a process of selecting "weak but promising" firms for incubator induction."

The summary of the main outcomes, problems and questions that have been brought to light while we have been analyzing business incubation models since 1985 till 2012 will be provided below.

Key outcomes of existing Business Incubation Models

Key outcomes of the business incubation models are:
a) Business incubation program is a support (or enabling) system for the entrepreneur.
b) Business incubation program has multiple stakeholders and sponsors. They shape significantly the process, efficiency, effectiveness and main outcomes of the program.
c) Business incubation program is a risk management system for the business environment, investors, business angels and entrepreneurs. It is an instrument that reduce uncertainty in the high-risky projects via stage-gate model of venture development.
d) Business incubation program requires a variety of players, playing as a team.
e) Business incubator should concentrate on the following key value-adding activities for the stakeholders (mainly for entrepreneur):
1. increase success rate and survival chances of the incubatee companies,
2. trust and credibility development,
3. the shortening of the entrepreneur's learning curve,
4. faster troubleshooting,
5. access to business networks and proactive formation of strategic alliances.
f) Incubation process is of key importance. It should add value to the entrepreneur while moving him along life cycle in the innovation value chain.

1. The business incubation process should be built as a combination of stage-gate and iterative models with the usage of PDCA cycle approach.
2. Business incubation performance is positively related to:

i. selection performance,
ii. intensity of monitoring and business assistance efforts,
iii. resource munificence,
iv. management and leadership capacity of the business incubator head.
g) Business incubator itself should be profit-driven and innovative organization able to learn, to be sustainable and focus on providing value to key stakeholders. Business incubator should measure it's efficiency, effectiveness, impact on the community, relevance of the results according to the stakeholders objectives.
h) Business incubator should act as a mediator, which provides links between government, industry and university. It is mandatory to consider a business incubator as part of innovation value chain within innovation ecosystem with sources and outputs. Thus, business incubator should provide a mechanism of transformation the demand coming from industry and

government for particular solutions/ technology to the supply coming from the entrepreneurial community (Pull approach)
1. Taking the example of corporate incubator, it should produce and incubate strategically aligned projects. If we will develop this idea to a typical business incubator, incubating projects should be aligned with investor's needs, industry and society needs, country's demand.

i) Business incubator should influence and proactively participate in formation of local entrepreneurial culture.
Problems with existing models Questions and problems, revealed after analysis of the prevailing models are listed below:

1. Incubation process and services:
-Most models of business incubators describe a business incubator as a transformation mechanism. The entrepreneur and/or business idea are inputs to the business incubation system. The system transforms the "material", and provides results. No model describes the importance of influencing the inputs in order to increase the performance of the business incubation system.
-Few models described the incubation process in detail.
-Few incubator's models explain which services to apply in the particular conditions and cases.
-Many models stress on the selection / admission procedures as one of the most important in the incubation process. However:
i. few analyze how to provide viability of entrepreneurs, their ideas and their competences, how to provide sufficient flow of entrepreneurs and business ideas of high quality for incubation program,

ii. there is no consensus on what selection criteria to use (potential of entrepreneur or idea).
- Most process models based on waterfall model of the process. However, in real world this rarely happen.
- How to combine virtual and physical business incubation?
2. Performance, effectiveness and efficiency of business incubator:
- Business incubation programs are becoming more and more short-term oriented. Only few propose pre-incubation services where risks and needs are on their peak.
- There is no clear guidelines of how to measure effectiveness and efficiency of the incubation process, which performance metrics to use (growth and financial performance at the time of incubator exit, etc).
-Well established and efficient incubation process is not enough for great performance if there is lack of inputs such as capable entrepreneurs and/or critical technologies for commercialization.

Criteria of selection:
i. What criteria should be considered at the time of the selection of possible incubatees?
ii. Would the existence of predefined criteria contribute to the economic results of incubation?
- To what extent performance of incubation depends on the incubator's ability to create options through which the selection of weak-but-promising intermediate potential firms is interesting?
3. Relationship between entrepreneur, business incubator and innovation ecosystem:
- There is no model that have linked entrepreneur's life cycle, incubation process and processes in the innovation ecosystem (external environment). "The model is divorced from the national and regional environment and the macro-politics of institutional change which determine the real aims and objectives of state-level incubation systems" (Aernoudt about Hacket & Dilts model, 2004).

-"The total absence of the role and influence of the incubatee firm - an important party in the co-production dynamic of the incubation process" (Rice, 2002)

4. Entrepreneurs' needs and performance:
- Almostall models describe "picking the winners" policy as the optimal (successful) approach. Bergek & Norrman's (2008) suggested, to deploy a selection process by assessing pairs of ideas/entrepreneurs, and winners/survivors in order to get more holistic vision. However, I would argue that "picking the winners" is the approach that applied by 99% of the incubators, venture funds, venture capitalists and other players in the venture industry in order to reduce risk of business incubator not produce unsuccessful venture. In that sense they are doing good job in order to increase success chances of selected. But this is a short-term oriented way to the incubation and they don't consider development of the region and those 99% would-be entrepreneurs that were rejected during the selection process. As we will see later one of the main problems of almost every business incubator and venture fund is not a deal selection, it is the deal sourcing and flow. Thus, "picking the winners" and rejecting others policy doesn't solve this problem.

-How would startup company performance be outside in the real world?

-How to incubate those target groups that will not be able to pass selection criteria (e.g. in rural areas)?

5. Culture
-No model describes an importance of cultural issues for the incubation performance. Business incubation program should be considered as a cultural transformation mechanisms.

Incubation activity has been addressed as a mechanism to support start-up through education, resource sharing, co-working space, and collaborative network (Smilor, 1987; Heckett and Dilts, 2004a; Dee et al., 2011). The incubation concept try to link the technology, knowledge and capital in order to increase the new start-up competency and support to develop the new start-up companies (Grimaldi and Grandi, 2005). In developed countries, the various studies using the incubation concept determine the business policy which assists in promoting sustainable economic growth (Salem, 2014). However, the incubation process is not exactly defined in many related studies (Tehodorakopoulos et al. 2014), especially in developing country. A developing country still encounters problems lack of quality start-up. Even though the government, private sector and university are continuing to provide support and educate the new start-ups, these start-ups still lack business and technology knowledge, and struggling to find an innovative partner. (National Science Technology and Innovation Policy Office, 2017). Moreover, there is less communication between institutions, each operates on its own (Wonglimpiyarat, 2016) hence there are duplicated activities, resources and no improvement of the incubation processes.

Incubations are an organization to support startup for creating an innovation. Incubations are designed to support and help a startup to grow rapidly from the start-up period through various services such as co-working space, coaching and mentoring, training create a collaborative network and the business advice (Smilor; 1987; Allen and McCluskey, 1990; Peter et al., 2004; Hackett and Dilts, 2004; Dee et al., 2011). The incubation service and support evaluated from concept of sharing physical infrastructure such as working space, tools and equipment until present business support activities such as business advisory services, mentoring, coaching, networking, business acceleration (Tehodorakopoulos et al. 2014). Most of incubation is a non-profit organization. The target group is always local startup company. Some incubators are associated with university and do not invest in the startup company (Dempwolf et al., 2014). The new generation of incubation focused on business skill and knowledge (Pauwel et al. 2016). A new start-up should be constantly monitored throughout the

process after receiving business advice and provide with sufficient funding. Grimldi and Grandi (2005) identified two incubation models; the first model, incubation emphasizes on reduce the start-up cost for the new startup by providing physical assets and market commodities. The second model, incubation offers high-value service such as funding, the business knowledge, operational support, and collaborative network. The incubation service should be tailored to the need of the new startup. Many researchers proposed the efficiency incubation mechanism. Smilor (1987) classified the benefit of incubation into four dimensions: credibility development, the shortening of the learning curve, faster troubleshooting and access to the business network. In addition, Heckett and Dilts (2004a) suggested that the incubation process should select startup performance before getting into the process because performance is the key to selecting a passion start-up. Berge and Norrman (2008) implied that the selection is one of the important tasks that the incubator use for deciding which ones will be accepted or rejected. In addition, there are two different selection approaches:

1) the selection based on the business idea by using the interviewer's existing knowledge and experience to evaluate the possible idea.

2) the selection based on the startup by evaluating from personality, knowledge, experience, skill and commitment of startup (Hackett and Dilts, 2004a).

Moreover, a research and service organization sponsors by the World Bank Group call information for Development Program (infoDev) (2009) recognize that the incubator should be a link between startup problems and the incubator activity. Therefore, they identify the connection between entrepreneurial life cycle and incubator process. The entrepreneurial life cycle consists of four stages: idea, startup, expansion and maturity. The incubator process comprised of three main stages: pre-incubation, incubation, and post-incubation. These connections help the business incubators to adapt to different strategies for incubating start-ups. In 2011, infoDev has divided incubator to three categories by the main service include seed capital providers, Network boosters, business development service. The individual startup has the most influence on the incubation models and services. The incubation should adjust the model that suitable for the start-up in order to increase the effectiveness and efficiency of the management.

Previously we have discussed about the importance of conceptualization in terms of designing an Incubation process. Let's check out several conceptualizations:

Firstly, hypothesis that models of business incubation could be described from several viewpoints was proved. Every model was clearly put in one or two of the following dimensions:
-structure vs process;
-black-box vs white-box;
-operations vs development.
This means that that every model tried to describe a business incubator within given dimensions applying only one of possible options. This, consequently, limits the model. For instance, Carter & Jones described process of business incubation, but they haven't explained what will be the structure of business incubator, it's resources and so on in order to implement the process. As well as they were concentrated on explanation of internal operations. No information was given how business incubator is interacting with other stakeholders of innovation value chain. Only Hacket & Dilts model tried to conceptualize business incubator in a systemic approach - from mixed viewpoints (process + structure, black-box + white-box). This is the only the model which is close to generic business incubation model.

Secondly, after application of our classification to all models it was realised that

there is a limited set of meta-models. The rest is modification of base-line models.

Thirdly, The Contextualization allowed to look at this phenomenon objectively. It's important not to idealize business incubation. There are several issues about this phenomenon that should be mentioned here:
- Incubation deals with a tiny portion of SME development
- It is no panacea, not a solution to vast unemployment
- Incubation requires a variety of players, playing as a team
- For success, it must be integrated in national plans
- It's about people and process, not only plans and policies
- Change comes slowly, and failures part of success
- From the outset, it must involve politicians and community
- Importantly, incubation must have a 'champion'
- Market emulation paradox exists

Forthly, there is possibility to create a generic business incubation model which will be able to cover structure and process, internal and external dimensions of business incubation. There is only one attempt of such model which is created by Hacket & Dilts. The intention will be to create a model with the following perspective:

- address issues in the analysis of 20 business incubation models
- put entrepreneur in the center of business incubation process (in some models it's not)
- address key problems of entrepreneurs within business incubation process
- stress on early stage entrepreneurs
- take into account key business incubation problems and dowm-sides.

Since 1980s when first publications about incubators appeared academics and practitioners investigated a plenty of questions. One of the most important questions was the question about limitations, constraints and challenges of business incubation. The review showed that many researchers conducted research on this issue.

List of main works, that have touched the issue of business incubation problems and down-sides:
1. Lalkaka, 2000
2. António Carrizo Moreira, Susana Paula Leitão Martins, CRER: An integrated methodology for the incubation of business ideas in rural communities in Portugal, 2009
3. Christine E. Coopero Stephanie A. Hamelo Stacey L. Connaughton, Motivations and obstacles to networking in a university business incubator, 2010
4. Johan Bruneel a,b, Tiago Ratinho c,n , Bart Clarysse a,b , Aard Groen C, The Evolution of Business Incubators: Comparing demand and supply of business incubation services across different incubator generations, 2011
The combined list of the possible problems could include approximately 20 points.

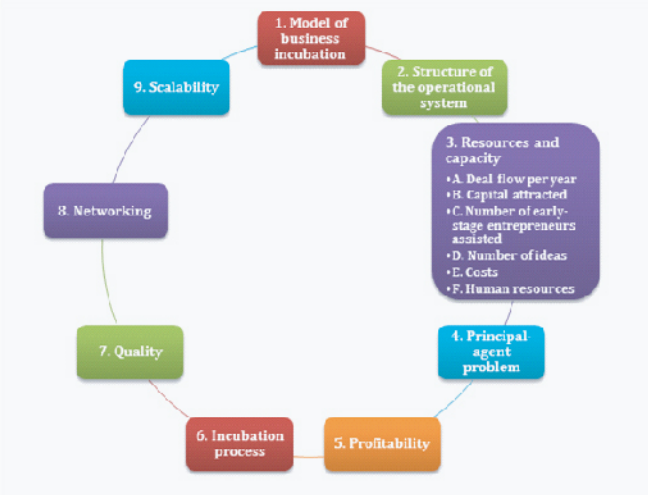


Figure-34: Problems of Business Incubators

Model of business incubation
- Existing models of business incubators can support only limited number of startups (at maximum 450K per year worldwide). Few business incubators implemented a model of virtual business incubators. Out of 9000 business incubators there is only 65 virtual business incubator

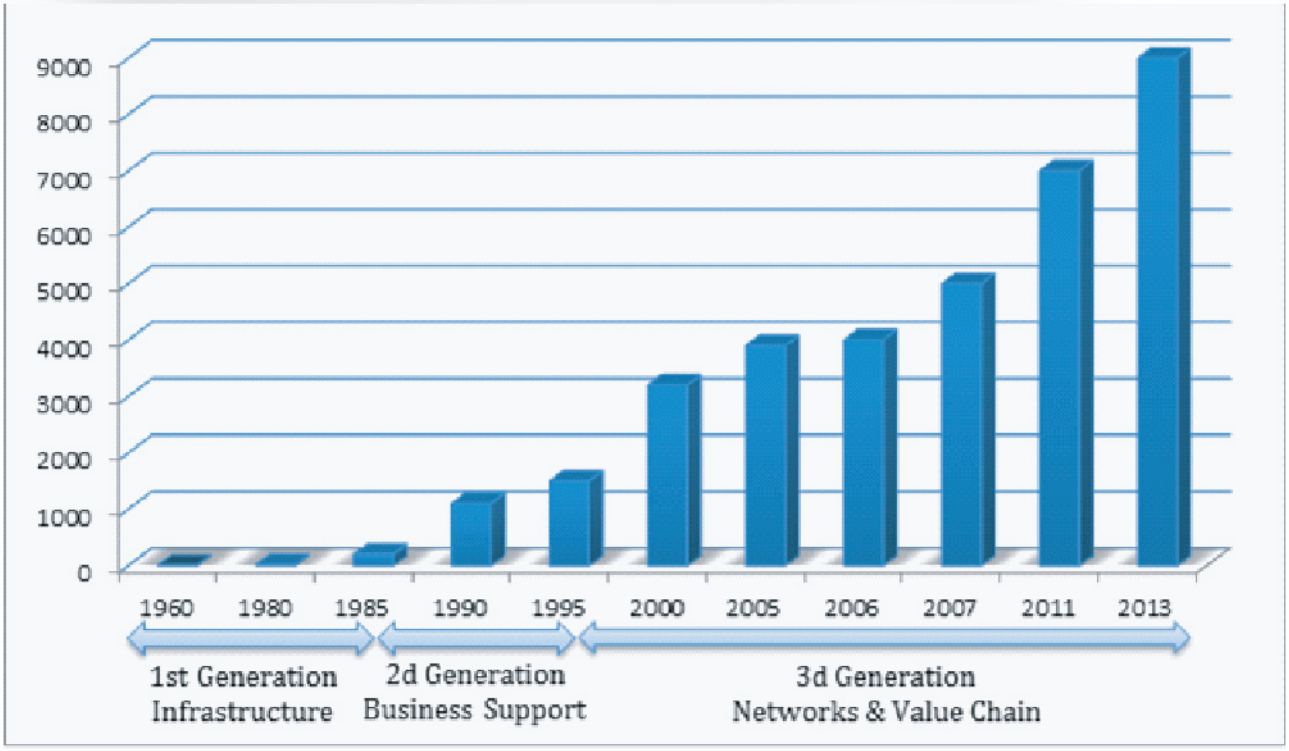


Figure-35: Number of Business Incubators Worldwide (9000, August-2020, 4th Generation)

- Few research is done in creating a framework for virtual business incubation, which can potentiall increase total number of supported companies.

Elitist - Funnel system of work.
-It caters to a selected group of potential "winners". There are tough selection procedures which allow to screen applicants down to 30-50 per incubator per year

-Funnel structure of the operations. 100 > 10 > 1

-Limited in out-reach and makes only a marginal contribution to job-creation in the short term

-Current venture industry and as a consequence system of business incubation (as one of the most effective and efficient economic development tools) is built as pyramid where 99 early-stage entrepreneurs are rejected.

Limited resources and capacity
- Limited capital for early stage entrepreneurs
- Limited number of brilliant ideas and talented people.
- Skills-intensive as it requires experienced management teams.
- Calls for good business infrastructure in a good location.
Incubation process
-It is highly dependent on risk, Thus, very tough procedures of selection, mediation and exit have been established in most business incubators
-Dependent on government support-in policy, infrastructure, initial funding.
- There is strong emphasis on late stage financing (risks are significantly lower), orientation of profit and reduction of investors risks in the venture industry and consequently in business incubation.
- It is impossible to support big amount of early-stage entrepreneurs (even 1000 startups per incubator).
-No more than 0,2 - 0,3% of population of the Earth can be involved in the innovation process (A. Krol, 2012)
-Paradox of market emulation

-Creates dependency by sheltering entrepreneurs from the harsh realities of the market.
-Not yet demonstrated to provide additionally, as most businesses start outside an incubator.
- Expensive
-It provides focused assistance and work-spaces to only a selected few,
-Requires external subsidy for some years before it can become self-sustainable.
Yet the major issue of 9000 Incubators failing to address some serious problems of 305 Million Startups rises because in most of the cases entrepreneurs are not independent and mostly depended on the facilitator or service provider despite of the maximum limits on average are 30-50 ventures per year for each.

This analysis is arguable because pull approach vs. push approach is an ongoing debate. In majority market conditions pull approach is better for building innovation ecosystems.

Appendix-II

NPD Frameworks to learn and apply for entrepreneurs in Ideation Process who want to follow "The Double Staircase Model"

The Ansoff Matrix:

The Ansoff Matrix Also known as the Product/Market Expansion Grid, is a strategic planning tool that provides a framework to help executives, senior managers, and marketers devise strategies for future growth.It is named after a Russian American applied mathematician and business manager, who created the concept. The Ansoff Matrix was developed by H. Igor Ansoff and first published in the Harvard Business Review in 1957, in an article titled "Strategies for Diversification." It has given generations of marketers and business leaders a quick and simple way to think about the risks of growth. The Matrix shows clear picture of how innovation works and significantly distinguishes between sustainable and disruptive innovations.

Agile Development Methodology:

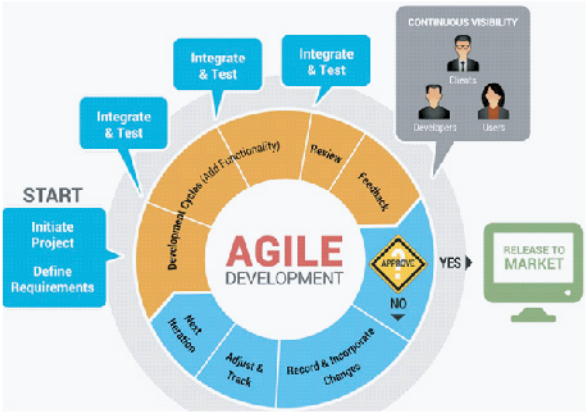


Figure-37: Agile Development Framework

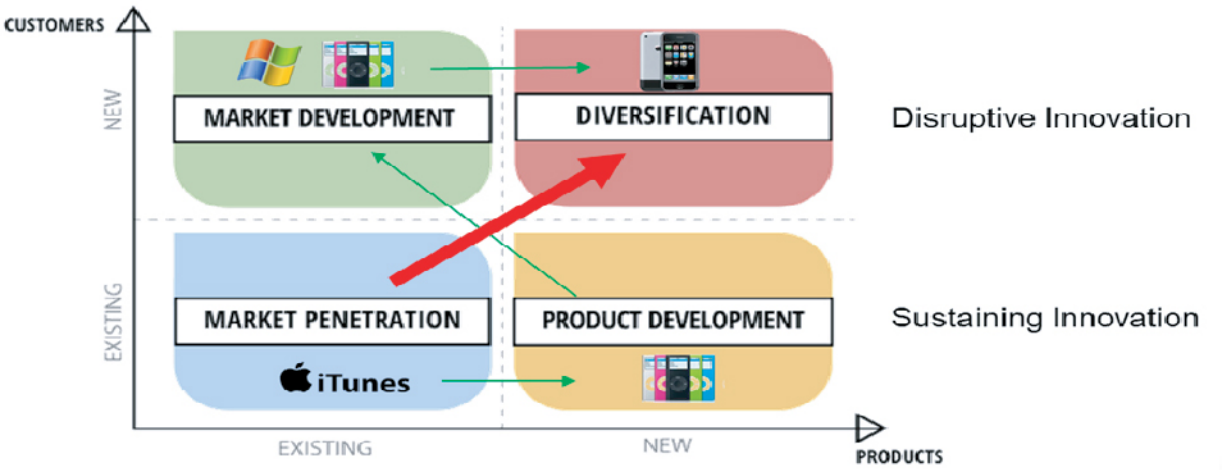


Figure-36: Ansoff Matrix; Case Study of Apple Inc.

Agile was formally launched in 2001 when 17 technologists drafted the Agile Manifesto. They wrote four major principles for agile project management, with the goal of developing better software:

-Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
-Responding to change over following a plan
Mostly used in software development, it approaches development requirements and solutions through the collaborative effort of self-organizing and cross-functional teams and their customer(s)/end user(s). It advocates adaptive planning, evolutionary development, early delivery, and continual improvement, and it encourages flexible responses to change It was popularized by the Manifesto for Agile Software Development. The values and principles espoused in this manifesto were derived from and underpin a broad range of software development frameworks, including Scrum, Kanban and waterfall methodologies which are now sub-sets of agile.

Lean Startup Methodology:

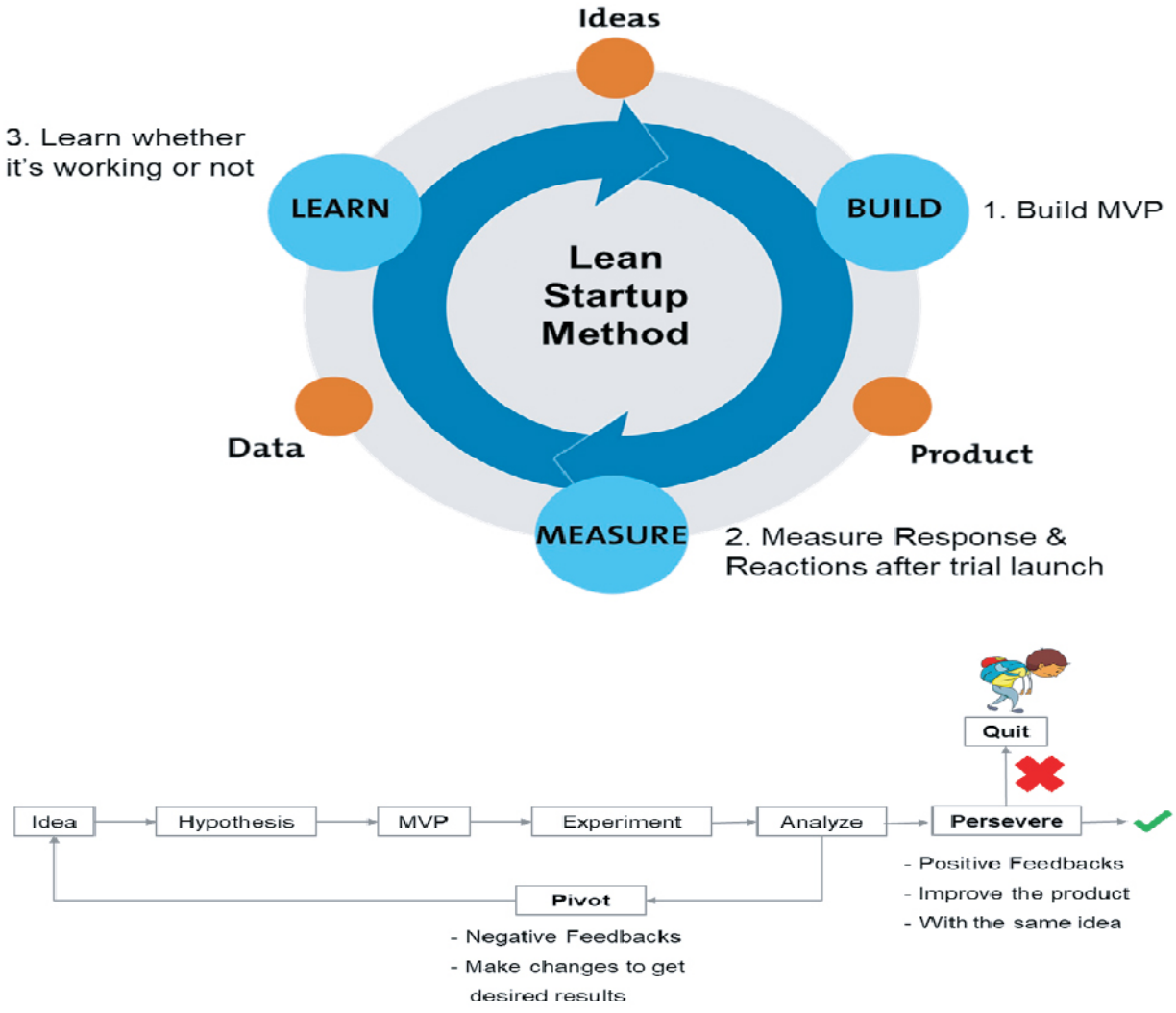


Figure-38: Lean Startup Method

Advocated by Eric Ries, Steve Blank and others is inspired by 'lean' principles pioneered by Toyota in the mid-20th century for its production process, Lean Startup Method is a startups version of agile development framework that provides a clearer scenario on the outcome. The process is based on Three simple steps: Build, Measure and learn; which indicates how much the feedbacks from initial users are important. One of the most popular examples is an app called 'Burbn' which was released as a check-in app with a lots of elements from mafia wars and a simple photo taking and sharing feature. The app felt heavy with all those mafia wars elements although after measuring the responses, it was found that the photo taking and sharing feature was a hit. So the co-founders decided to pivot based on the feedbacks and hence the modern day 'Instagram' was found.

Effactuation:

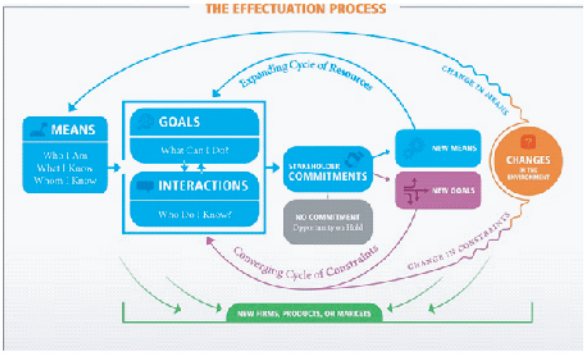


Figure-39: Effactuation Process (Saras Sarasvathy, 1990)

It is developed by Saras Sarasvathy in the 1990's based on her detailed research on startups and entrepreneurs. Saras Sarasvathy's theory of Effectuation (2001) describes an approach to making decisions and performing actions in entrepreneurship processes, where you identify the next, best step by assessing the resources available in order to achieve your goals, while continuously balancing these goals with your resources and actions.

Effectuation differs from the causal logic, where there is a predetermined goal and the process to achieve it is carefully planned in accordance to a set of given resources. Sarasvathy argues that the causal logic is not suited for entrepreneurship processes that are inherently characterized by uncertainties and risks.

The fundamental world view for effectuation is called the Pilot-in-the-plane, which describes the future as something that can be influenced by actions, i.e. creating own opportunities.

The four principles of effectuation are:

-Bird-in-Hand: You have to create solutions with the resources available here and now.
-Lemonade principle: Mistakes and surprises are inevitable and can be used to look for new opportunities.
-Crazy Quilt: Entering into new partnerships can bring the project new funds and new directions.
-Affordable loss: You should only invest as much as you are willing to lose.

The world view and the four principles are used in entrepreneurship processes to plan and execute the next best step and to adjust the project's direction according to the outcome of actions.

Sprint Methodology:
Mostly developed by Google, the Sprint Method is a five-day process for answering critical business questions through design, prototyping, and testing ideas with customers. It's a "greatest hits" of business strategy, innovation, behavior science, design thinking, and more-packaged into a battle-tested process that any team can use.

The key facts about this method is that Outcomes won't be realized until a long time passes by in hardship. The objective is to Iterate and test in a very compressed time frame to help prototyping and validate ideas most rapidly and effectively with Right team, Right challenge and enough effort in time to focus on the problem. (Not for all decisions)
The most common example is the opening

of an online store for Blue Bottle Coffee. To open an online store would take a long time and Years of refinement al thought The initial direction would be CRUCIAL. The steps followed by are as below,

First: Mapped out online purchase process of customers, refined with feedbacks.

Then they came up with some designs, prototyping all using keynotes to the potential customers. Surprisingly based on feedback they eliminated the most favored design.

The five Steps of Sprint are as follows,

1. Maps out customer journey getting expert inputs to decide on one well defined objective.
2. Sketching out all solutions considering all ideas
3. Each member votes on an idea with a sticker and winning one gets storyboarded in greater details.
4. Convert storyboard into prototype in absolute minimum but accurate representation (no code/manufacturing) to get customer feedbacks
5. Ideas put to test interviewing customers takings notes for the lessons of the sprint. Sprint method is also an integral part of scrum, waterfall and agile methodologies.

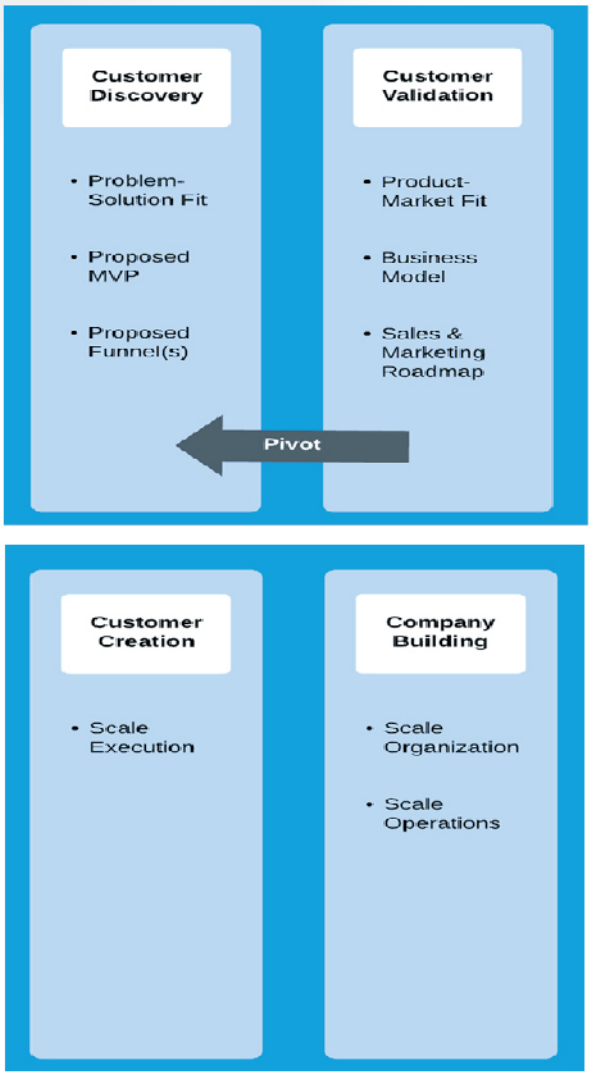


Figure-41: Customer Development Methodology

Customer development is a formal methodology for building startups and new corporate ventures. It is one of the three parts that make up a lean startup (business model design, customer development, agile engineering). Customer development was developed by serial entrepreneur Steve Blank in the 1990s. While writing about his experiences as an entrepreneur in the Silicon Valley for his memoir, Blank began to notice patterns in the startups he was involved with. Recognizing that startups are not simply smaller versions of large companies, he observed that entrepreneurs need to have a systemized approach to guide their search for "repeatable and scalable business

models." The revelation led to his first book, The Four Steps to the Epiphany: Successful Strategies for Products that Win, which served as the course text for his first class and heralded the birth of Customer Development, which in turn spawned the Lean Startup movement and laid the base for the present ecosystem of silicon valley.

Key Characteristics:

- Best way to create successful Business
- Effective for Startups
- Consisting four steps
- Can't go to second step before completing the first one.
- This helps to find correct information
- Saves money from unnecessary assumptions

Step-1: Customer Discovery

1. Split your idea and vision and Test the guesses on potential customers
2. Take feedback from real users and Based on the feedback decide whether the idea pass or fail and Adjust the idea according to the feedbacks
3. After finding the market, go out from assuming and Meet and talk with real customers in market
4. Search a real problem with exact feedback To find the perfect business model
5. Is the MVP really solving problems or not? Based on the market data come to a conclusion Whether to go forward with the current product or make changes

Step-2: Customer Validation

-Start actual Selling, Sell the MVP, Interact with the customer and figure out Is the idea working or not and is it Possible to grow or not?

-Search answers, experiment, and adjustments depending on the results(sales)Build and a repeatable process to find a solid System

-This step is The last restart option before failing badly.

Step-3: Customer Creation

-From here focus on execution and Have to know clearly about the market Otherwise, loss of huge money in this step

- The step to raise venture capital for growth with Most chance to get funding as Will have the product that solves problem and Will know the market that can be dominated with it.

Step-4: Company Building

- From an informal customer discovery small startup to a formal department based big company
- People starts doing these on starting while It should be the last step that switching from search mode to mission mode.

Startup J Curve

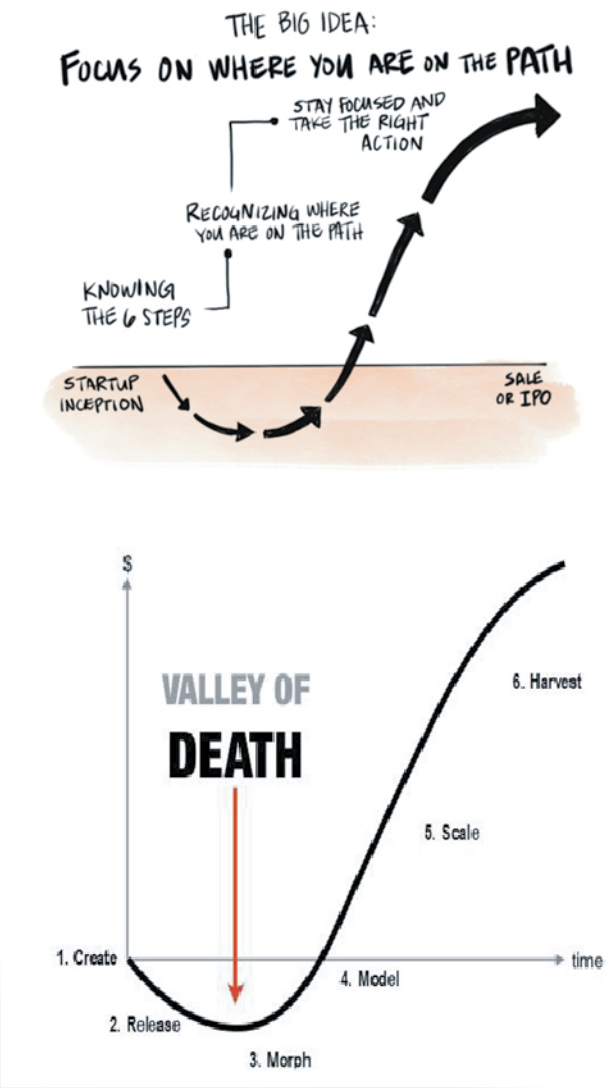


Figure-42: Startup 'J' Curve

The Six Steps to Entrepreneurial Success seeks to dispel the myth of "overnight startup success". What really goes on behind the scenes is a lot messier than entrepreneurs (and the general public) have been led to believe. Most people assume that startups struggle to hit a certain point and then hit viral to become an instant success.

That couldn't be further from the truth. In reality, most startups go through a roller coaster ride of false starts, abandoned opportunities and changed directions. The irony is that most startup owners don't realize this until they've been through it.

Author Howard Love applied the term "The Start-Up J Curve" to start-up success in 2016, with the release of his book of the same name. Author Howard Love noticed a peculiar thing when he studied startups that became a huge success (like Pinterest or Twitter). Unlike the media headlines, startups weren't simply overnight successes. They were failures. Twitter was a secondary project after the founders of Odeo, a blogging platform, failed to compete against iTunes. Pinterest began after the founders of Tote, a shopping app, failed.

Love found that these failures all had one thing in common. They went through a predictable long-term process that could be graphed as a J-curve. In the short term, each of them had their own unique path. Over the long-term, however, they went through six distinct and predictable phases.

Key Characteristics:

- No worry about revenue model before proving your product has transactions.
- No strategies to scale until nailing your business model.

Six Phases:

- Create: Getting everything together ; best time to raise money
- Release: MVP will give reality check to give better direction otherwise difficult to pivot.
- Morph: Iterate through feedback to get product market fit.
- Model: Making sure there is a business before growing it.
- Scale: Testing profitability of the model based on scale up.
- Harvest: The Startup turns into a company.

The analysis behind the Start-Up J-Curve caused Love to rethink what he had been told about start-ups. In particular, he learned that one of the major factors in the failure of a startup wasn't the product. It was the business owner's mentality.

Acknowledgements

Authors would like to acknowledge the work of ICT Division specially Innovation Design and Entrepreneurship Academy (iDEA) project with each and every person who made the Student to Startup Initiative a grand Success alongside with all the researchers around the world mentioned in the references who worked in such an unpopular part of a very trendy topic.

References

1. https://medium.com/startup-autopsies/
2. https://www.failory.com/blog/startup-failure-rate
*3. https://www.researchgate.net/publication/261052728_*
*Business_Incubation_Process_Framework_The_Case_of_Iranian_*
High-Tech_innovations
4. https://worldbusinessincubation.wordpress.com/business-incubation-models/
*5. https://www.researchgate.net/publication/236620369_*
*The_Evolution_of_Business_Incubators_Comparing_demand_and_*
supply_of_business_incubation_services_across_different_incubator_generations
6. https://get2growth.com/
7. https://review42.com/what-percentage-of-startups-fail/
8. https://en.wikipedia.org/wiki/Business_incubator
*9. https://www.researchgate.net/publication/270787931_Simulation_*
of_Generation_of_New_Ideas_for_New_Product_Development_and_IT_Services
10. http://ieomsociety.org/ieom2018/papers/329.pdf
11. https://www.worldscientific.com/doi/pdf/10.1142/S1363919606001387
12. https://startuptalky.com/wework-case-study/
13. https://www.theinovogroup.com/incubation-is-the-hard-part-between-discovery-and-success/
14. Global Innovation Index 2019, Cornell University, INSEAD, World
Intellectual Property Organization (WIPO), 2019

CHANGE IN PROPAGATION CONSTANT WITH MOLAR FRACTION AND OTHER PERFORMANCE ANALYSIS THE SENSITIVITY OF OPTICAL FIBER SENSOR IN COMSOL MULTIPHYSICS

Salma Masuda Binta, Department of Electrical and Electronics Engineering, Bangladesh Army University of Science and Technology
Abu Saleh Musa Miah, Department of Computer Science and Engineering, Bangladesh Army University of Science and Technology
Md. Mohammad Farhan Ferdous, Japan-Bangladesh Robotics and Advanced Technology Research Centre (JBRATRC)
Imam Hossain, Specialist, Digicon Technologies Ltd.
Sohanul Habib, Department of Computer Science and Engineering, BRAC University

Abstract- *This paper presents the change in propagation constant with a molar fraction of silicon nanowire to check their sensitivity. A modal answer approaches the powerful, ?nite part methodology (FEM) employing a full-vectorial H-?eld formulation that has been accustomed to verifying the single-mode operation. The modal answer of the elemental space-?lling mode has conjointly been obtained to spot the cutoff conditions of the conductor modes. Here power fraction of the sensing arm as a function of the fiber radius for a specimen index is measured.*
Keywords- propagation constant, ?nite element methodology (FEM), full-vectorial, single-mode, molar fraction, sensitivity

I. INTRODUCTION

Nanowire is employed as optical sensors similarly as a biosensor. For the detection of biological and chemical species has gained attention thanks to its distinctive properties, the appliance of element nanowire (SiNW) as a sensing nanomaterial [1]. Several sensing nanomaterials with distinctive properties desired size, and chemical compositions are unreal to be incorporated at intervals the device with the fast growth and development of advanced engineering, one in every one of them is that the appliance of one-dimensional (1D) properties, desired size, and chemical compositions are unreal to be incorporated at intervals the device. one in every one of them is that the appliance of one-dimensional (1D) nanostructures (nanotubes, nanowires, nanorods, nanobelts, and hetero nanowires) at intervals the transducers in previous studies which can enhance the detector performance, as an example, TiO2 nanowires [2], carbon nanotubes [3], CuS nanowires [4], NiO-Au nanobelts [5], CuS nanotubes [3], and graphene oxide-modified metal nanoribbons [6].

Silicon nanowire is one in every one of the 1D nanostructures and has emerged because of the promising sensing nanomaterial upon its distinctive mechanical, electrical, and optical properties [7-11].

The foremost reason why SiNWs have attracted attention within the event of ultrasensitive sensors is due to their high surface to volume ratios [12, 13] thusly extraordinarily upgrading as far as possible to FM focuses and giving high affectability. additionally, the dimension of SiNW is within the vary of ?1-100 nm, therefore creating it terribly comparable and compatible with the dimensional scale of biological and chemical species [14, 15]. Having the tiniest dimension, SiNWs exhibited sensible lepton transfer in detection as a result of the buildup of charge in SiNWs directly happens at intervals the majority of fabric leading to the quick response of detection. Evanescent-field-based optical conductor sensors represent some vital options in sensing applications. By means of activity tiny changes in optical section or intensity

of the guided light-weight, these sensors gift glorious properties like high sensitivity, quick response, immunity to magnetism fields, and safety within the detection of flammable and explosive materials. besides increasing demands and speedy development of engineering in varied fields, the mixture of engineering, biology, chemistry, and photonics opens new opportunities for developing optical sensors with subwavelength or nanometric structures. Recently, subwavelength-diameter silica nanowires are incontestable for notability at intervals the visible and shut to infrared spectral ranges. unreal by taper-drawing of optical fibers, these wires show glorious diameter uniformity and atomic-level sidewall smoothness, creating them doable to guide light-weight with low optical losses. light-weight guided on such a nanowire leaves an outsized fraction of the guided field outside the wire as temporary waves, creating it sensitive to the index amendment of the encircling medium [16].

II. POWER FRACTION IN SENSING ARM

The variation of the nanowire core radius has also been analyzed and results are presented the power fraction in the different optical media of the sensing arm in Fig. 1.1.

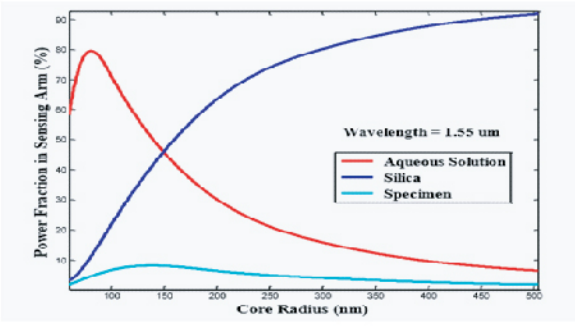


Fig.1.1: As a function of the fiber radius for a specimen index power fraction of the sensing arm

The power fraction is minimum in the core and maximum in the specimen and aqueous solution regions, for a small core diameter. As the core diameter increases, the power fraction in the core and aqueous solution regions of the sensing arm cross over when core radius about 150 nm, and the power fraction in the core and the aqueous solution become maximum and minimum respectively with the increase of core radius. The power in the specimen exhibits a peak near a core radius of around 150 nm and above that decreases to zero.

III. METHODOLOGY

An element nanowire and InAs mistreatment COMSOL four.4 to research its completely different characteristics. These characteristics embody effective mode index, field elements, flux elements, polarization etc. COMSOL with MATLAB was conjointly used for observant completely different outputs of element nanowire. The FEM in COMSOL study engaged the RF module; the performance of the RF module is to mix the optics and photonics interfaces. within the RF module, to style an element and InAs nanowire we tend to elite magnetic force waves, frequency domain.

IV. RESULT

The propagation constant difference AB(um-1) between the reference and the sensing arm with the nanowire fiber radius have been examined for different refractive index values in Fig. 2.1.

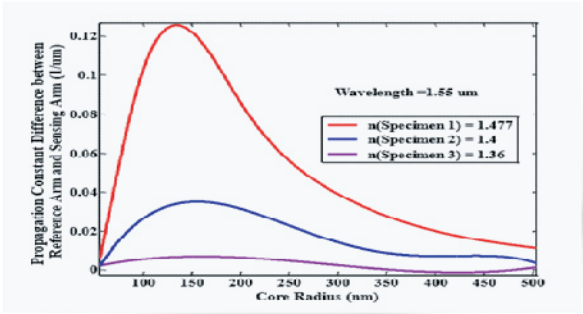


Fig.2.1: As a function of the fiber radius for different specimen indexes change in propagation constant

For all the specimen refractive index values, the change in the propagation constant initially increases, reaching a peak value at a fiber radius of about 150 nm and

finally decreases. For a specimen refractive index ns=1.477 near the core refractive index (= 1.482), AB is higher compared to AB for a specimen with a refractive ns=1.36 index near to that of the aqueous solution (=1.355).

The change in the propagation constant difference AB (um-1) between the reference and sensing arms and the power fraction in the specimen as a function of the specimen thickness, for a core radius of 200 nm, have been investigated in Fig. 2.2. As the specimen thickness increases, both the propagation constant and the power fraction in the sensing arm increase linearly.

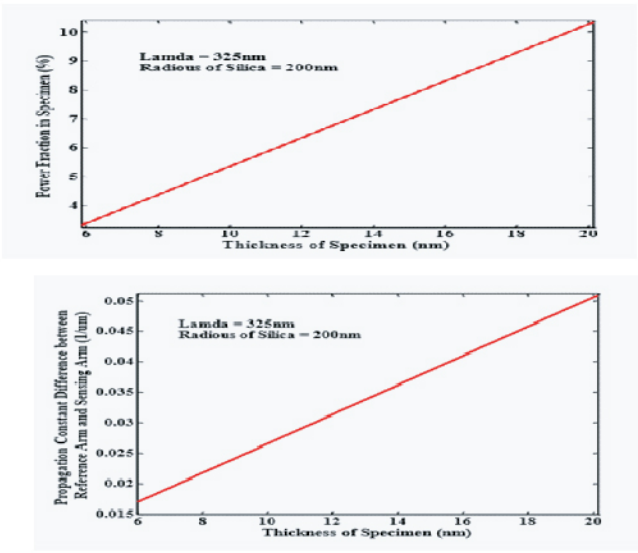


Fig.2.2: (a) Change in propagation constant and (b) The variation of the specimen thickness with power fraction in the specimen

for different molar concentration (C) ranging from 10-4 M to 10-1M overall refractive index ns of the specimen to be dictated has been determined. For this ns propagation constant has been analyzed and C-dependent AB(um-1) has been obtained in which two curves corresponding to core radius 100 nm and 200 nm respectively. We concerned it shows that linearly with molar concentration (C) AB increases.

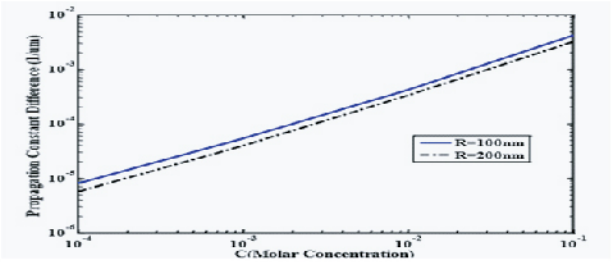


Fig 2.3: As a function of molar concentration (C) of the specimen changes in propagation constant ($\Delta\beta$)

For R 100 nm, Slope of the curve $\frac{\Delta\Delta\beta}{\Delta C}$ 0.042 μm 1 (approximately)

For R = 200 nm, Slope of the curve = $\frac{\Delta\Delta\beta}{\Delta C}$ = 0.032 μm-1 (approximately)

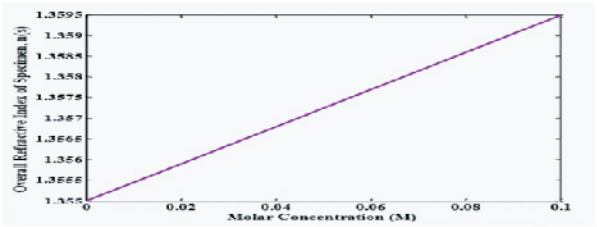


Fig.2.4: Change of specimen index with respect to molar concentration (M)

From this curve Slope $-\frac{\Delta n_s}{\Delta C} - .015$

For $R = 100$ nm

$S_N - \frac{0.042 \mu m^{-1}}{.045} - .933\ \mu m^{-1}$

For phase shift $\Delta\varphi = 2\times 10^{-3}\pi$

Length of Sensitive area $-\frac{\Delta\varphi}{\Delta\beta} - \frac{2\times 10^{-3}\pi}{0.042\ \mu m^{-1}} - 150$ nm

For R = 200 nm

$S_N - \frac{0.032 \mu m^{-1}}{0.045} - .711\ \mu m^{-1}$

For phase shift $\Delta\varphi - 2\times 10^{-3}\pi$

Length of Sensitive area $= \frac{\Delta\varphi}{\Delta\beta} = \frac{2\times 10^{-3}\pi}{0.042\ \mu m^{-1}} = 197$ nm

From this calculation, it can be said that indicating thinner wires provide higher sensitivity which reduces the length of the sensitive area that S_Nincreases with the decreasing of the wire radius,

V. CONCLUSION

A phase shift has been noted due to the presence of a sensing arm and a reference arm in the sensor. Assuming the specimen to be polystreptavidin, characteristics like propagation constant, propagation constant difference and power fraction have been studied and plotted against variations of core diameters. The sensitivity of the optical sensor has been studied against variations of the molar

concentration for two different radii of nanowire range. The concept of 'the thinner the wire, the higher the sensitivity' has been presented in this work. Finally, optical sensing with nanowires may set forth a new approach to miniaturized optical sensors with high sensitivity, the study has suggested.

REFERENCES

[1] JahwarharIzuan Abdul Rashid, Jaafar Abdullah, Nor Azah Yusof, and Reza Hajian, "The Development of Silicon Nanowire as Sensing Material and Its Applications," Journal of Nanomaterials, vol. 2013 (2013), Article ID 328093, pp. 16, 2003.

[2] G. Tian, K. Pan, Y. Chen et al., "Vertically aligned anatase TIO2 nanowire bundle arrays: use as Pt support for counter electrodes in dye-sensitized solar cells," Journal of Power Sources, vol. 238, pp. 350-355, 2013.

[3] F. Shahdost-fard, A. Salimi, E. Sharifi, and A. Korani, "Fabrication of a highly sensitive adenosine aptasensor based on covalent attachment of aptamer onto chitosan-carbon nanotubes-ionic liquid nanocomposite," Biosensors and Bioelectronics, vol. 48, pp. 100-107, 2013.

[4] L. Qian, J. Mao, X. Tian, H. Yuan, and D. Xiao, "In situ synthesis of CuS nanotubes on Cu electrode for sensitive nonenzymatic glucose sensor," Sensors and Actuators B, vol. 176, pp. 952-959, 2013.

[5] Y. Ding, Y. Liu, J. Parisi, L. Zhang, and Y. Lei, "A novel NiO-Au hybrid nanobelts based sensor for sensitive and selective glucose detection," Biosensors and Bioelectronics, vol. 28, no. 1, pp. 393-398, 2011.

[6] Y. Sun, S. H. Yang, L. P. Lv et al., "A composite film of reduced graphene oxide modified vanadium oxide nanoribbons as a free standing cathode material for rechargeable lithium batteries," Journal of Power Sources, vol. 241, pp. 168-172, 2013.

[7]H. Lee, J. Hong, S. Lee, S. D. Kim, Y. W. Kim, and T. Lee, "Selectively grown vertical silicon nanowire p?n+ photodiodes via aqueous electroless etching," Applied Surface Science, vol. 274, pp. 79-84, 2013.

[8] A. Gao, N. Lu, P. Dai et al., "Silicon-nanowire-based CMOS-compatible field-effect transistor nanosensors for ultrasensitive electrical detection of nucleic acids," Nano Letters, vol. 11, no. 9, pp. 3974-3978, 2011

[9] J. Y. Oh, H. Y. Jang, W. J. Cho, and M. S. Islam, "Highly sensitive electrolyte- insulator semiconductor pH sensors enabled by silicon nanowires with Al2O3/SiO2 sensing membrane," Sensors and Actuators B, vol. 171, pp. 238-243, 2012.

[10] J. Bae, H. Kim, and X. M. Zhang, "Si nanowire metal-insulator-semiconductor photodetectors as efficient light harvesters," Nanotechnology, Article ID 095502, p. 21, 2010.

[11] P. K. Kim, S. J. Cho, J. Sung, H. S. Oh, and G. Lim, "Bio-molecules detection sensor using silicon nanowire," in The 2nd International Conference on Smart Materials and Nanotechnology in Engineering, vol. 7493 of Proceedings of SPIE, SPIE, Weihai, China, 2009.

[12] J. H. Choi, H. Kim, H. S. Kim et al., "MMP-2 detective silicon nanowire biosensor using enzymatic cleavage reaction," Journal of Biomedical Nanotechnology, vol. 9, pp. 732-745, 2013.

[13] A. A. Talin, L. L. Hunter, F. ?onard, and B. Rokad, "Large area, dense silicon nanowire array chemical sensors," Applied Physics Letters, vol. 89, no. 15, Article ID 153102, 2006.

[14] K.-I. Chen, B.-R. Li, and Y.-T. Chen, "Silicon nanowire field-effect transistor-based biosensors for biomedical diagnosis and cellular recording investigation," Nano Today, vol. 6, no. 2, pp. 131-154, 2011.

[15] O. A. Sadik, S. K. Mwilu, and A. Aluoch, "Smart electrochemical biosensors: from advanced materials to ultrasensitive devices," Electrochimica Acta, vol. 55, no. 14, pp. 4287-4295, 2010.

[16] John M. Senior, Optical Fiber Communications Principles and Practice, 3rd edition.

Reg. No. 13/76

Contents

COMPUTER ENGINEERING DIVISION
THE INSTITUTION OF ENGINEERS, BANGLADESH
Shaheed Prokaushali Bhaban, IEB Headquarters : Ramna, Dhaka-1000

Phone : 9566336, 9559485, 9556112; Fax : 88-02-9562447
E-mail : info.iebhq@gmail.com

www.iebbd.org
/cse.div.ieb