UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

The development of a framework to measure the efficacy and effectiveness of Business Incubators in South Africa

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A Dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Masters in Engineering.

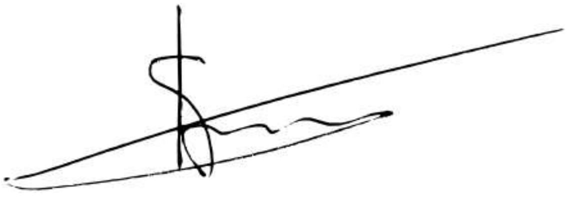
Date

13/12/2022

Declaration

I declare that this dissertation is my own, unaided work, except where otherwise acknowledged. It is being submitted for the degree of Master of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

Signed this 13th day of December 2022



Stephen Anyera Ojango

For Richard Kegode Lukuyu 1st Corinthians 13: 1-13

Acknowledgements

I would like to sincerely thank the following people:

- Dr. Sunjka for being a very patient supervisor and mentor who has supported me during the research
- Dr. Doherty for being an insightful encouragement and guide in the write up process
- Vuuma Collaborations for teaching and showing me how to clarify complexity using data and asking the right questions.
- Thokozile Makhanya, Elinor Engelking, Tebogo Lefophana, Machiri Marodi, Tsepo Phohleli and Lehlohonolo and Noncedo Mahao for being unwavering friends.

More than anything, I would like to thank my family; Nelson Ojango and Julie Mmbone, Samuel Kegode, Sherline Kegode, Elyse Kegode and Geoff Alenga for sharing in all the review calls, hard emotions and giving unconditional love and support through this journey. I love you more than I can express.

Abstract

Business incubators have been identified as a key development tool for the successful incubation of new and existing small businesses. Understanding their performance, efficacy and effectiveness in the development of small businesses and subsequent economic development is therefore of critical importance to practice and research on entrepreneurship within South Africa. Research on the efficacy and effectiveness of interactions within incubation is unclear, with no distinct measure or reference to the performance of incubator. An exploratory study was therefore undertaken to determine how the operational processes of business incubators could be improved, for the effective assessment of their contribution towards their objectives.

The main objective of the research in response to the critical research question was to develop a way for Business Incubator's measure their operational processes so that their contribution towards their objectives can be assessed. The overarching research design was qualitative in nature and followed the Soft Systems Methodology in support of the exploration of the research objective. Semi Structured and unstructured interviews were used as the primary instruments of data collection. Thematic and content analysis as well as systemigram and Causal loop diagramming were analysis and modelling tools used in the research. This approach provided insight and understanding of Business Incubators and the business incubation space in South Africa.

A notable finding of the research was the identification of business incubation pipeline flow being a major challenge experienced within incubator operations, with pipeline being defined as the progression of beneficiaries from recruitment through to their exit. By focusing on critical areas within pipeline processes, expounding on the concept of Operations Management Systems and their relevance in Business Incubation and exploring the concept of 4IR with particular attention to its principles, a framework to measure the operations of incubators was developed as a key result for the research.

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List of Acronyms

4IR Fourth Industrial Revolution.

ANDE Aspen Network of Development Entrepreneurs.

BBEEE Broad-based Black Economic Empowerment.

BDS Business Development Support.

BIP Business Incubation Performance.

C4G Catalysts for Growth.

CLD Causal Loop Diagram.

CRQ Critical Research Question.

DSBD Department of Small Business Development.

DST Department of Science and Technology.

DTI Department of Trade and Industry.

ESD Enterprise Supplier Development.

ESG Environmental Sustainable Goals.

EU European Union.

ISP Incubation Support Programme.

NBIA National Business Incubation Association.

POPIA Protection of Personal Information Act.

SBDC Small Business Development Corporation.

SEDA Small Enterprise Development Agency.

SMMEs Small Medium and Micro Enterprises.

SSI Semi Structured Interviews.

SSM Soft Systems Methodology.

STP SEDA Technology Programme.

VSM Value Stream Map.

Chapter 1 Introduction

1.1 Research Context and Background

Government officials and civil leaders have widely recognised that enhancing entrepreneurial capabilities within Small Medium and Micro Enterprises (SMMEs) can contribute towards driving economic growth and addressing the high unemployment rate, the high income inequality and persistent poverty within South Africa [1]. However, problem of the high failure rate among SMMEs still looms. Several studies within South Africa reveal there is an excessive business failure rate which ranges from 60 to 80% among SMMEs in their first two to five years of operation [1] [2] [3]. There is also no general agreement among scholars and experts as to why precisely this is so [4].

A 2015 report on the entrepreneurial ecosystem map of South Africa from Aspen Network of Development Entrepreneurs (ANDE) indicated that there were over 214 organisations that support the SMME entrepreneurial environment in South Africa, with 89 of them being business capacity development providers i.e. Business Incubators, Business Accelerators or Business Coaching Organisations [5]. These business incubators and business accelarators have been shown and recognised to help SMMEs in their infant stage through to inception [5]. As of 2022, Small Enterprise Development Agency (SEDA) an agency of the Department of Small Business Development (DSBD) of South Africa which provides non-financial support to small enterprises and cooperatives, has 53 branches and supports 99 Technology Incubation Centres across the country [6]. This shows that the South African Business Development Services Provider (BDSP) space is active and growing.

In a white paper on the Metrics and Milestones for Successful Incubator Development, the National Entrepreneurship Network of India explained Incubation as a group sport with the effective coming together of several stakeholders who bring different kinds of expertise relevant to incubation [7]. The Key stakeholders mentioned in BI literature can be categorised in four broad groups [8] [9]:

1. **Host Organisations:** These could be academic institutions, funding institutions like an Angel group or a corporates [7] [8] [9]. The critical role of the host partner is to create mechanisms and linkages between the incubator, potential SMMEs, experts and coaches in different areas who can support SMMEs and funding organisations.

2. **Funding organisations:** The primary function of funding organisations is to provide financial support to the incubation process [7] [8][9]. There are 2 kinds of funding organisations critical to incubation and required to build successful relationships [7]

   (a) Funding organisations that fund the development of the incubator as an organisation

   (b) Funding organisations that help develop early stage capital money for the entrepreneurs and SMMEs incubated at the incubator

3. **Entrepreneur/SMME teams:** While it could be argued that entrepreneurs and SMMEs are products of incubation, they are still crucial stakeholders in the process since incubation does not only work 'on' them but 'with them' [9] [10].

4. **Policy Organisations:** These primarily consist of Government agencies and government departments such as Departments of Science and Technology, Departments of Business and Trade and others who also perform the critical role of developing appropriate policies to support economic growth through incubation, its measurement and its funding from public funds [7].

1.2 The Burning Platform: Performance measurement of business incubators

1.2.1 The need for performance measurement

Performance in the context of business is defined as the ability of a company to implement optimal organisation with the aim of offering a product or service that meets the expectations of consumers and customers [11]. It can also refer to the efficiency and capabilities of the product or service [12].

Measurement is the process of associating numbers with physical quantities and phenomena and is fundamental to almost all everyday activities [12].

Performance measurement can thus be defined as the regular measurement of the results (Outcomes) and efficiency of services and programs. The '***regular***' aspect of measurement highlights progress towards the specified outcomes [13]. If the right things are not measured or are measured inaccurately, those using the performance data will be misled and bad decisions are likely to follow. Performance measures should thus accurately reflect what is happening in the area and whether all objectives are being met [14].

For the Host organisation, measurement, metrics and milestones serve as a guideline for development and provide both motivation and incentives to work towards outcomes and impact. It also helps the host institution to understand what they are committing to and whether or not they are ready to venture into the space [14][7].

Incubators demand heavy investment for both the incubator and the SMMEs it incubates [7]. These investments are made with the expectation of long term and ongoing results and impact. For the Funding organisation, measuring progress, outcomes and impact is therefore necessary to know if there is adequate impact against the investment made. Measurement also creates visibility of an effective or otherwise partnership with the host organisation. It helps them to track critical developmental milestones as well as take timely decisions regarding further funding or additional support [7].

Measurement is valuable to the entrepreneur and SMME teams since it shows their progress through incubation. This not only helps them in their strategies for maximising opportunities based on their capacity, but also seeking funding for growth from investors [9] [10][7].

For policy organisations, the need for an evaluation of their performance helps nurture and develop policies that facilitate the potential remarkable effect of Business Incubators on economic development [15]

For the industry as a whole, performance measurement is very important because it;

- Helps establish that incubators are drivers of economic development
- Enables everyone in the industry to raise the required resource to incubators more easily
- Helps reward and showcase real winners
- Creates approaches, best practices and milestones for scaling incubation
- Provides critical early indicators of progress or lack of it informing decision making at all levels given that maturing and evolving an incubator can take several years.

1.2.2 The challenges of performance measurement in incubators

Hatry highlighted the following common complaints people had about performance measurement [13];

1. You cannot measure what I do
2. The measures are not fair because I do not have total control over the outcome or impact
3. It will invite unfair comparisons
4. Performance data will be used against our program
5. We do not have the data
6. We do not have the staff resources to collect the data
7. It is not our responsibility

While these were taken more from a policy making perspective, they do reflect some of the challenges highlighted in performance measurement in global research on business incubation.

From their 2017 research report, ANDE highlighted that Practitioners and experts in incubation complained that all incubators were compared with each other very often leading to a less than satisfactory result in what and who may emerge as success [16]. Primary success factors of one type of incubator may not be exactly the same as for another kind and not differentiating between these was leading to gross over generalization which is misleading. This they argued could cause a huge disincentive for stronger players in the industry [16].

The difference in incubators was not only in terms of types but also with regards to the sector the incubator operated in [14]. For example, firms in sectors such as software have low technical uncertainty and a relatively rapid time to market compared to science-based ventures. Investment in these sectors is important because science-based ventures are often those that can lead to long-term regional advantage [17]. However, the average incubation cycle is 2-3 years, and when relying on government funding, a typical election cycle is 4 years, which means that there may be pressure to focus on sectors where rapid results can be shown. This can also lead inexperienced managers to think that ventures are not making significant or sufficient progress [17].

Taking these differences into consideration, there will be some variations in performance metrics for each kind of incubator. So far the business development space has not proposed an accepted set of metrics that are relevant and useful to the different types of incubators. This would require for a broad set of acceptable categories of incubators which could cause potentially more confusion in terms of measurement [15] .

One of the consequences of having no standard success metrics is incubators developing their own performance measures [18]. Moreover, many incubators are either wholly or partly publicly funded [7] [18]. In the competition to attract public funds many incubators need to demonstrate 'success' which can lead to over-reporting successes and under-reporting failures especially when self-reporting [19]

1.2.3 Considerations in developing performance measures for incubators

Incubators are organisational structures that are expected to develop capabilities that will support start-ups at scale and in a sustainable manner [20] [21]. The funding organisations provide seed finance to help operationalise a strong organisational structure that would support new SMMEs in an ongoing manner. When the incubator does not become organisationally sustainable in the defined time period of that funding, that is deemed a failure even if some of the companies that it may have supported may go on to be highly successful. That by definition means that every incubator should be evaluated for sound organisational development; this should be separate from metrics on outcomes and long term impact from the incubator [7] .

There are many possible incubation performance measures, each accruing value to one or several different stakeholders [14] [22] [15]. However, many players are still indirectly linked to the success of the metrics of others. Without harmonizing these objectives and ensuring that all players are being rewarded, there may not be sufficient incentives to continue participating in the long term. Because these stakeholders have different objectives by which to measure performance, there is a possibility of different patterns of behaviour that may or may not be beneficial to the system as a whole [22] .

Incubator performance is often shown in terms of aggregated incubatee performance i.e the success of the incubated SMME or entrepreneur. This assumes that the performance of the incubatee is due to the activities of the incubator, but we find few studies that draw clear causation between incubation processes and incubatee results [23] [10]. Moreover, this past work does not distinguish between incubation models that are either 'picking winners' (choosing from an already strong talent pool) or growing a local talent pool through strong intervention [23].

There have been numerous performance measures identified and proposed across incubation. Only a few, such as job creation, are collected most of the time, and it is reasonable to assume that this is not only because it helps justify public investment but also because it is a fairly easy metric to collect [18]. From a practical standpoint, Lubik noted that to track all of this information centrally would be time and resource intensive, suggesting that if a more comprehensive performance evaluation activity was planned, it would likely require buy-in from multiple players and require the active and ongoing participation of client firms and entrepreneurs [14].

1.3 Problem Statement

The importance of SMMEs in South Africa keeps increasing against the backdrop of high unemployment levels and political flux. In South Africa alone, there are in excess of 2.5 million SMMEs contributing approximately one-fifth of GDP to the country's economy [24]

The increasing number of BIs and related studies in South Africa shows that BIs are good catalysers for the development of SMMEs [21][20]. However, research on their performance measures particularly with regards to the interactions within incubation process as described in section 1.2 above in South Africa is still unclear, with no distinct framework that incubators can use to ensure that their operation is set up and operating effectively.This research then seeks to develop a such a framework.

1.4 Critical Research Question

How can a framework be developed so that incubators in South Africa can measure that their operations are set up and operating effectively?

1.5 Research Objectives

The main research objective is to develop a framework for Business Incubators so that their operational processes can be assessed for efficacy and effectiveness.

- ***Efficacy:*** The ability of an operation to produce a desired or intended result [25].
- ***Effectiveness:*** Performing activities in a manner that will create most value for the customer [26] [25]

Achieving the final research objective requires sub-objectives as listed below:

1. Characterize the goals and objectives of Business Incubators in South Africa

2. Describe the current operational processes of Business Incubators in South Africa by identifying areas of success and concern within current BI operational processes
3. Propose ways in which operational processes of incubators can be assessed so that their contribution to their objectives can be improved.

1.6 Research Scope and Delimitations

This dissertation involves two main elements. The first element entails outlining the goals and understanding of the current state of Business Incubators in South Africa. This includes analysis of literature regarding Business Incubator models in general and the analysis of the current state of Business Incubation in South Africa.

The second element involves the design and development of a conceptual operations management framework based on the core Fourth Industrial Revolution (4IR) design principles that is able to act as a guide for business incubation practitioners. The aim of the framework is to provide operational guidelines for leveraging good practices in incubation and the identification of areas of concern enabling incubators to achieve their desired outcomes. Through the use of the framework, practitioners should be able to develop their own management routines and work execution flows. This dissertation focused on the development and creation of the operational framework demonstrating the concept for adoption when implemented in business incubators. The development of the framework and concept demonstrators are adequately documented so that future users can utilise and possibly extend the framework to a tailored implementation framework.

1.7 Summary of Research Methodology

The research method was based on the Soft Systems Methodology (SSM) approach. Participants consisted of seven business incubator stakeholders (Respondent 1 to 7) and data collected through the use of semi-structured interviews. Thematic and content analysis was done from the interviews and conceptual models (Systemigrams and Causal Loop Diagrams) developed to form the basis of the design of the conceptual framework. The research method is elaborated in chapter 3.

Ethical clearance was obtained according to the University of the Witwatersrand's Human Research Ethics Committee (HREC)(non-medical), ethics **protocol number H20/05/30**.

1.8 Summary of Chapter Overview

- chapter 1: **Introduction**
  - This contains the pretext of the research which introduces the burning platform, the problem statement, the aims and objectives and a summary on the research method
- chapter 2: **Literature Review** This chapter discusses critical aspects related to the fulfillment of the research objectives. These include:
  - The history of Business Incubation and the current state of business incubators in South Africa.
  - The theories and concepts of Operational Management Systems
  - The components and design principles of the 4IR.
- chapter 3: **Research Methodology**
  - This section describes the Soft Systems Methodology and how it was applied in the research.
- chapter 4: **Data Processing and Analysis**
  - This section contains the thematic and content analysis results as well as the systemigrams and causal loop diagrams developed.
- chapter 5: **Conceptual Framework Development**
  - This section describes the final conceptual framework developed.
- chapter 6: **Discussion**
  - This section discusses the final conceptual framework in relation to the 4IR design principles.
- chapter 7: **Conclusion and Recommendations**
  - This section summarises the findings of the research against the set objectives and highlights focus areas within the framework that Business Incubators in South Africa should target and prioritise.

Chapter 2 Literature Review

The focus of this research is to a develop a performance measurement framework that incubators in South Africa can use to ensure that their operations are set up and operating effectively. The purpose of this literature review is to anchor the report by

- Providing an understanding of Business Incubators and the business incubation space in South Africa
- Expounding on the concept of Operations Management Systems and their relevance in Business Incubation
- Exploring the concept of 4IR with particular attention to its principles and components as the underlying foundation for the development of the conceptual framework

The chapter will demonstrate the interconnection and interdependancy of these three key concepts in achieving the final desired research outcome.

Preamble

For information and literature on Business incubators and the Fourth Industrial Revolution, the multidisciplinary databases shown in Table 2.1 were used.

Table 2.1: Multidisciplinary databases used in the literature review development

Multidisciplinary databases	
Academic	**Industry**
Scopus	SEDA Publications and audio visuals
EBSCO Host	South Africa DTI Publications
Wiley Online Library	South Africa DSBD Publications

Key words and phrases searched for are shown in Table 2.2 and were based on the research objectives stated in chapter 1:

Table 2.2: Key words and phrases searched in databases

Business Incubators	**Fourth Industrial Revolution**
Business Incubator Space in South Africa	Components of 4IR
Performance of Business Incubators	Characteristics of 4IR
Best Practices in Incubation	Design Principles of 4IR
Challenges facing Incubators	

For principles and literature on Operations Management Systems, the following textbooks were used:

- ***Operations strategy*** **-** M. Lewis and N. Slack. Pearson Education, 2014.
- ***Operations and supply chain management*** **-** F. R. Jacobs, R. B. Chase and R. R. Lummus. McGraw-Hill/Irwin New York, NY, 2014
- ***The lean toolbox. Vol. 4*** **-**J. Bicheno and M. Holweg. PICSIE books Buckingham, 2000
- ***Process Mastery with Lean Six Sigma*** **-**G. L. Sye and H. Sinko. Soarent Pty Ltd, 2009.

2.1 Business Incubators

Definition and Origin

In its generic sense, the term 'Business Incubator' is often used to describe a wide range of organisations that in one way or another facilitate entrepreneurs and early-stage start-up companies by providing a supportive environment to help develop their ideas from inception through to commercialisation and the launching of a new enterprise [27] [28] [29]. This broad definition of the term embraces technology centres and science park incubators, business and innovation centres, organisations which have no single physical location and concentrate instead of managing a network of enterprise support services ('incubators without walls'), so-called 'new economy' incubators, and a variety of other models [29].

The origins can be traced back to Western industrialised countries in the late 1970s and early 1980s [30]. Faced with a rapid rise in unemployment resulting from the collapse of traditional industries, it was recognised in both the Europe and the USA that fresh strategies were needed to help regenerate crisis sectors, regions and communities.This resulted in the formation of Business Incubators [31]. These 'first generation' incubators in the 1980s were essentially offering affordable space and shared facilities to carefully selected entrepreneurial groups. In the 1990s the need was recognized for supplementing the work space with counselling, skills enhancement and networking services to access professional support and seed capital, for tenants within the facility and affiliates outside. This has led to the 'second generation' incubator. Starting in 1998, a new incubation model emerged in parallel. This is intended to mobilize ICT and provide a convergence of support, towards creating growth- potential, tech-based ventures [31] [32]. This generational progression of incubators is shown in Figure 2.1 below.

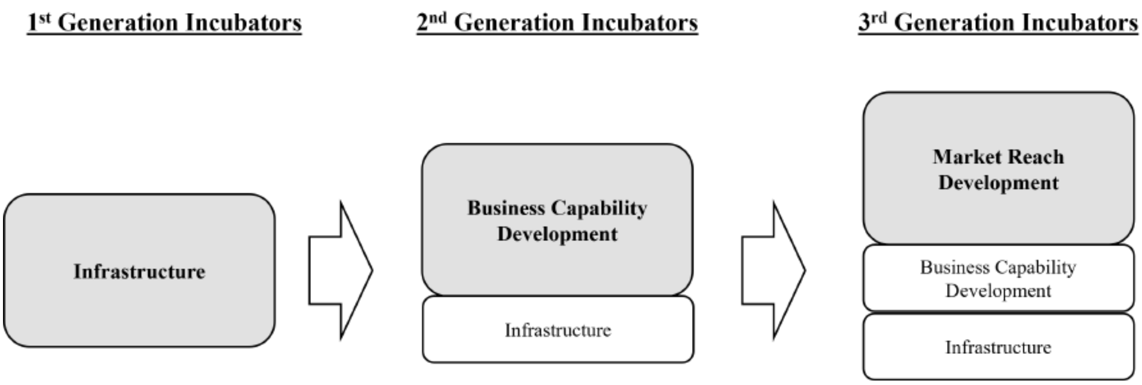


Figure 2.1: The Evolution of Business Incubators [32]

2.1.1 The importance of Business Incubators

The incubation phenomenon is considered an enabling technology that facilitates the growth and development of new SMMEs [33]. Fundamentally, SMMEs are businesses therefore they will either offer products or services. Their life cycles thus follow the product/service life cycle shown in Figure 2.2

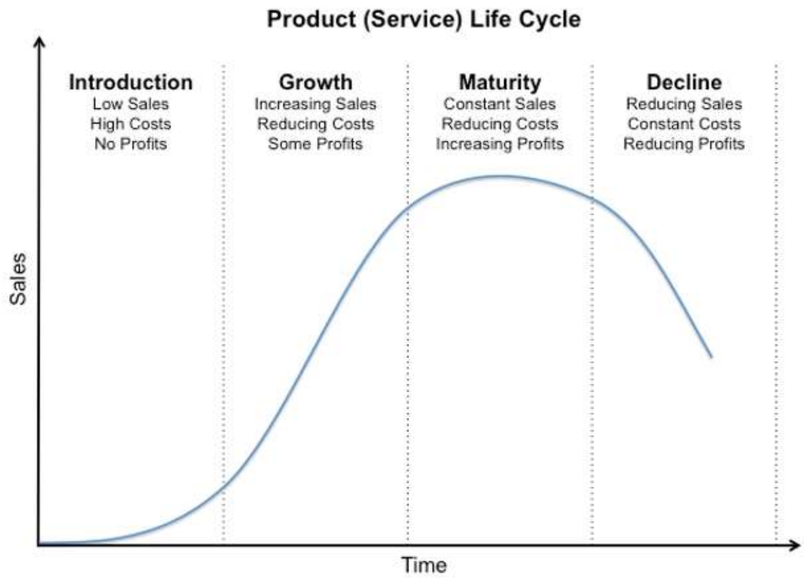


Figure 2.2: The Product/Service Lifecycle [34]

Incubators play a different growth role depending on the stage at which the small firms at finds itself [35]. With this in mind, there are three types of incubation processes that highlight the importance of incubators throughout the product lifecycle [33] [36] [37] ;

1. ***Introduction:*** An incubation process aimed at creating new businesses through the development of new entrepreneurs. These entrepreneurs want to develop/commercialise their talent and ideas [36] [37].

2. ***Growth:*** An incubation process that involves the diagnosis and treatment of business problems, with the aim of lowering the business' failure rate and enhancing growth. Incubation here can also be considered a business acceleration [33]

3. ***Maturity:*** An incubation process, which involves the development of spin-offs. This occurs when an entrepreneur has left a company either permanently or on sabbatical with the aim of developing a product or service with the company, which is complementary or supplementary to the product or service being provided by his or her original employers. This incubation process falls under maturity since the spin off is as a result of a mature business [37].

2.1.2 Incubation Models

Business Incubation Models have been developed by researchers, consultants and practitioners since 1985 to better define, analyze and evaluate the various incubation process [21]. Notable models from literature include [30] [32] [33]:

- Campbell, Kendrick and Samuelson Model (1985)
- Smilor model (1987)
- Booz, Allen and Hamilton Corporate Incubator Model (2000)
- Costa-David, Malan, Lalkaka, National Business Incubation Association (NBIA) Model (2002)

2.1.2.1 Campbell, Kendrick and Samuelson Model

Campbell, Kendrick, and Samuelson [38] first introduced the model shown in Figure 2.3 in 1985 to illustrate 4 key practices that a "value-added incubator" should provide :the diagnosis of business needs, the selection and monitoring of the services provided to the firms, the investment of capital and the access to the working, network of the incubator.

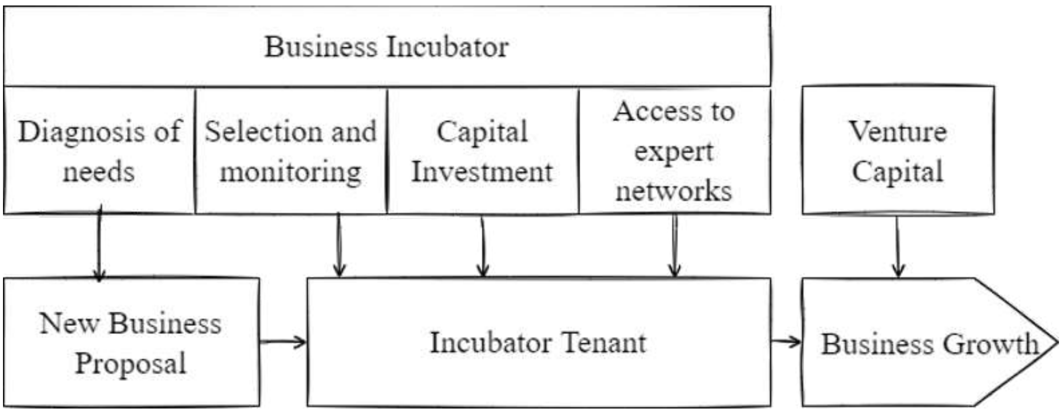


Figure 2.3: The Campbell, Kendrick and Samuelson Model [38]

The main outcome of the their model development stressed process functions of the incubator as the main business development tool that could transform an idea into a real business [38]. The model did however have several shortcomings [33];

- Even though it did identify the incubation process as being important, it did not detail how the process should happen

- The model considered that all potential entrepreneurs or early-stage startups were potentially viable and did not take into account their level of capability.
- The model had no linkages between the life cycle of entrepreneur, incubation process and external environment.

2.1.2.2 Smilor model

Smilor was one of the pioneers in 80s who shifted the viewpoint on incubators from provision of physical resources to the business expertise and services provision [32]. His model was thus developed by refining Campbell's model [39]. He did this by describing main incubator affiliates, support systems and description of main outcomes of the incubation process as shown in Figure 2.4.

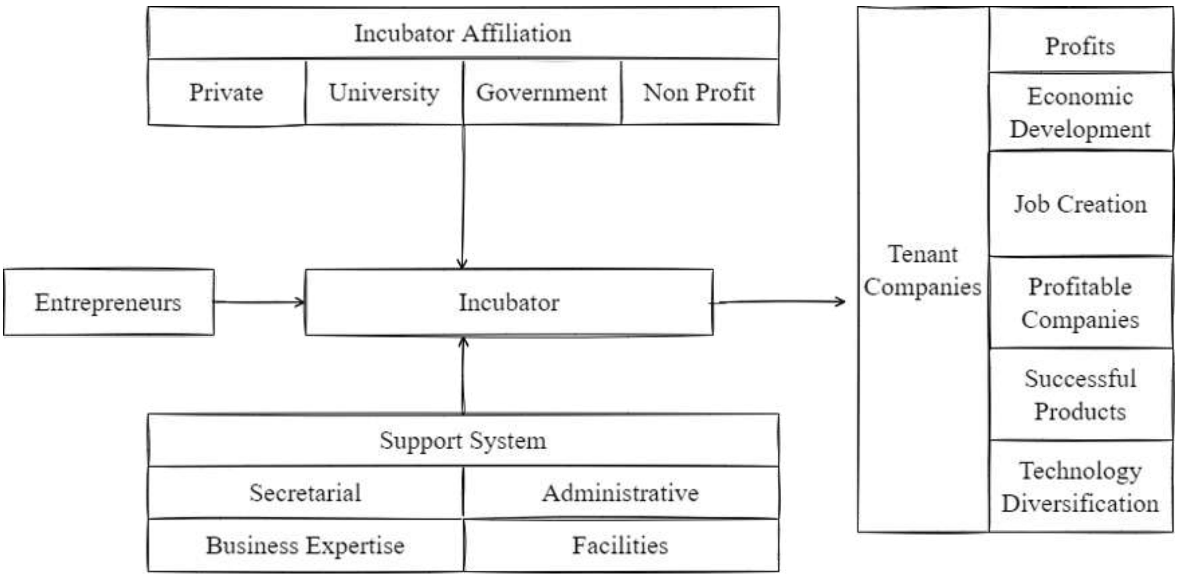


Figure 2.4: The Smilor Model [39]

This model is still relevant and important for modern day incubation mainly because of its comprehensive effort at identifying and explaining the various components of the incubation system. The model however fails to account for the incubation processes occurring internally [33].

2.1.2.3 Booz, Allen and Hamilton Corporate Incubator Model

This model (shown in Figure 2.5) was published in an article in 2000 where 3 consultants (Gregor Harter, Klaus Holbling and Steffen Leistner) from Booz, Allen and Hamilton explicitly described the process of corporate business incubation, it's pros and cons as well as key success factors that could help corporations to boost innovations [40].

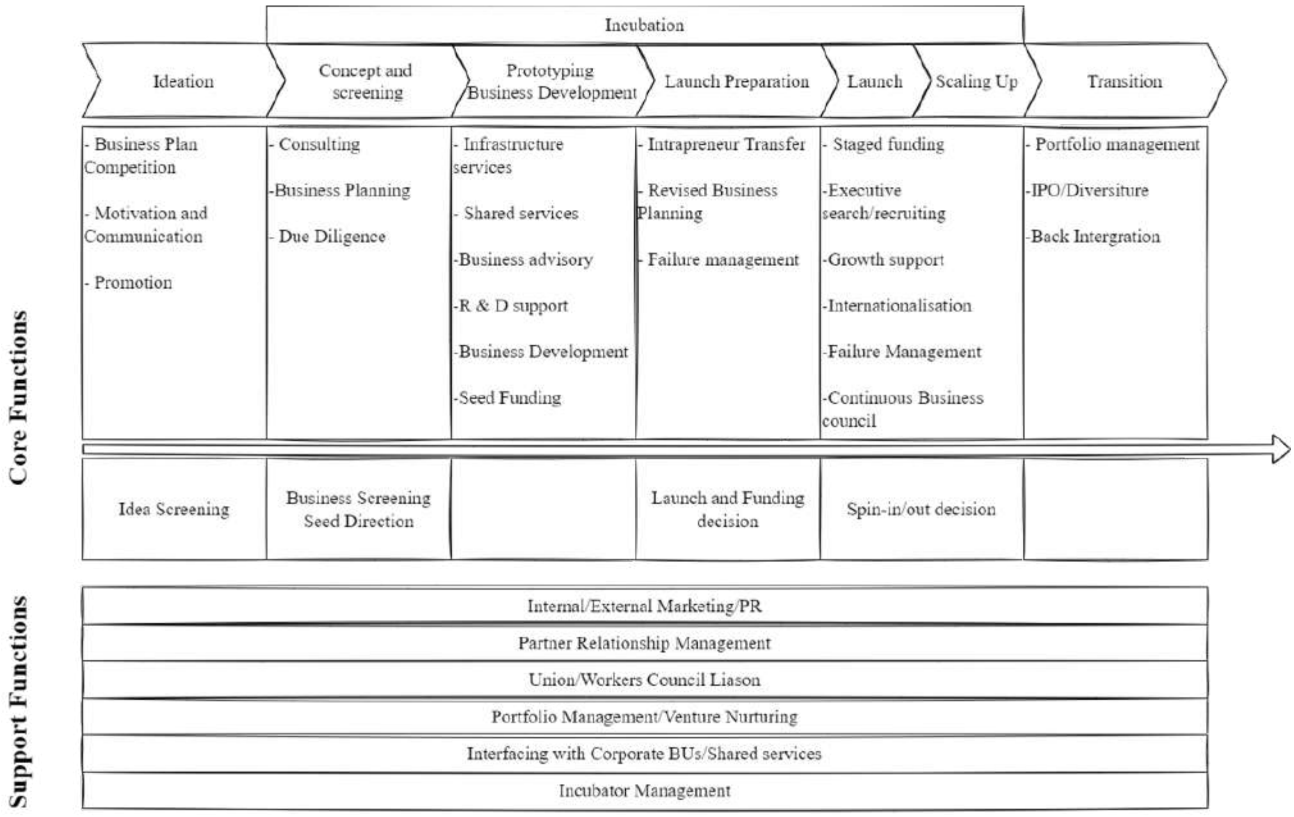


Figure 2.5: The Booz, Allen and Hamilton Corporate Incubator Model [40]

The goal for the model development was to create a systemic tool for developing risky projects within the corporation environment.The core strength of this model is that it shows the internal incubation processes through its stage-gates. Each stage is characterized by core and support functions. The model also provides direct linkage to the entrepreneurship process and corporate business processes. The model, however, does not show or detail external environments and influences on the incubation process [40] [41].

2.1.2.4 Costa-David, Malan, Lalkaka, NBIA Model

The model shown in Figure 2.6 was developed by Costa-David, Malan, Lalkaka for NBIA. This model was presented in a 2002 European Union (EU) incubator benchmarking study as a general 'model of incubation' as best practice to be adopted in Europe [29].

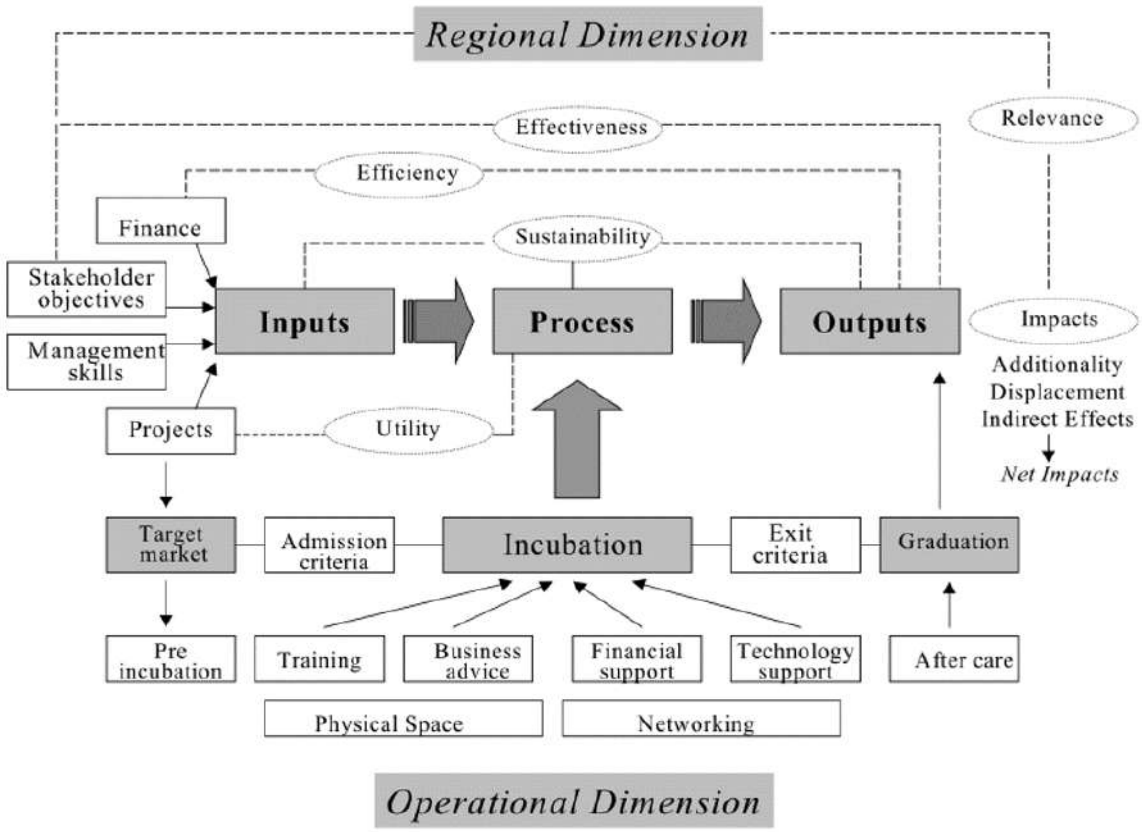


Figure 2.6: The Costa-David, Malan, Lalkaka, NBIA Model [29]

The merit of this model is that it links the incubation process to the external environment [41] [29]. Another important idea that it highlights is establishing a feedback loops for measuring efficiency and effectiveness of the incubation process.

The two challenges of the model are however that;

- It is fundamentally inward looking because it it does not provide exact sequence of practices and step-by-step incubation process [42]
- Even though it shows the links to the external environment, it does not give detail on how these links work [41] [42]

2.1.3 Performance measurement of Business Incubators

2.1.3.1 Defining Success in Business Incubation

As mentioned in chapter 1, performance in the context of business is defined as the ability of a company to implement optimal organisation with the aim of offering a product or service that meets the expectations of consumers and customers [11].

Researchers have however found that it's challenging to give a unified definition on what 'success' with regards to performance represents relative to business incubators as well as a common set of related measures of success [43] [44]. There are a number of reasons for this. The greatest being that business incubators are started for many different reasons; some, to increase the economy, others to increase the job market [43]. For this reason, most research on success focuses on factors that contribute to success or failure [45] [18]

A study conducted by Shrivistava [46], investigating the relationship between the success and failure factors of business incubators relative to those of the businesses (micro-enterprises) they supported, gave results indicating the importance of the various enablers,functions or themes for the micro-enterprises and business incubators. The results suggested that business operations, business strategy and creating long term business models were recurring and strong themes for micro-enterprises and business incubators, irrespective of the industry that they operated in. How these themes were actualised in the real world was, however, varied without any standard.

2.1.3.2 Current Measures and Methods of Incubator Performance Assessment

Presently, various incubator researchers and academics acknowledge the shortcomings of only using financial measures thus performance research has shifted its attention from traditional, cost accounting principles towards a more 'balanced' sets of measures [18] [47] [48] [19]

Measures of incubator performance

In their development of a Business incubator assessment model, Tsygankov et al found that the main performance indicators of business incubators are usually divided into following 3 levels of activity: pre-incubation, incubation as it is, and post-incubation (after graduation from incubation) [49]. They built up on this with their own methodology, which allowed for the assessment of incubator performance at all three incubation stages by so-called 'hard' (quantifiable) and 'soft' (non-quantifiable) criteria illustrated in Table 2.3. According to this approach, the business incubator's performance is evaluated by the progress of incubated companies, so the main performance indicators are reduced to mere assessment of residents at these three stages.

Table 2.3: Conceptual Framework of hard and soft assessment criteria [49]

Pre-Incubation	**Incubation**	**Post Incubation**
	Hard Criteria	
-Amount of sales -Profitability ratio -Rate of enterprise's growth -Independent sales' realization	-Amount of sales -Profitability ratio -Rate of enterprise's growth -Independent sales' realization -Competitive advantages -State financing -Client retention -Incubation area	-Amount of sales -Number of employees -Net profit -Competitive advantages -State financing -Attraction of clients -Retention of clients -Incubation area
	Soft Criteria	
-Business acumen -Reputation -Team's professionalism -Innovative character of the business offered -Strategic goals -Knowledge of target sphere	-Improving business acumen -Improving reputation -Improving team's professionalism -Improving customer loyalty -Enlarging partner network -Improving knowledge of target sphere -Cost saving due to Business Improvement tools	-Professional attitude to client -Wide business partner network -Mass advertisement -Introduction of innovative products -Contribution to economic development

In a Systematic Literature Review on critical factors and performance measurement of Business Incubators, Pattanasak et al asked the critical research question, 'How do business incubators measure their performances?' with the aim of identify the current evaluations of BIs [50]. The study presented an overview of previous BI studies and did not specifically mention any incubator types.

Their research showed that the performance measurement of business incubation performance could be classified into six dimensions according to the classification implemented by Obaji et al [51]. These dimensions were then classified as either tangible or intangible [50]. These dimensions are shown in Table 2.4

Table 2.4: Classification of performance measurement of business incubation [50].

Performance Dimension	**Tangible**	**Intagible**
Entry and exit criteria	Tenants' exit	-Tenants' entry
Managerial skills	Incubator profitability Growth of startups	-Innovation
Service providing	Financial support by incubators	-Differences from competitors -Mentoring, consulting, and networking support -Incubatees' satisfaction
Policy and structure		-BI Governance -Government policy
Social capital		-Internal relationships between incubators and incubatees and the relationships among incubatees themselves - External relationships between BIs and other organizations, such as universities or the government -Recognition -Community impact
Resources	Physical assets Financial resources	-Staff capabilities -Expertise of staffs

Key findings from the research were that intangible performance received more attention from scholars while regarding tangible measurement, most articles focused on the dimension of managerial skills with the sub-dimension of startup growth.

Both research studies highlight the complexity and nuances of performance measurement and acknowledge the shortcomings of only using only financial measures to determine the success of incubators. They however show that current performance measures do not cater to all stakeholders in incubation, detailing primarily outcome indicators of incubation with focus on incubatees with not much emphasis on inputs or processes within incubation. This could potentially be misleading as they measure outcome rather than performance.

Methods of performance assessment

In general, there are three approaches used in the assessment of the performance of BIs [15]:

- ***The control group concept:*** Performance is measured based on whether one is in incubation or not in incubation with the control group not being in incubation. [52] [53] [54] [55]

- ***The benchmarking concept:*** Performance is measured based on a set standard or baseline performance. [18] [56] [57] [58]
- ***The in situ concept:*** Performance is measured within internal processes [23] [27] [59].

Each of these approaches has several advantages as well as challenging obstacles. One challenging difficulty for the control group approach, for example, is collecting data from non-incubated firms [52]. In addition, this kind of study can have strong restrictions to be generalized. The in situ approach also has a significant complexity of evaluation, such as regional differences, objective differences, and different types of incubators and data availability. The biggest challenge with benchmarking is determining the set standard or baseline performance [18].

2.1.3.3 Hackett and Dilts Real Options Theory

As mentioned, quantification of the performance of organizations has been based traditionally on financial criteria with dimensions such as annual sales, annual profit, number of clients, and growth among others as highlighted in subsubsection 2.1.3.1. However, supporters of the multiple-objective school argue that performance measurements should incorporate the different stakeholders of an organization – a systemic perspective [60]. To this effect, Hackett and Dilts developed a real options theory [19].This can be represented as Figure 2.7

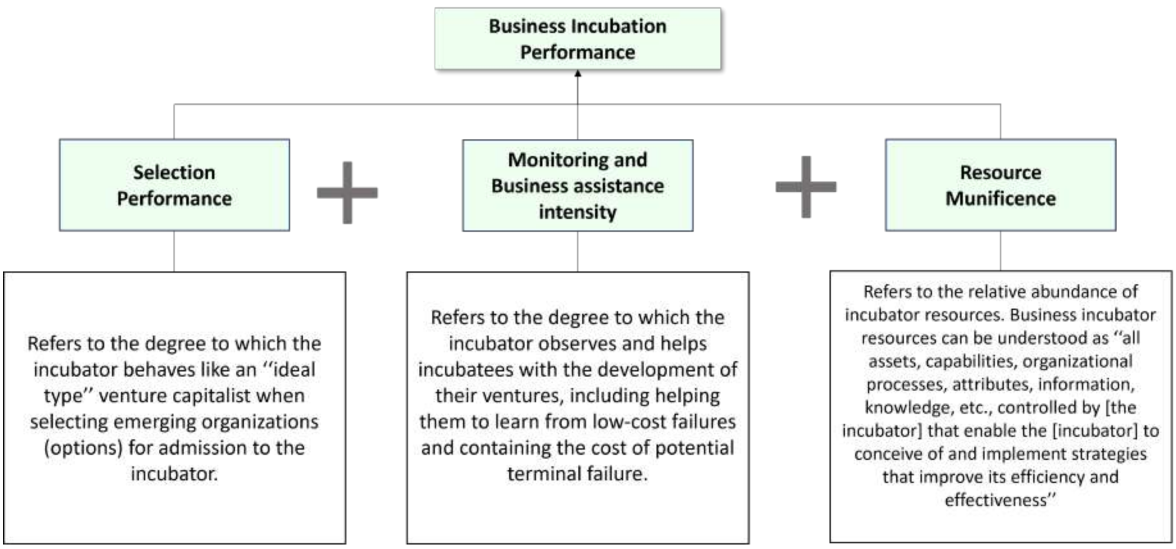


Figure 2.7: The Costa-David, Malan, Lalkaka, NBIA Model [19]

This theory shows a comprehensive framework for the assessment of incubator performance and states:

"*Business incubation performance—measured in terms of incubatee growth and financial performance at the time of incubator exit—is a function of the incubator's ability, developed over time and with the accumulation of new venture development capabilities and resources, to create options through the selection of weak-but-promising intermediate potential firms for admission to the incubator, and to exercise those options through monitoring and counseling, and the infusion of resources while containing the cost of potential terminal option failure.* [19]"

As stated in the theory, Business Incubation Performance (BIP) is measured in terms of incubatee growth and financial performance at the time of incubator exit. Hackett and Dilts argued that operationally, there are five different mutually exclusive incubatee outcome states at the completion of the incubation process [19]:

1. The incubatee is surviving and growing profitably.
2. The incubatee is surviving and growing and is on a path toward profitability.
3. The incubatee is surviving but is not growing and is not profitable or is only marginally profitable.
4. Incubatee operations were terminated while still in the incubator, but losses were minimized.
5. Incubatee operations were terminated while still in the incubator, and the losses were large.

The importance of this approach to performance measurement is that it draws scholars' attention to the complexity of the incubation process, while providing a parsimonious framework for describing it, and predicting and explaining incubation process outcomes [19].

2.1.4 Business Incubation in South Africa

2.1.4.1 History of Incubation

Since South Africa's democratic transition in 1994, the promotion and upgrading of SMMEs has been a continuous thread and objective in national government policy [61] [62] [63] [64]. The SMME economy is considered a vital element for addressing several of the major objectives for post-apartheid reconstruction and development, including for economic restructuring and poverty alleviation [62]. Figure 2.8 shows the key phases of incubation evolution within South Africa.

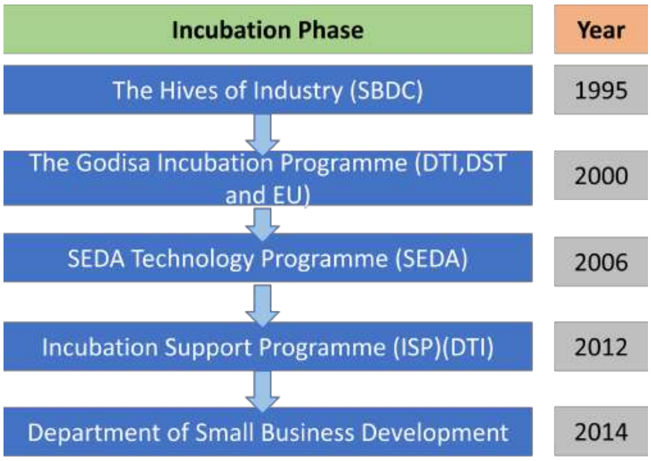


Figure 2.8: The Key Phases in the Evolution of Business Incubation in South Africa [35]

As shown above, the concept of business incubation in South Africa began in as a result of the drive to develop SMMEs when the Small Business Development Corporation (SBDC) initiated the 'hives of industry' [61] [65]. These hives of industry were infrastructural initiatives and established in order to bridge the gap in opportunities for growth between small and large business enterprises in South Africa [61]. A critical milestone in the development of business incubation is South Africa was the establishment of the Godisa Trust programme [45] [66]. The programme was established through a partnership between South Africa's Department of Trade and Industry (DTI), Department of Science and Technology (DST) and the European Union (EU) and marked an important new phase in which the country began to consolidate its business incubation efforts for small enterprise development [67].

The South African government's plan to consolidate and rationalize small enterprise development activities led to the establishment of SEDA in 2004 which had a mandate to implement the consolidation plan. Under an agreement between the DTI, the Godisa programme merged with a number of other government initiatives to form the SEDA Technology Programme (STP).The programme was established to support strategically government efforts to achieve economic growth, job creation and the alleviation of poverty [2]. One of the main achievements of STP was the expansion in the network of public sector business incubators reaching a total of 42 incubators by 2012 [35].

In 2012 the DTI launched the Incubation Support Programme (ISP). It's primary objective was to build successful enterprises with the potential to create employment opportunities and revitalize and strengthen both local and national economies [62]. Private sector involvement in business incubation was reflected in the establishment of nine private sector business incubators by 2012. The major private sector actors in the landscape of business incubation at the time were Shanduka Black Umbrellas, Raizcorp, Aurik, Sasol Chemcity, Maxum (Innovation Hub) and Bandwidth Barn [35]

The Department of Small Business Development (DSBD) was thereafter established as a standalone national department in accordance with the reorganisation of some national departments announced by the President in May 2014.

2.1.4.2 Current state of Incubators in South Africa

According to ANDE 2018 report [16], South Africa's entrepreneurial ecosystem map consists of almost 150 Business Development Support (BDS) Providers supporting entrepreneurs in 2017, with estimates exceeding this figure. BDS Providers are defined as all programmes, including incubators, accelerators, hybrids, corporate Enterprise Supplier Development (ESD) programmes and others, that offer non financial services and products to entrepreneurs and SMMEs at various stages of their business needs. These services are primarily aimed at skills transfer or business advice. 51 technology-based business incubators, 10 enterprise supplier development, and 14 rapid youth incubators were among the identified BDS providers [16].

Success Factors of Incubators in South Africa

Not all business incubators are successful. For this reason , many researchers have investigated the factors that contribute to the success of business incubation. Buys and Mbewana identified a total of 39 success factors reported literature [45]. Many of the factors they identified however represented different aspects of the same basic construct, while others were deemed irrelevant to the conditions in South Africa. The list was shortened to the success factors listed in Table 2.5. These success factors are also supported by reports and research from institutes such as ANDE and Catalysts for Growth (C4G) [16] [24].

Table 2.5: Success Factors of Business Incubators in South Africa [45]

Success Factor	Description
Access to science and technology expertise and facilities	Conducive environments for business incubation are located where access to scientific and technical knowledge and services and supporting infrastructure is readily available, either from universities or institutions such as the CSIR, Science Parks and science councils.
Availability of funding	Incubators must have the ability to help raise capital and provide business tax and risk management services for its clients. Conducive environments are those that have ready access to low-interest funding such as government grants and loans or angel and venture capital.
Quality of entrepreneurs	Successful incubation depends on the quality of entrepreneurs being incubated. Entrepreneurship development seems to be more important than selection. The entrepreneurs must have sufficient knowledge and ability, be prepared to take calculated risks, and have the desire to succeed.
Stakeholder support	The involvement and support of stakeholders are vital for success. It is important that there is clarity, consistency and cooperation from its stakeholders that is consistent with the needs and capacities of the locality it is aiming to serve. There should be consensus on a mission that defines the incubator's role in the community and quantifiable objectives to achieve the mission. Incubators should develop stakeholder support, including a resource network.
Supportive government policies	The success of services directed to entrepreneurship promotion depends largely on a broad based consensus on economic and industrial policy. Initiatives such as business incubators make sense only if the relationship between entrepreneurship and economic growth has been acknowledged at all levels of government. Government policies should therefore be aimed at creating and sustaining environments that are conducive for business incubation, that is, having the characteristics described in this report.
Competent and motivated management	The success of business incubators depends to a large extent on the quality of the management teams appointed to operate them. The team leader should have a business background and entrepreneurial skills and be well networked in the community. The management team should be given measurable objectives against which performance can be monitored. Incubators must recruit and appropriately compensate management capable of achieving the mission of the incubator.

Financial sustainability	Incubators should operate as viable businesses, with their own sources of sustainability such as taking equity, royalties and even ongoing subsidies. The ultimate test of success of an incubator is whether it can be self sustaining. Incubators should be dynamic models of sustainable, efficient business operations.
Networking	Partner networks contribute to incubator successes through sharing of the wisdom reaped from both achievement and failure. Networking is also important in expanding market opportunities for entrepreneurs and graduates. This network typically includes universities, industrial contacts, and professional service providers such as lawyers, accountants, marketing specialists, venture capitalists, angel investors, and volunteers.

Challenges affecting Incubators in South Africa

There are a number of challenges that business incubators must overcome [68]. This is particularly true for South Africa where business failure and unemployment still continue to be particularly high [69]. There are however, limited studies exploring the challenges facing BIs in South Africa. Challenges found in these studies can broadly be listed as below [20] [16] [70] [24]

Table 2.6: Challenges Business Incubators in South Africa Face

Challenge	Description
Access to qualified staff	Management functions play a pivotal role in keeping BIs alive, however, a lack of certified staff within the programmes restrict the services offered to the incubatee.
Mismatch in BI value offering and SMME expectation	There exists a mismatch as to what SMMEs expect out of BIs. Some expect training and skills development in a particular area in business while the BI offers training in other areas
Lack of entrepreneurial skills in SMMEs	Some incubators struggle to assist incubatees because they offer services within their capabilities with the expectation that SMMEs going to them have fundamental entrepreneurial skills.
Access to funding and sponsorship	Depending on the programme and the funder goals/motives, BIs may lack access to funding and this makes it difficult for them to remain operational and support entrepreneurs.
Geographical areas	The geographical area where BIs are located, are not always favourable to incubatees. This makes it difficult for them to offer their service at large and makes it difficult for incubatees to be part of the programmes.
Lack of commitment from entrepreneurs	Some entrepreneurs lack commitment. This becomes a challenge to BIs because they end up utilising their resources to assist entrepreneurs that are not committed.

Government policies	The ineffective implementation of policies such as Broad-Based Black Economic Empowerment (BBBEE) and Protection of Personal Information Act (POPI) create negative incentives within the BI space limiting the operations of the programmes.
Mentorship and Training of BI trainers	There is limited training available in terms of business management, marketing processes, administrative management and public relations offered to managers and trainers within BIs.
Stakeholder support	There is a gap in the relationship between stakeholder endorsements and BIs. This could be caused by the discipline of either the BI or the stakeholder involved.
Reporting pressure from Funders	Given that funding is often dependant on results and outcomes, BIs are incentivised to inflate and misreport outcomes. This makes it difficult to accurately report outcomes which in turn has a knock on effect in available funds for other programmes.
Changes in leadership	BIs have stated a change in stakeholder leadership. Parent Companies, Universities, Funders etc, may affect their operations as Key Performance Indicators, goals and motives change with the leadership.

Incubators face many problems impacting on the success of their incubation of SMMEs most of which are operational in nature [20]. In order to address the fulfillment processes within incubation are running effectively, Operations Manangement Sytems were explored. This is because Organisations that implement operations management systems not only enhance their existing workflows, but also set up feedback structures on which processes are working and which are not and need improvement.

2.2 Operations Management Systems

Definition of Operation Management Systems

Operations Management is considered a functional field of business and can be defined as the design, functioning, and improvement of the systems that create and deliver a firm's primary products and services [26]. An Operations Management System is therefore the integrated requirements, responsibilities and business processes that enable the orchestration of the firm's operations and is concerned with the effective running of the entire system [71] [72].

2.2.1 Operations in the context of Business Incubation

Operations may refer to manufacturing or service processes used to transform the resources employed by a firm into products or services desired by customers [26]. Manufacturing processes produce some type of physical product, such as an automobile or a computer. Service processes produce an intangible product, such as a call centre that provides information to customers or a hospital that treats accident victims in an emergency room [26][25]. For a process to be considered a service process, it must deliver a service package, which is defined as a bundle of goods and services that is provided in some environment. This bundle consists of five features [26]:

1. ***Supporting facility:*** The physical resources that must be in place before a service can be offered.
2. ***Facilitating goods:*** The material purchased or consumed by the buyer or the items provided to the customer.
3. ***Information:*** Operations data or information that is provided to the customer, to enable efficient and customized services.
4. ***Explicit services:*** The benefits that are readily observable by the senses and that consist of the essential or intrinsic features of the service.
5. ***Implicit services:*** Psychological benefits that the customer may sense only vaguely, or the extrinsic features of the service.

From the definition of Business Incubation in section 2.1 and the elements of the service package described, incubation is considered a service process.

2.2.1.1 Aspects of Service Processes

Processes within operations can be conveniently categorized into 5 main aspects as shown in Figure 2.9.

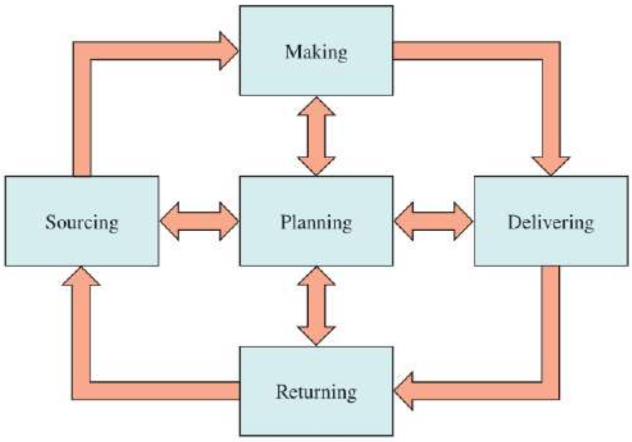


Figure 2.9: Aspects of operations processes [26]

- ***Planning:*** consists of the processes needed to operate an existing supply/value chain strategically. Here a firm must determine how anticipated demand will be met with available resources. A major aspect of planning is developing a set of metrics to monitor the supply chain so that it is efficient and delivers high quality and value to customers [26].

- ***Sourcing:*** involves the selection of suppliers that will deliver the goods and services needed to create the firm's product. A set of pricing, delivery, and payment processes are needed, along with metrics for monitoring and improving the relationships between partners of the firm [26].

- ***Making:*** is where the major product is produced or the service provided. The step requires scheduling processes for workers and the coordination of material and other critical resources such as equipment to support producing or providing the service. Metrics that measure speed, quality, and worker productivity are used to monitor these processes [26].

- ***Delivering:*** is also referred to as logistics processes. Carriers or facilitators are picked to coordinate and schedule the movement of goods and information through the value chain and manage the information systems to customers [26].

- ***Returning:*** In the case of services, this involves all types of follow-up activities required for after-sales support [26].

2.2.2 Key theories and methodologies that define Operations Management Systems

Operations management systems are built on theories and methodologies which have been employed to increase efficiency in operations and production [26][72]. Among the key theories and methodologies are; Lean thinking, The Theory of Constraints and Six Sigma [26]. The synergy between these methodologies is that they want to provide the best value for the customer [73].Table 2.7 summarizes the key aspects of the three methodologies.

Table 2.7: Comparing lean, the theory of constraints and six sigma [74] [75]

Methodology	**Lean thinking**	**Theory of Constraints**	**Six Sigma**
Core Methodology guidelines	1. Identify value 2. Map the value stream 3. Create Flow 4. Establish pull 5. Seek perfection	1. Identify constraint 2. Exploit constraint 3. Subordinate non-constraints 4. Elevate constraint 5. Repeat the process	1. Define 2. Measure 3. Analyse 4. Improve 5. Control
Focus	Eliminating waste and unnecessary steps in company processes.	Focus on the point weakest (constraint) impeding workflow and causing both delays and inefficiency	Reducing all sources of variation to improve quality, increase efficiency and shorten cycle time
Assumptions	-Waste removal will improve business performance. -Many small improvements are better than systems analysis	-Emphasis on speed and volume -Uses existing systems -Process interdependence	-A problem exists. -Figures and numbers are valued -System output improves if variation in all processes is reduced
Primary effect	Reduced Flow time	Fast throughput	Uniform process output
Performance Measure	Flow	Throughput	Fluctuation
Secondary effects	-Less variation -Uniform output -Less inventory -Improved quality	-Less inventory/waste -Throughput cost accounting -Improved quality	-Less waste -Fast throughput -Less inventory -Improved quality
Implementation approach	Top-down directive process involving strong leadership support and engagement	Top-down directive process involving management participation	Top-down directive process involving structured management engagement (project champions, sponsors)
Criticism	-Statistical or system analysis not valued	-Minimal on-ground worker input	-System interaction not considered -Processes improved independently

Sproull [76] argues that in order for any operation to maximise its process flows, it needs to reduce waste, be able to easily identify constraints and minimise variability. These aspects happen to be the focus area of each individual methodology as highlighted in Table 2.7. Sproull essentially combines these methodologies leveraging their strengths as they account for each others weakness [76]. A representation of this is shown in Figure 2.10.

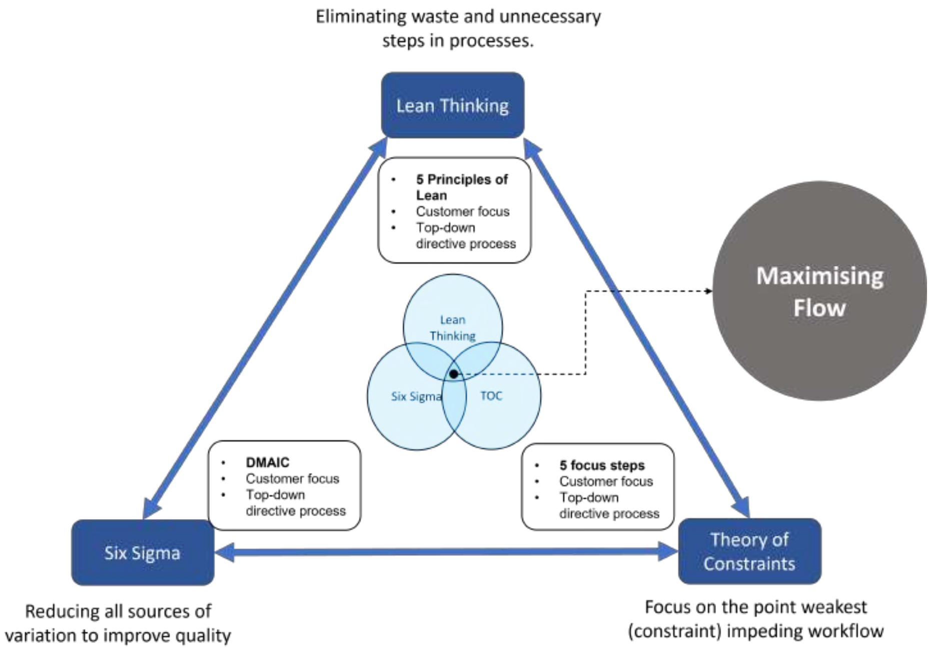


Figure 2.10: Maximising Flow by combining Lean, TOC and Six Sigma [76]

2.2.3 Operational Performance Measurement

Performance measurement is a prerequisite for directing improvement in any operation [25]. Traditionally, it has been seen as a means of quantifying the efficiency and effectiveness of operations [25]. There has been a steady broadening in the scope of what is measured to include efficacy [25].

- ***Efficiency:*** A ratio of the actual output of a process relative to some standard. Doing activities at the lowest possible cost [26] [25]
- ***Effectiveness:*** Performing activities in a manner that will create most value for the customer [26] [25]
- ***Efficacy:*** The ability of an operation to produce a desired or intended result [25].

Performance measures are often aggregated using the five generic performance objectives, quality, speed, dependability, flexibility and cost [26] [25].

This idea of aggregation is illustrated in Figure 2.11

The more aggregated performance targets have greater strategic relevance in so much as they help to draw a picture of the overall performance of the business, although by doing so they necessarily include many influences outside those that operations strategy would normally

Figure 2.11: Levels of aggregation of performance measures [25]

address. The more detailed performance targets are usually monitored more closely and more often, and although they provide only a very limited view of an operation's performance, they provide in many ways a more descriptive and complete picture of what should be and what is happening within the operation.

Operational performance based on Stratified systems thinking

Stratified systems thinking is a body of theory that indicates the level of work or level of complexity at which a person can effectively function [77] [78]. Though not explicitly a theory in operations management, it identifies five levels of work, differentiated on the basis of complexity and time-span of decision-makingas seen in Figure 2.12.

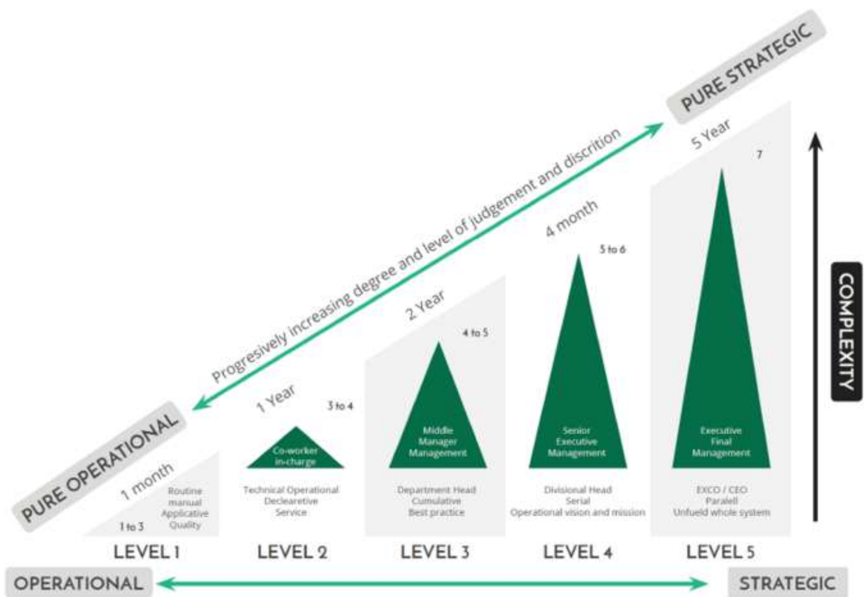


Figure 2.12: Elliot Jaques' Stratified Systems Theory [77] [78]

Though primarily used for the assessment of cognitive function and ability of employees to adapt to complex roles in order to make quick and accurate decisions, stratified systems thinking can be used as a lens through which to look at performance measurement [78][79].

By overlapping the levels of work with the aggregated performance measures used in operations, a framework for assigning performance measure to operational level of work can be developed. This framework would not only give the performance measure, but would also help in defining and tying in the level of work to the performance measure. This rationale was used in the framework final development for the research.

2.2.4 Operational Excellence

Operational excellence a term which was popularized by the Shingo Institute at Utah State University [80]. The concept of operational excellence developed in time, by having as a main foundation the philosophy of continuous improvement. Dahlgaard and Dahlgaard-Park [81] defined operational excellence using 'the 4Ps':

- excellent ***people***, who establish .
- excellent ***partnerships*** (with suppliers, customers and society) in order to achieve .
- excellent ***processes*** (key business processes and management processes) to produce .
- excellent ***products***, which are able to delight the customers.

It was later considered a philosophy of leadership, teamwork and problem solving resulting in continuous improvement throughout the organisation by focusing on customer needs, employee empowerment and process optimisations [82]. Na˘fta˘na˘ila˘ and Cioana˘ [83] simply stated it as a philosophy at the operational level with strong implications at a strategic level.

Excellence Models

As implied above, modern day organizations not only maximize the benefits for the organizations, but also the customer and other stakeholder's needs are taken care. Many researchers have devoted considerable attention to develop the models for operational excellence [80] [84] [85].

Excellence models combine both technical and social factors in the pursuit of sustainable improvement, being based not only on operations management and on engineering processes but giving also special attention to people and the influence they have on the successful implementation of any programme [80]. Arau'jo and Sampaio [86] support the idea that the real implementation of excellence models happens when they are fully integrated with the regular practices of the organisation.

The most well-known and globally accepted model used to support the implementation of operational excellence programmes is the Shingo Model. According to the Shingo Institute [87], the Shingo Model is not an additional improvement programme, but a set of 'guiding principles' that support the organisation's daily initiatives

Figure 2.13: The Diamond: The Shingo Transformational Process [87]

Pauline Found [85] distilled a single unified excellence model that focused on the transformation of the organisation's vision into results .

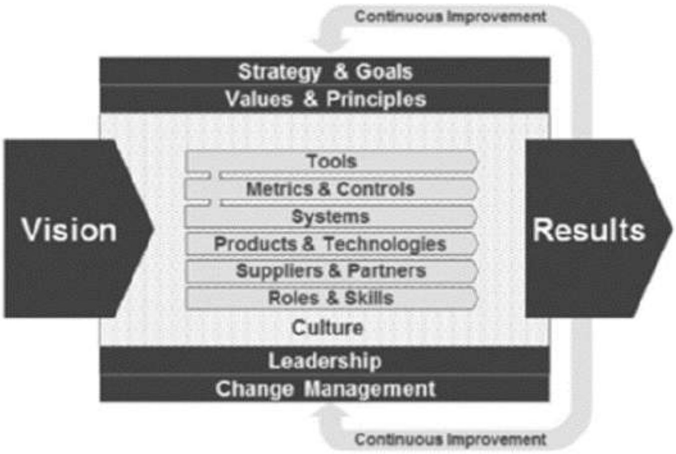


Figure 2.14: Boston Scientific Strategic Operational Excellence Model [85]

This model focused on the alignment of vision to deliver results through products and technologies, supplier and partner relationships, by utilising and developing skills and capabilities to use an inter-related set of tools, systems with appropriate metrics and controls. This was all under-pinned by a culture and mind-set of improvement and driven by a strategy, set of business goals, underpinned by values and principles on a foundation of leadership and change management [85].The model was considered a systems approach to Operational Excellence.

Elements of Operational Excellence

Vuuma Collaborations, a consultancy firm specialising in business performance and operations management systems, identified four critical elements to pursue operational excellence shown in Figure 2.15.

- ***Leadership:*** This entails consistent strategy, its visibility and its messaging from leaders to employees to build and sustain operational structures. This is especially important given most initiatives occur from a top down perspective.
- ***Skills and capabilities:*** This is about ensuring the right skills and capabilities are developed and maintained at the right level within the organisation. Vuuma Collaborations identified the skills shown in Figure 2.15 as being critical in achieving operational excellence.
- ***Operational Management System:*** This details the workflows and processes the organisation should operate in order to fulfil the stakeholders' requirements as well as

their integrated performance measures. It also helps in creating accountability and clarity on roles as well as detailed management routines (Planning and feedback meetings) to support the operations.

- ***Data:*** The right data provides businesses with the capabilities to generate real time insights and predictions to optimize their performance. Without being data driven, decision making becomes difficult and unpredictable. Figure 2.15 lists the crucial aspects of data required for operational excellence.

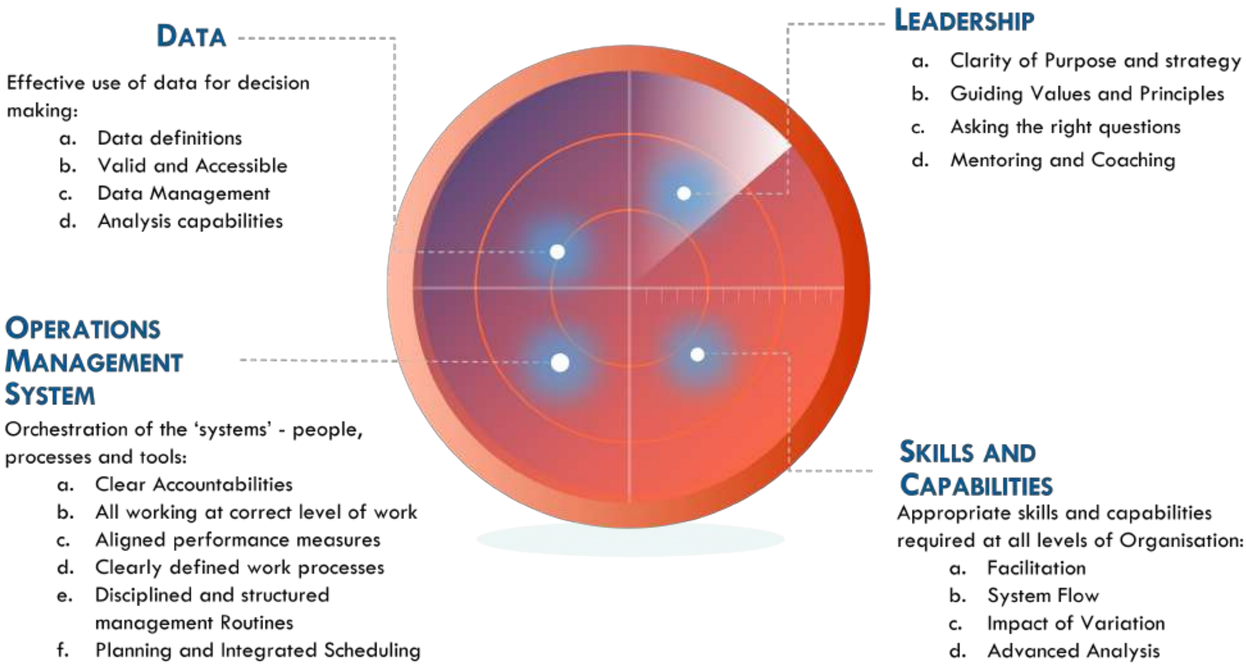


Figure 2.15: Elements to pursue operational excellence [85]

2.3 The Fourth Industrial Revolution

The business incubation space is known for its social and product innovation and its disruptive nature in terms of the types of businesses created and the products and services these businesses offer [88]. As a result the space has become almost synonymous with the fourth Industrial revolution which is also seen as innovative and disruptive [89]. Some incubators even brand themselves and their operations in alignment with the fourth industrial revolution [90][91]. Its is therefore pertinent to define the components and principles of the Fourth Industrial Revolution to better understand how they can then be leveraged in the performance measurement of business incubators.

Definition of the Fourth Industrial Revolution

Industrial revolutions are complex phenomena that affect first knowledge and science, then technology, business, education and finally society and its values [92]. It is believed that the concept of 4IR had its origins in Germany through a project that described the strategic approach to digitalization in manufacturing (Industry 4.0). 4IR is a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum [93]. He defined it as a fast paced world where individuals move between digital domains with the use of connected technology to enable and manage their lives [94]. This definition was subsequently recognized and accepted by other leading industrial nations. In any case, 4IR is built on three preceding technological transformations: steam power, which was the transformative force of the nineteenth century; electricity, which transformed much of the twentieth, and the era of the computer beginning of 1970s [95].

2.3.1 Components of the Fourth Industrial Revolution

When technologies within 4IR are examined in the literature, they tend to appear with words such as "applications, concepts, basic technologies, providing technologies, innovators". However, the most commonly used term is the word "component" [96]; therefore, in this study the term of "component" is preferred.

Figure 2.16 shows the agreed classification of components of 4IR

- ***Additive Manufacturing:*** Additive manufacturing is regarded as the process of making parts from 3D model data. The process activities such as machining, milling are completed by layer upon layer(powder bed, wire fed systems, powder fed) that means

Figure 2.16: Components of Industry 4.0 [96]

small lots products could be produced by less raw materials. In this technology, the tasks enable JIT production system because of succeeding versatility, speed and adaptability [97].

- ***Augmented Reality:*** Augmented reality is defined as the interactive technology that enables harmony between the virtual world and its users while the virtual world is being used as the part of the real surroundings. This technology enhances human-machine interaction, remote controlling on maintenance tasks and visual inspection of the human provided by virtually. It could be used in many applications by combining computer generated graphics and physical objects [98].

- ***Autonomous Robots:*** Autonomous technology allows for machinery and robots, to act and behave autonomously after being programmed to do so. This technology allows for systems to think, act and react autonomously which also allows for decisions to be made remotely if control systems allow you to determine these behaviours from afar. This can all help contribute to a company's competitiveness, productivity and of course, profitability [99].

- ***Big Data and Analytics:*** Big data technology can be defined as the transformation of data sets that are so broad and complex, structured or unstructured that the existing information systems cannot process, and which have been called information trash until today into a meaningful and processable form. Thanks to big data technology, businesses are provided with advantages such as accessing an unlimited data network, the real time perceptions that arise accordingly, being aware of instant developments, being able to see their place among other competitors, having the opportunity to make comparisons, and making quick decisions [100].

- ***Cloud computing:*** Cloud computing is the general name given to services that provide common information sharing between devices with computer features. Cloud computing benefits businesses in terms of rapid elasticity to increasing or decreasing capacity, reduction of costs, independent location of resources and network access from anywhere [101] [102]

- ***Cyber Physical Systems:***A cyber physical system (CPS) is an industrial automation system that integrates information technologies and the physical reality of business operations with the virtual world. Thanks to CPS technology, different learning models occur in the business, the responsibilities of the employees increase, the machines generate data during production and creates an error-proof environment. CPSs thus act as supportive systems in the production processes of enterprises. [103][104]

- ***Vertical and Horizontalal System Integration:*** Vertical integration refers to the flexible and reconfigurable systems within an operation and the extent to which they are fully integrated with each other for achieving agility; horizontal integration deals with the integration of manufacturers, partners and customers within the Supply Chain of the operation [100]

- ***The Internet of Things:*** The 'things' and 'objects' connected to the Internet. Each of these objects has its own identification number and internet protocol thus, objects can be easily identified. IoT supports the communication tools between smart devices and their interconnections and enables objects to communicate and connect with each other either through wired or wireless connections. The success of IoT used in an enterprise depends on standardization that ensures interoperability, compatibility, reliability and efficient operations on a global scale [105].

- ***Simulation:***This is a form of imitation of a situation, process or environment. Simulations leverage real-time data to mirror the physical world in a virtual model, which can include machines, products, and humans. This allows operators and managers to test and optimize either machine settings or process flows in the virtual world before the physical changeover, thereby driving down setup times and increasing quality [106].

2.3.2 Design Principles of the Fourth Industrial Revolution

In their study, Hermann, Pentek and Otto [107] found that Industry 4.0 was built on 4 fundamental design principles. Since the concept of the revolution is not a specific methodology or tool, but a rather a fluid concept, the design principles are useful for understanding the subject matter.

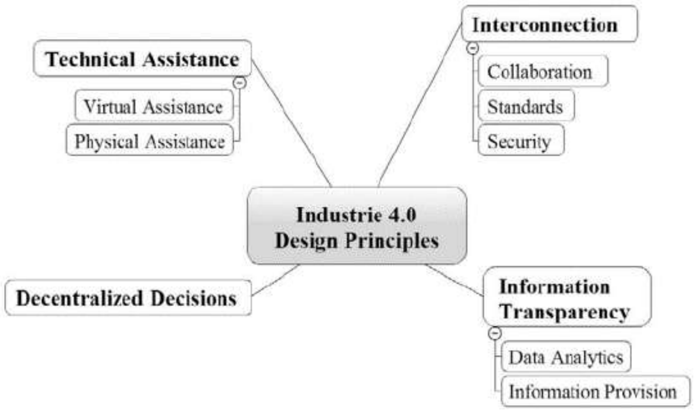


Figure 2.17: Design Principles of Industry 4.0 [107]

2.3.2.1 Principle 1: Interconnection

This is the ability of machines, devices, sensors, and people to connect and communicate with each other via the Internet of Things (IoT) and then make use of that information to function and execute improvements. The first step is to connect your Smart Tools, sensors, machines, and workers together to create advanced data collection resources. With this, you gain widespread visibility into your operation and capture in-depth and accurate knowledge. The next step within interconnection is to integrate this data with other smart solutions and analyse the data in real-time. This creates a network of interconnected data-generating points that can be accessed at any time anywhere. This principle dwells on the technology's ability to provide enhanced information for future decision-making [107] [108].

2.3.2.2 Principle 2: Information Transparency

Transparency in the context of 4IR is used to describe how easy it is to observe the actions taken and the information being stored. With this in mind, Information Transparency is an essential design principle because the information is clear and easy to access, providing a fast and powerful method to extrapolate knowledge. Embracing this design principle enables the monitoring of processes and allows management to instantly adjust and optimize for higher efficiency. The more information being collected, the greater visibility one gains into the operation, and the greater the ability you have to make effective and long-lasting improvements [107] [108].

2.3.2.3 Principle 3: Decentralised Decision Making

The decentralization of decisions stems from the ability of cyber-physical systems to make choices independent of people. Instead of requiring workers to painstakingly watch for variances or oversee material needs, the cyber-physical system will manage these issues autonomously through a decentralized network of IoT and cloud computing. Naturally, this leads to machines and systems that can take action and perform their tasks with little to no human intervention, making factors like problem-solving, calibration, adjustments, and notifications a fast and autonomous system. Only in the case of exceptions, interferences, or conflicting goals are tasks delegated to a higher level. A decentralized system is also highly adaptable and scalable which determines how efficiently you can respond to industry changes [107] [108].

2.3.2.4 Principle 4: Technical Assistance

Technical assistance in the context of 4IR is the ability of cyber-physical systems to support humans by aggregating and visualizing information comprehensibly so that making informed decisions and solving urgent problems on short notice is simple and effective. Work instruction software is a prime example of Technical Assistance being used to support people with visually interactive procedural guides.Technical assistance can also be thought of as the ability of cyber-physical systems to physically support humans by conducting a range of tasks that are unpleasant, too exhausting, or unsafe for their human co-workers [107] [108].

2.4 Relating 4IR to Business Incubation and Operations Management Systems using the S- Curve framework

Definition of the framework

S-Curves are a phenmenon showing the typical path of product or service performance. They are a way of depicting incremental, disruptive and radical innovation [109]. The method was introduced as a result of several studies on technologies and firm performance [110]. The method is however should not be limited to technologies [109]. Lean and six sigma practitioners have observed that processes essentially follow their own performance curves and have used s curves to track their performace [79]. Figure 2.18 shows the typical innovation s-curve phenomenon.

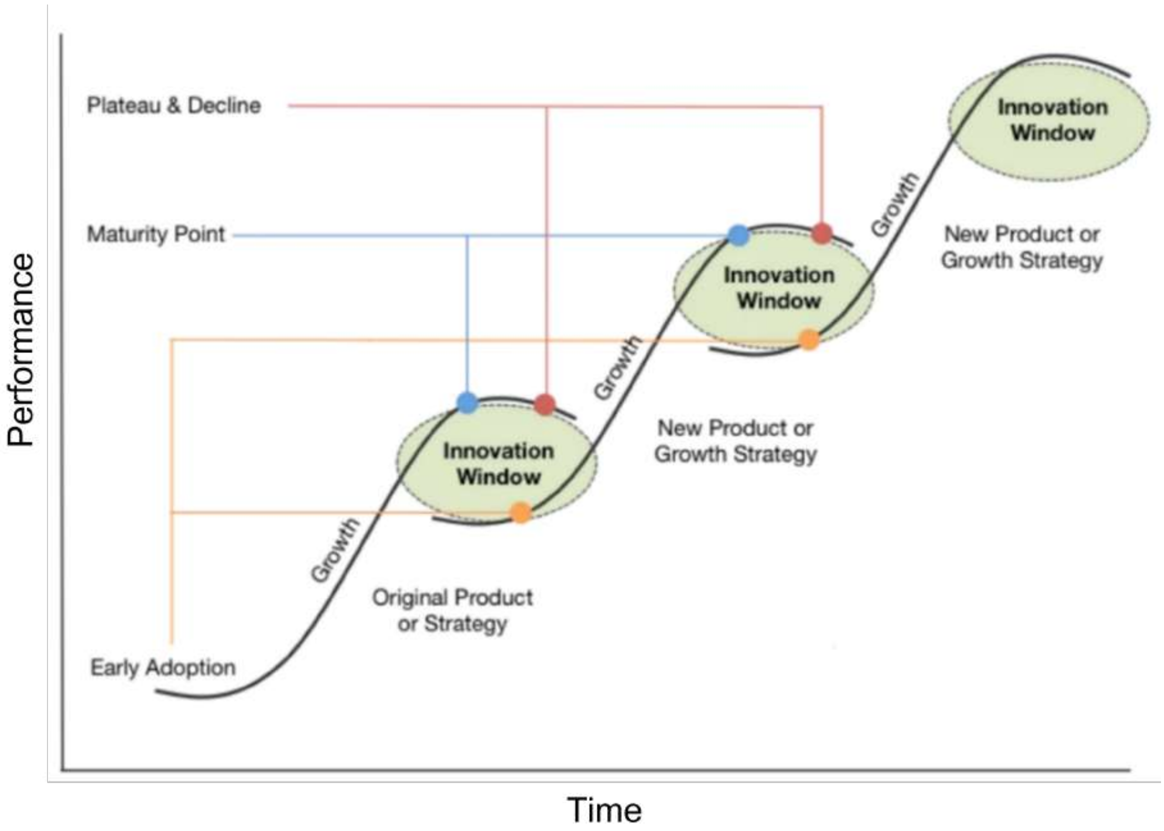


Figure 2.18: Growth Trajectories of S-Curves [109]

The S-curve above shows an innovation from its early beginnings as the technology or process is developed, to an acceleration phase (a steeper line) as it matures and, finally, to its stabilisation over time (the flattening curve), with corresponding increases in performance of the item or organisation using it. At any point, there may be a step change in the technology (a radical innovation) resulting in a new S-curve.

The S-Curve pattern of innovation highlights the fact that as an industry, product, or business model evolves over time, the profits or performance generated by it gradually rise until the maturity stage. If an organization can pinpoint its position on the life cycle curve (S-curve), and it has a sense of the slope of the curve, it has an excellent mechanism for determining where its performance is headed [109]

2.4.1 Principles over Components

In a study conducted by Manabu Sawaguchi [111] on innovation activities based on S-Curve analysis and patterns of technical evolution, four innovation patterns emerged using "Affinity

Diagramming". The categories of the patterns are based on Christensen's aspects of innovation [112] where he classified innovation as either being radical, incremental, disruptive or sustaining.

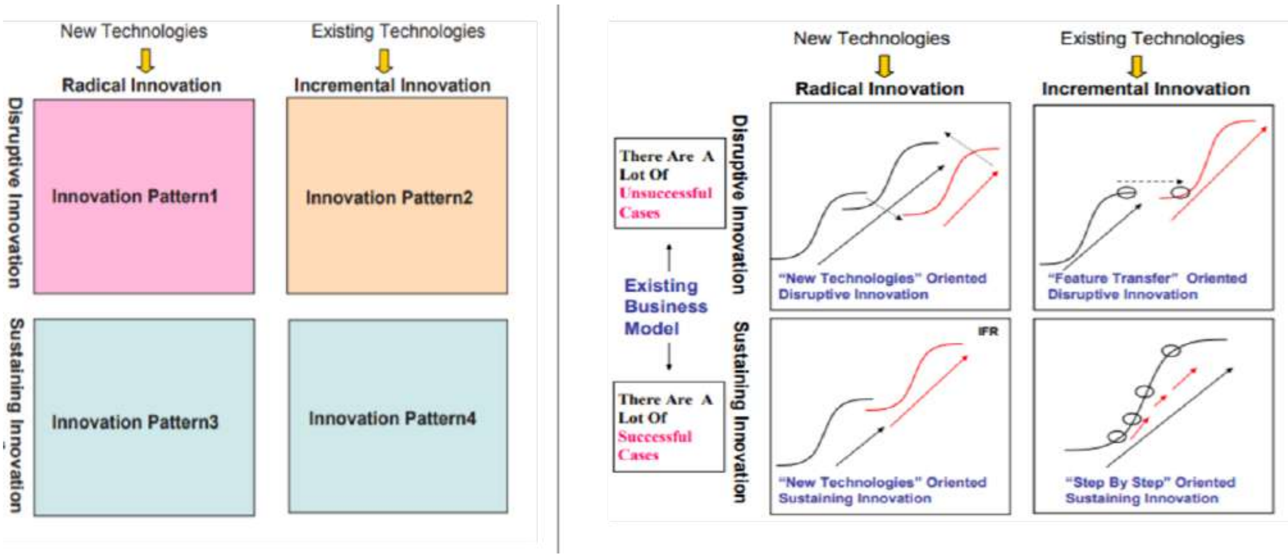


Figure 2.19: The relationship between "S-curve" and "Four innovation patterns" [111]

- ***Innovation Pattern 1:*** shows the creation of a new S-curve for the next product/process by utilising new radical disruptive innovations.
- ***Innovation Pattern 2:*** shows the creation of a new S-curve for the next product/process by utilising new incremental disruptive technologies.
- ***Innovation Pattern 3:*** shows the creation of a new S-curve for the next product/process by utilising new radical sustaining technologies.
- ***Innovation Pattern 4:*** shows the progression along the S-curve for the next product/process by utilising new incremental sustaining technologies. This is often in the form of improving processes.

In the context of BIs in South Africa, it is agreed that BIs fall in the space between early to growth stages [61]. On top of that, given the questioning of the efficacy of incubators, it can be inferred that the space is still not operating at its best capability [61].

As shown by Figure 2.19, changing the technology without optimising the operational process performance does nothing but create a new S curve. This gives the illusion of improvement under the current operations capability, whereas in reality a new operational capability functioning under the same process has been created. This is further illustrated in Figure 2.20.

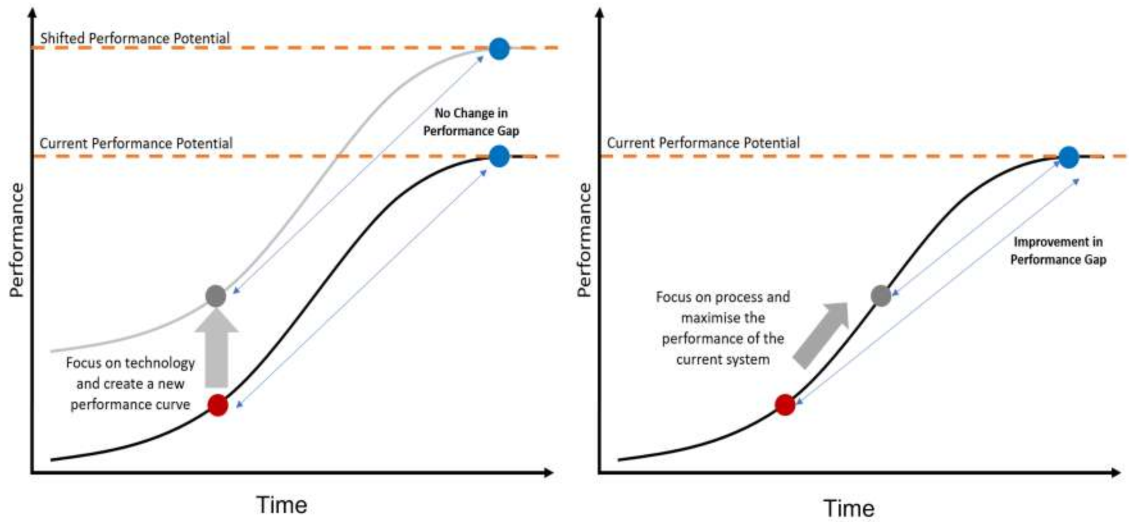


Figure 2.20: Changes in the performance gap based on focusing on improving processes vs focus on changing technologies [85]

It also does not ensure sustainability in improvement, as technology costs are incurred. Solidifying and ensuring that the operational processes are right before infusing technology is a much more sustainable and proven way of ensuring performance improvement and operations are improved on principles.

2.5 The Preliminary Conceptual Framework

The initial conceptual framework for the research shown in Figure 2.21 and presented in the 32 South African Industrial Engineering Conference[113], shows the service loop between three key stakeholders of business incubation; the SMMEs, Business Incubators and the Government. SMMEs come up with business ideas and seek to monetize opportunities, business incubators provide support for the invention and actuation of these ideas while government provides the legislation and policies that enable both incubators and SMMEs to carry out their duties. It also acknowledges the existence of challenges existing on both the SMME and Business Incubator operations.

The idea was that framework would then leverage the Fourth Industrial revolution design principles; Interconnection, Information Transparency, Decentralised Decision Making and Technical Assistance as links between three key stakeholders to create visibility of performance and enhance the development of successful SMMEs.

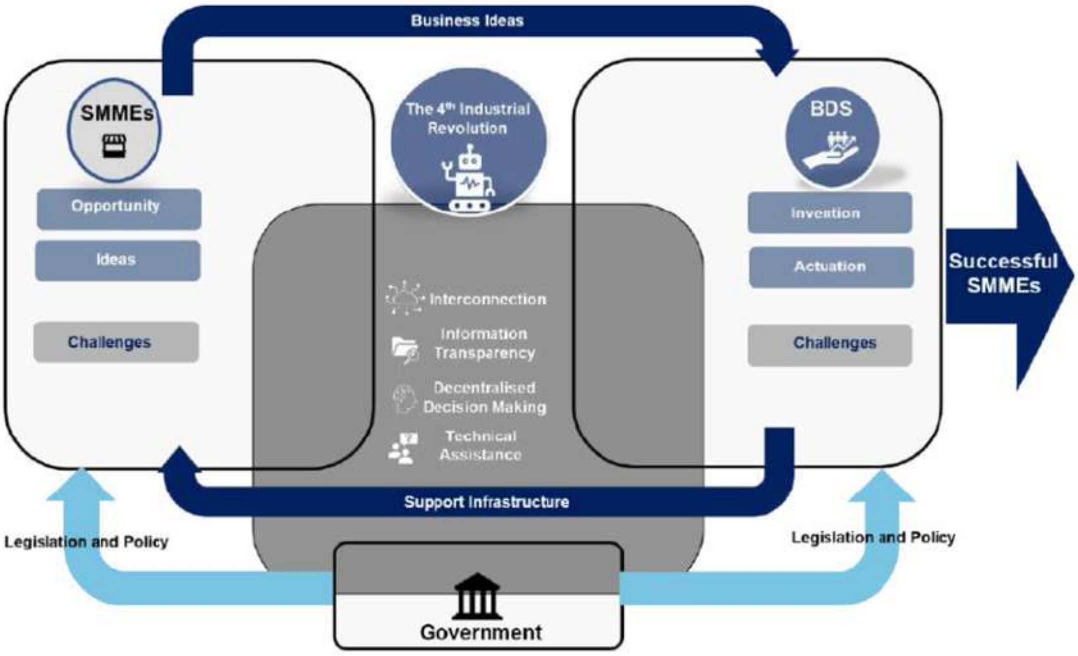


Figure 2.21: Preliminary Conceptual Framework (Author's own design)

The layout of the framework suggests that the 4IR design principles could be used in four primary ways to measure performance and increase the efficacy of Business Incubators:

- to monitor and expedite the opportunities and ideas SMMEs bring to the Business Incubators
- to monitor and track the invention and actuation processes within Business Incubators
- to escalate the challenges faced by both SMMEs and Business Incubators within Incubation
- to enhance the implementation of legislation and policy within the BI space

Its important to note that this diagram is a point of departure conceptual framework for the dissertation investigation.

Chapter Summary

The literature review followed the structured approach below and can be thought of as being two parts. The first part consisting of:

1. Discussing Business Incubators
    - Exploring historical and accepted business incubator models used in industry; listing their merits and demerits
    - Current Performance measurement methods and criteria of Business Incubators
    - Business incubation in South Africa; its history, current state, success factors and challenges of the space as found in academic literature
2. Operations Management Systems in the context of business Incubation
    - Classification and justification of business incubation as a service process
    - Theories and concepts vital to the development of an Operations Management System for Business Incubation
    - Elements necessary for operational excellence
3. The fourth industrial revolution
    - The definition of the Fourth Industrial Revolution
    - Key Technologies and Components that make up the Fourth Industrial Revolution
    - The design principles of the Fourth Industrial Revolution

These first three sections of the chapter highlighted the concepts, definitions, theories and ideas that would be used to form the final conceptual framework for the research. The second part of the chapter shows and critiques how the Business Incubation, Operations Management Systems and the Fourth Industrial Revolution could potentially link to form the final conceptual framework. The second part consists of:

1. The S-curve framework
    - Definition of the framework
    - Importance of the framework in the context of performance measurement (Principles over components)
    - The S-Curve in the context of Business Incubation
2. The preliminary conceptual framework

Chapter 3 Research Methodology

This chapter details the overarching research design and method in support of the exploration of the research objectives. The research took place in three distinct stages as shown in shown in Figure 3.1:

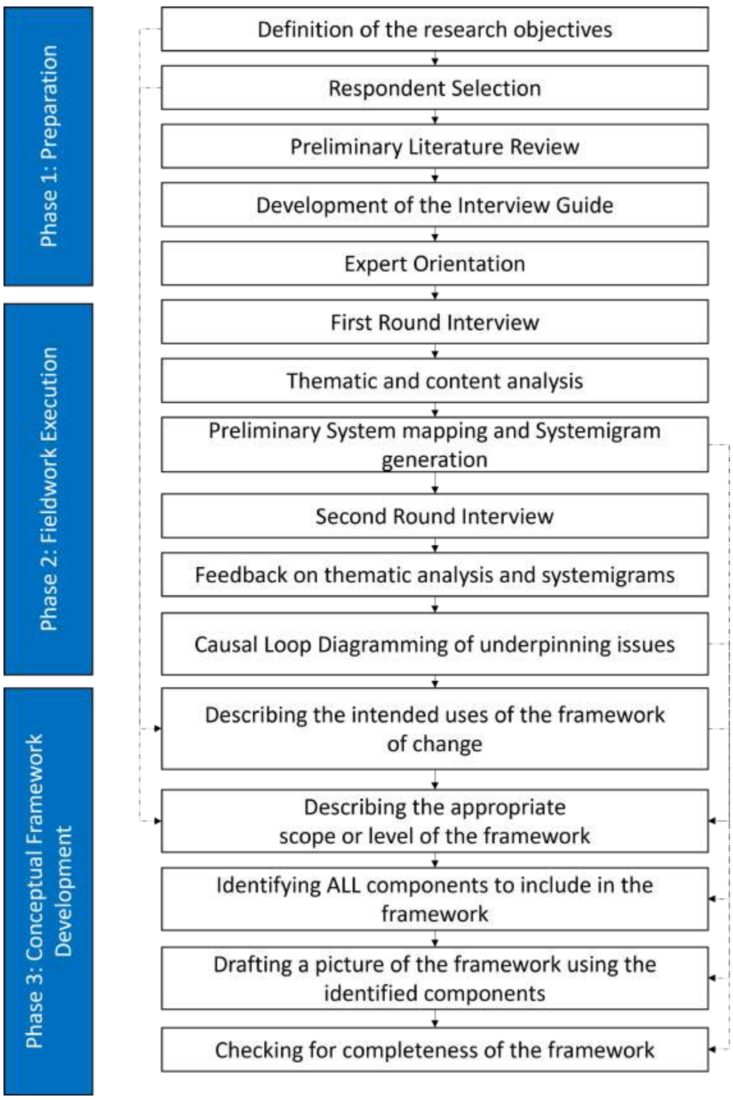


Figure 3.1: The Research Design Flow

1. ***Conceptual Framework Development:*** This phase was the the shift from thematic results and behavioural models on incubation to an executable framework which could be used by an incubator. The process followed a structured approach and tied in significantly with concepts on Operational Management Systems detailed in section 2.2 as well as 4IR design principles stated in subsection 2.3.2. The final outcome of which is detailed in chapter 5.

2. ***Preparation Phase:*** This consisted of firstly clearly defining the objectives of the research and identifying what research methodology would best be suited to achieve these objectives. Preliminary literature review on the incubator space gave insight as to what should be focused on and helped in choosing Systems thinking and the SSM as the methodology for the research. Questions for the purpose of better understanding the incubator space were then formulated after which respondents for the research were then chosen. Both of these steps were guided by the research objectives and findings from preliminary literature review with a pilot test being conducted to ensure the right information was gathered. The final step in this phase was the orientation of the final selected respondents.

3. ***Fieldwork Execution:*** As previously stated, this followed the Soft System Methodology. Execution was done in two rounds of semi structured interviews each with its own desired outcomes. Transcripts from the first round of interviews were analysed using thematic and content analysis for the purpose of creating as rich a picture as possible. New information and literature based on the respondents feedback was also exlpored and triangulated to support the thematic and content analysis. Another outcome of the first round of interviews was the creation of preliminary maps of the incubation space. The second round of interviews was used as a means of gaining clarity on the outcomes of the first round of interviews and the development of a comprehensive systemigram of the incubation space. Overlaying the round 1 analysis results with the systemigram would help in the creation of Causal Loop Diagrams that would help highlight the core issues affecting the incubation space and thus give clarity on how best to develop a way to assist Business Incubator's to improve their operational processes.

3.1 Research Design Justification

To address the Critical Research Question (CRQ) and objectives of this study, systems thinking in the form of the SSM was deemed appropriate for three primary reasons:

1. The environment in which operations of BIs takes place was considered a 'problematic situation' as defined in SSM

   > 'The complexity of problematical situations in real life stems from the fact that not only are they never static, they also contain multiple interacting perceptions of reality. This comes about because different people have different taken-as-given (and often unexamined) assumptions about the world. This causes them to see it in a particular way. One person's 'terrorism' is another's 'freedom fighting'; one person sees a prison in terms of punishment, another sees it as seeking rehabilitation. These people have different worldviews. Tackling problematical situations has to accept this, and has to pitch analysis at a level that allows worldviews to be surfaced and examined. For many people worldviews are relatively fixed; but they can change over time. Sometimes a dramatic event can change them very quickly.' [114]

2. The desired framework will operate in an environment with people and for people.

   > 'All problematical situations, as well as containing different worldviews, have a second important characteristic. They always contain people who are trying to act purposefully, with intention, not simply acting by instinct or randomly thrashing about – though there is always plenty of that too in human affairs.'[114]

3. SSM is a systemic rather than systematic methodology.

   > 'SSM assumes that any complex set of behaviours has unique emergent properties better seen as characteristic of the system as a whole rather than any particular aspect of it. Its focus is the whole, rather than the parts' [115]

3.2 Research Approach

Systems Thinking

Systems thinking can broadly be understood by its two major features; Gaining a bigger picture (going up a level of abstraction) and appreciating other people's perspectives [116]. For these reasons, systems thinking was used as the basis for devising the research framework.

System thinking emerged as a discipline in providing an antidote to the ills of conventional thinking, mainly as a way to make sense of complex, messy systems that require interdisciplinary approaches to problem solving [117]. Peter Senge [118] concisely laid out a set of maxims that encourage the use of out of box thinking or holistic perspective to approach complex problems:

- Today's problems come from yesterday's solutions
- Cause and effect are not closely related in time and space
- Small changes can produce big results – but the areas of highest leverage are often the least obvious
- The cure can be worse than the disease
- The easy way out usually leads back in
- Behaviour grows better before it grows worse
- The harder you push, the harder system pushes back

Research methods based on Systems Thinking have delivered positive results in organisations where systems thinking modelling is characterised by the following tenets [118]:

- Represent both parts and wholes in a system through a holistic view
- Highlight interconnection between parts using feedback loops
- Integrate people, process and tools

The intuition provided by systems thinking can be used to enhance the world view of incubator operational processes by emphasising their systemic behaviour. Of the various methodologies within systems thinking, the Soft Systems Methodology was selected.

3.2.1 Soft Systems Methodology

SSM is an approach in the broad domain of systems thinking [119]. It is an action-oriented process of inquiry into problematic situations in which users navigate their way from finding out about the situation, to taking action to improve it. The Methodology was born out of research conducted at Lancaster University to apply Systems Engineering approaches to solve "management/business problems" [120]. The learning emerges via an organised process in which the situation is explored using a set of models of purposeful action (each built to encapsulate a single worldview) as intellectual devices, or tools, to inform and structure discussion about a situation and how it might be improved [114].

The SSM method takes the form of a cycle and is broken down into seven distinct stages [114]. The method consists of two types of activities: real-world activities (Stages 1, 2, 5, 6 and 7) and systems thinking activities (Stages 3 and 4).

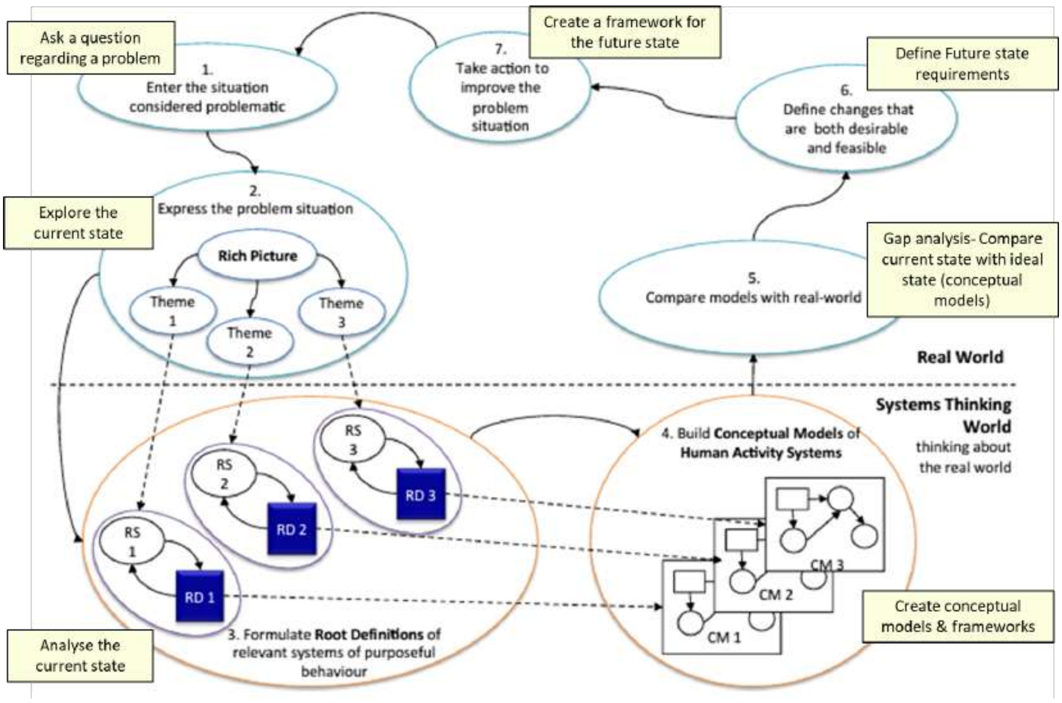


Figure 3.2: The 7 step Soft Systems Methodology [120]

This methodology was more than just a process; Checkland and Wilson also developed a set of tools to help users carry out the seven steps [119]. These include:

- Rich Picture
- Conceptual and formal system models
- CATWOE(Customer-Actor-Transformation-Worldview-Owner-Environment)

3.2.1.1 Developing a Rich Picture

The implementation of SSM to a complex situation requires collecting as much data as possible to make its representation. Drawing a rich picture is one of the most widely known devices of SSM to represent the elements in the complex situation. Its purpose is to represent visually the structures, processes, stakeholders, relationships, culture, conflicts and issues [120]

Setting and Participants

A total of seven experts were selected through a combination of stakeholder analysis of the SMME/Business Incubator space with regards to both Incubator organisations and roles within incubators as well as purposive sampling [121] [122] [123].

- **Stakeholder analysis** - is a process of systematically gathering and analysing qualitative information to determine whose interests should be taken into account when developing and/or implementing a policy or program or framework [124]. The aim is to gain a deeper understanding of the stakeholder's values, incentives and the power dynamics in the system so as to determine the pivotal actors [124].
- **Purposive sampling** - is a non-probability sample that is selected based on characteristics of a population and the objective of the study [125] [126]. The key criterion and characteristics sought included years of sectoral experience and competencies and skills based on their roles in the incubator [127]. These criteria are shown in Table 3.1. This was done to ensure data richness and that the sample matched the scope of the research. This in turn guaranteed data collected moved from descriptive analysis to more interpretive analysis [125].

Table 3.1: Respondent selection criteria

Criteria	Rationale
Incubator Reputation	How well known was the incubator within the space; It was assumed that well know incubators would have more experience in dealing with a wider range of Entrepreneur / SMME issues
Incubator Type	Was the incubator a university, government or corporate incubator; This would inform the organisational and governance structures of incubators.
Role within incubator	What role did the respondent have within the incubator; Managers, analysts and auditors were deemed best suited for the study to articulate incubator operations See section 4.1
Years of sectoral experience	How many years of experience did the respondent have; 5 or more years was the preferable years of experience

Research Instruments

Given the qualitative nature of the research and to ensure the proper transition between the system thinking world and the real world activities as shown in Figure 3.2, this study utilised and triangulated data using three forms:

- ***Interviews:*** This was the primary mode of data collection for the research and involved both unstructured and Semi Structured Interviews (SSI). Interviews were carried out either in person or via online calls via microsoft teams and took between 45 minutes to 1 hour with the session being recorded. The first round interviews were SSIs following predefined a priori themes shown in Table 3.2. The a priori emerged as a result of the desired end outcome of the research. The SSIs were designed to have several questions prepared in advance while leaving them sufficiently open to allow subsequent in depth active follow-up strategies; questions, prompts, probes, statements and other interventions. This was done to get more detailed knowledge about the Incubator environment, getting a sense of how the apparently straightforward aspects were actually more complex and how the 'surface' appearances may be misleading about 'depth realities'. [125] [128].

  The unstructured interviews were used for the second round of interviews as follow-ups to gather additional information as needed and aid in gaining clarity for the creation of the incubation systemigram. This strategy was consistent with the SSM approach that requires fluid movement back and forth between data collection and data analysis in order to determine root definitions and the development of conceptual models [125]. All interviews were transcribed by a professional transcriber and set up in an excel spreadsheet for the thematic and content analysis.

Table 3.2: A priori themes of the study

Topic	Definition	Questions Asked	Desired Outcome
Organization structure and Background	The framework of the organization's identity, goals and objectives and its relationship with operating processes	• How would you describe a business incubator?	• The purpose and goals of the organization • The structure and activities are directed to achieve the goals of the incubator.

Best Practices	Professional Industry specific procedures that are accepted or prescribed as being correct or most effective	• What is the application and/or selection process for SMMEs into incubation? • Do you believe the process is efficient and effective? • How do you evaluate or predict the success of a start-up SMME in its early phase in incubation?	Details and Best practices on • Intake/Selection process • Training process • Post training process • Legislation
Barriers and Success Factors in Incubation	Internal and external influences which can impact the potential progress and success of a business incubation	• What would you say are some of the positive factors affecting the growth of SMMEs in incubation? • Why do you think these factors have a positive effect? • What are some of the systemic challenges Incubators face?	• Current challenges and success factors in SMMEs addressed by Incubators • Current challenges and success factors faced by Incubators
4IR and Innovation in incubation	The application and usefulness of 4IR components and principles in incubation	• What do you think the Fourth Industrial Revolution means for SMMEs and Incubators in South Africa?	• The current challenges and opportunities 4IR presents in incubation

Prepared interview questions for any single interview were limited to the list of questions shown in Table 3.2. These questions were determined through a pilot interview with an incubator manager before the execution of the research [129]. In the pilot, it was seen that it was not necessary to ask every question explicitly, as the answers to some emerged while the respondent answered others. Leading questions were also avoided as the intended outcome was to stimulate an informative conversation without suggesting that one kind of response was somehow more desirable than another [129] [130]. As previously mentioned, prompts and follow up strategies were used when topics or issues which were not clear or provided a new perspective were brought up.

- ***Field notes:*** Hand written field notes were taken throughout the study and used to capture intriguing information and perspectives that had not been planned. The field notes also helped in the development and thought process of possible follow-up questions and were particularly useful in the second round interviews in the development of the systemigram. Ideas and views they captured also helped in distilling the essence of the final conceptual framework. Example field notes can be found in section A.2.0.3

- ***Secondary documents:*** These were documents and reports recommended by respondents as well as documents found while conducting ongoing literature reviews and interview preparations. The literature review entailed collecting and obtaining accurate, clear, and relevant academic data that supported the study. For the identification of relevant articles and papers, reliable and reputable multidisciplinary databases were used as well as government and industry sites and annual reports.

Data Analysis

Interview Transcription Data Analysis in the study was done done for round 1 interviews in accordance with the SSM and included coding and theme analysis following the structure shown in Figure 3.3.

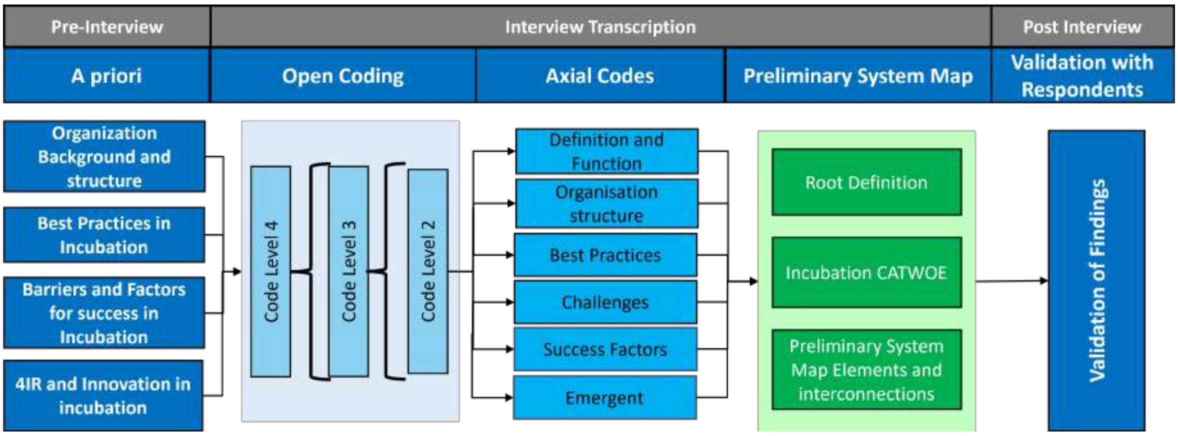


Figure 3.3: Summary of Interview Transcription Data Analysis process

Coding of the data consisted of looking at the content of the replies elicited by respondents through open and axial coding. Open coding was used in the initial passes through the data as it allowed an open-minded search for meanings and potential codes. Axial coding was used for the development of the core concepts in the data [129] [131].

- ***Open coding:*** Data collected from the interviews was divided into segments and scrutinized for commonalities that reflect general categories or themes. After meaningful categories were identified, the data was further examined for properties, specific attributes or subcategories that characterize each category [129].

- ***Axial coding:*** During the process of open coding, one or more categories emerged as being central to the phenomenon under investigation. One of these categories was then chosen as a core category, and other categories were identified as possibly reflecting the context in which the core category was embedded i.e the core category served as an axis around which certain other categories appeared to revolve in some way [129].

Content Analysis was done to form a basis of comparison with existing literature for the purposes of confirming findings and identifying patterns,themes, or biases. During the content analysis, a start list of open codes was created based on the responses on the a priori questions shown in Table 3.2. These open codes represented the lowest level theme of detail or statement made by a respondent [132]. A coding scheme was then developed to create categories for the open codes [133]. The scheme consisted of 4 coding levels. It should be noted that for some of the final themes, it was not seen as necessary to go to code level 4. Figure 3.4 shows an example of how coding was done during the analysis.

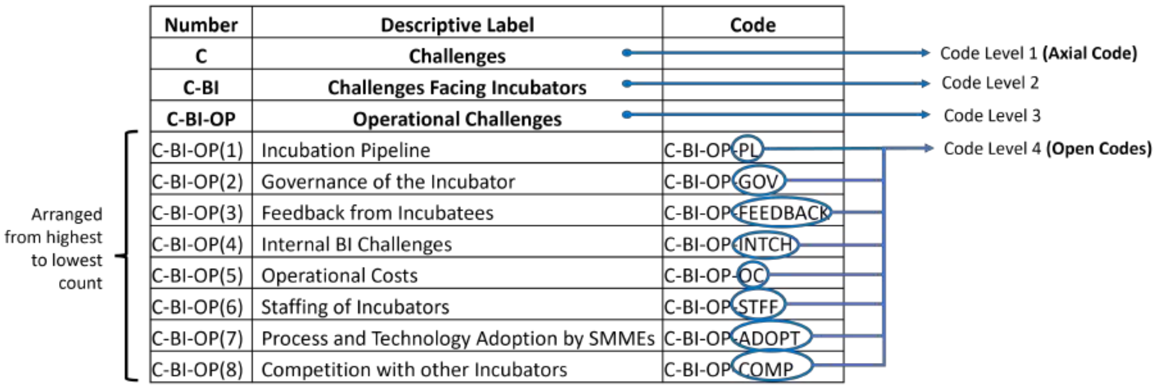


Figure 3.4: Coding process example

- ***Code Level 4:*** This was the starting open code and represented the lowest level theme of detail or statement made by a respondent
- ***Code Level 3:*** This was a level above the basic open code theme and highlighted the concept/basic structure which the open code described.
- ***Code Level 2:*** This level was used to describe the affected party/stakeholder which the concept/basic structure in level 3 described i.e whether it was a system issue, an incubator issue, an auditor issue or an SMME issue.
- ***Code Level 1:*** This was the overarching axial theme of the data and consisted of 6 axial codes as seen in Figure 3.3.

Pareto charts were used for frequency count analysis to determine key codes upon which to focus. Basic frequency analysis was first done on level 2 codes before paretos drawn for level 3 and 4 codes as shown in Figure 3.5.

From the paretos, primary, secondary and supplementary codes were established. Primary codes were codes that ranked highest on the Pareto. Secondary codes while not as frequent as the primary codes still fell under the upper end of 80-20 rule of pareto analysis [79] and were seen as supportive codes that could potentially give greater into the incubation space.

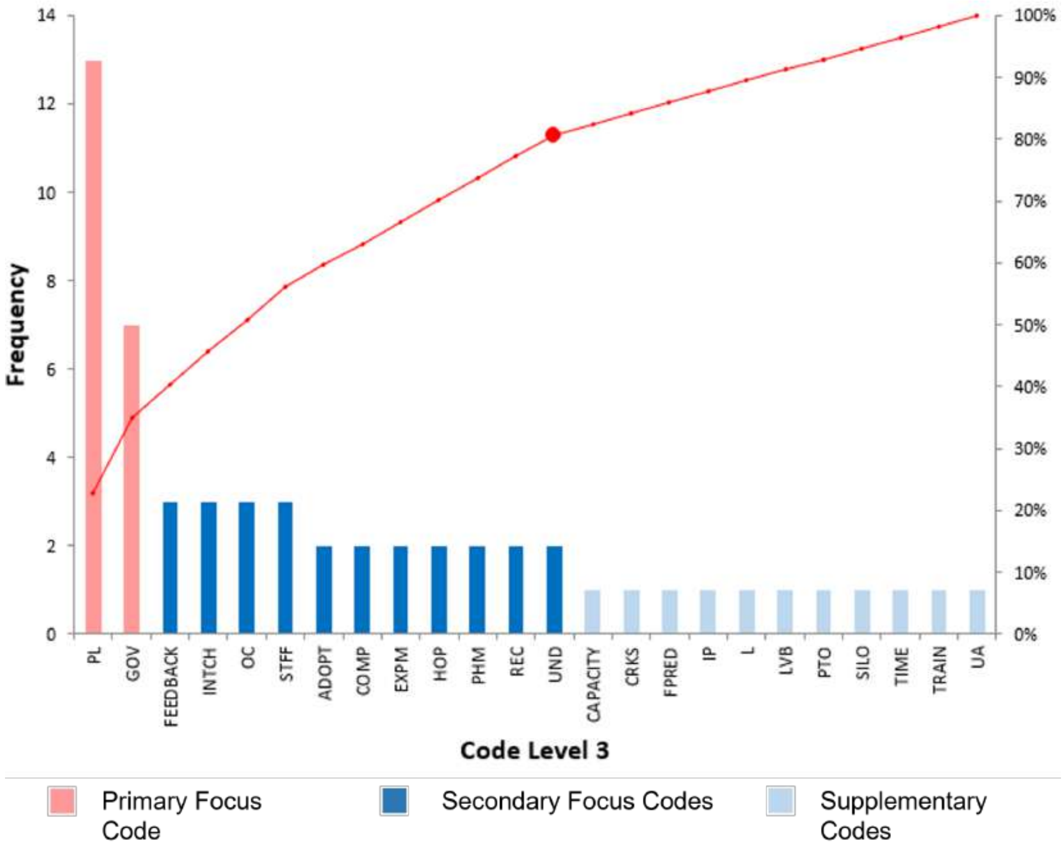


Figure 3.5: Pareto chart example code level 3: How analysis was undertaken

Supplementary codes were codes which had low frequencies and fell on the lower end of the 80-20 pareto rule.

Validation of the results of this analysis was done using triangulation and comparison with findings and ideas gathered from the other research instruments mentioned in section 3.2.1.1. The findings were also confirmed by respondents and set up the conversation for round 2 interviews.

3.2.1.2 Establishing the Root Definition and developing purposeful activity models

The task of constructing purposeful activity models is often viewed through the perspective of a declared worldview identified as relevant to the investigation [114]. In order to do this, a statement describing the activity system to be modelled is needed. Such a description is known in SSM as a Root Definition [120].This a statement of purpose that captures the essence of the particular situation of the relevant system. At the heart of the Root Definition is the transformation that is performed by the relevant system [120].

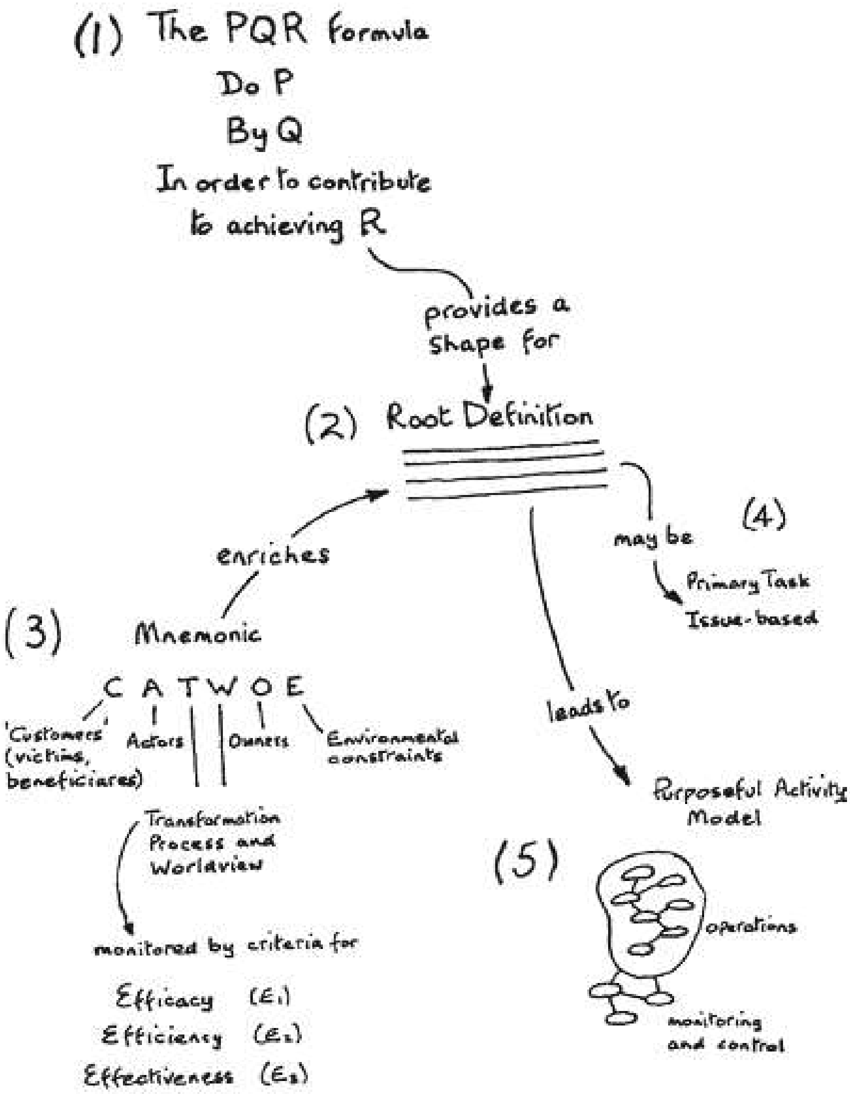


Figure 3.6: Guidelines which help with building models of purposeful activity [114]

Figure 3.6 shows that to best describe the Root Definition of any system, two aspects are needed;

1. ***PQR Formula:*** do P, by Q, in order to help achieve R [114]. Following the formula answers the questions: What? How? and Why? respectively. The PQR formula allows you to write out the root definition as a statement.

2. ***CATWOE Framework:*** a technique that provides a framework for defining and analysing business stakeholder perspectives. The mnemonic stands for Customer, Actor, Transformation, Worldview, Owner, and Environment and is detailed in Table 3.3

Table 3.3: Defining CATWOE [120]

	Mnemonic	**Description**
C	Customers	The individual(s) who receive the output from the transformation
A	Actors	Those individuals who would DO the activities of the transformation if the system were made real
T	Transformation Process	The purposeful activity expressed as a transformation of input to output
W	Worldview	The big picture and wider impact of the transformed system or process
O	Owners	The wider system decision maker who is concerned with the performance of the system
E	Environmental Constraints	The key constraints outside the system boundary that are significant to the system

The PQR formula would be addressed through content analysis during the interview process. From the emergent codes and themes in the preliminary data analysis, the root definition and the incubation CATWOE framework would be established and used and the foundation for building the purposive activity models. Two modelling methods chosen for use in the study;

1. ***Systemigrams:*** for expression and holistic understanding of the root definition of the system

2. ***Causal Loop Diagram (CLD):*** to distill the essence and behaviour of the issues faced within the system

Systemigrams

Systemigrams are useful learning tools for visually representing descriptions of natural complex language systems [134] [135]. They leverage the objectives of non-traditional SSMs by providing a visualization of an entire system, highlighting the complexities of its functionality and of the relationships between its components. Systemigrams are thus generally employed in the early stages of problem formulation, as stakeholders and analysts first conceptualize the system or problem under consideration [136] [137].

One of the central uses of systemigrams is presenting stakeholders with a visual presentation of the key words they used to describe the system under consideration [134] [138]. This visual representation depicts system relationships and functions in a more instructive way than natural language descriptions, since systemigrams allow stakeholders to view all of their previous descriptions of a system simultaneously [136] . Figure 3.7 below is an example of a systemigram used to synthesize the systems thinking from the literature definition [139].

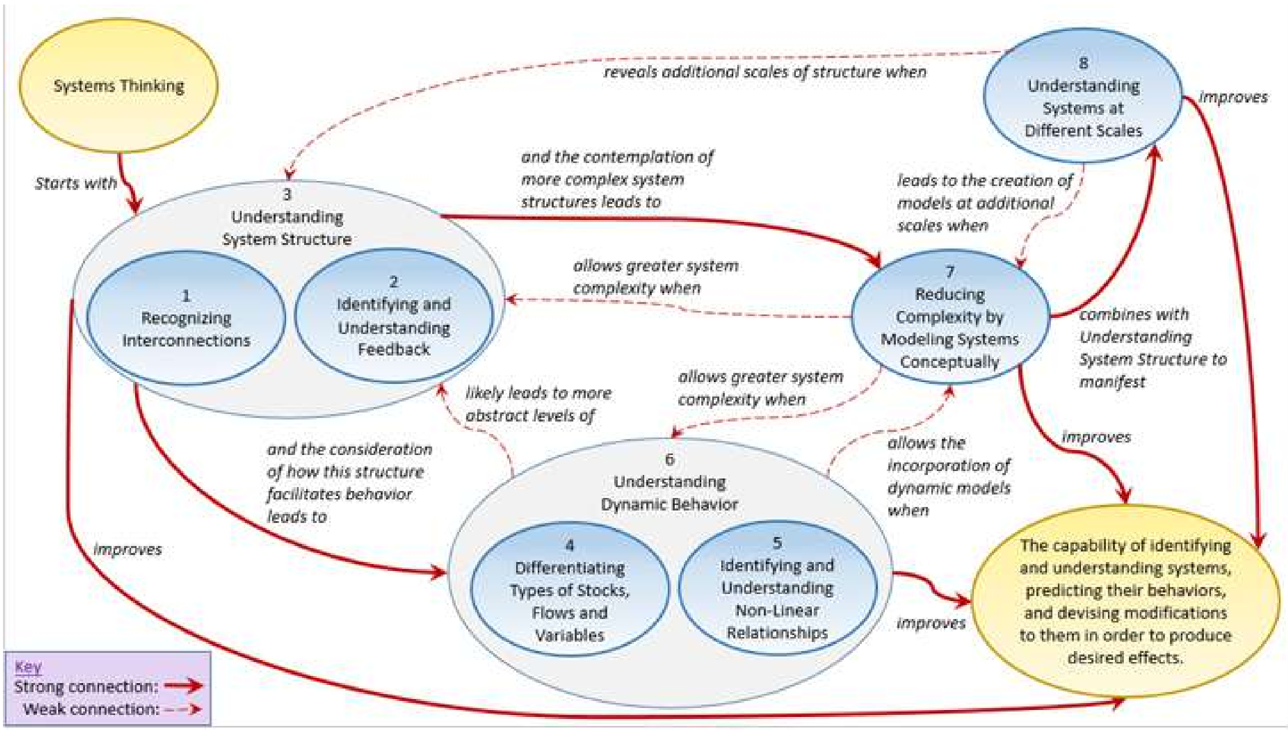


Figure 3.7: The definition of Systems thinking systemigram [139]

As with most principles and tools of systems thinking, systemigrams consists of three components shown in Figure 3.8. These components are evident in the systemigram in Figure 3.7

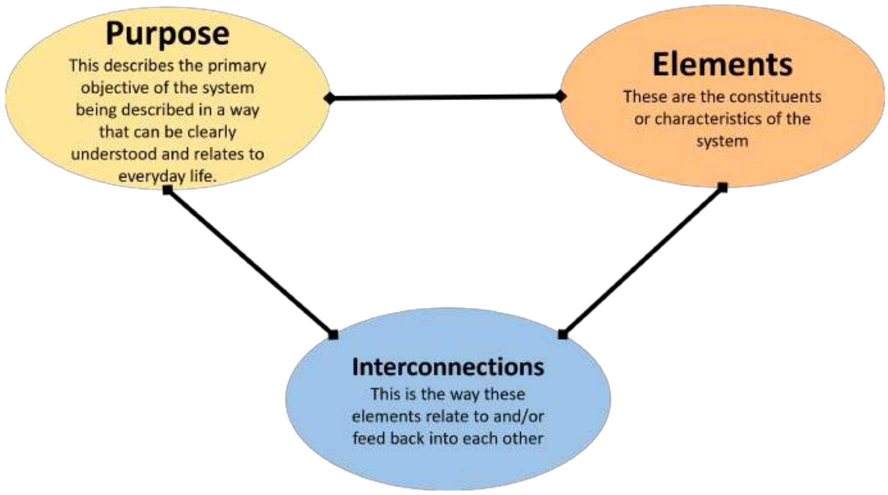


Figure 3.8: Systemigram Components [136] [138] [139]

- ***Elements*** - In the case of the systemigram above, the elements are the characteristics of systems thinking numbered 1 to 8 as well as the yellow bubbles. It should be noted that elements can be grouped together.
- ***Interconnections***- In this systemigram, thick lines represent strong connections, while thin dotted lines represent weaker, but still important, connections.
- ***A purpose*** - The purpose of the systemigram is understood by reading the elements diagonally across the diagram starting from the top left bubble to the bottom right bubble. This often forms the mainstay story of the systemigram. In Figure 3.7 this gives the statement;
  "*Systems Thinking starts with understanding system structure and the consideration of how this structure facilitates behaviour leads to understanding dynamic behaviour which improves the capability of identifying and understanding systems, predicting their behaiours and devising modifications to them to produce desired effects*"

It is important to note that the system of Systems Thinking as depicted in this systemigram operates as a series of continuous feedback loops. That is to say, the system does not cease to function at the final node. Rather, as each of the elements improves and in turn improves connected elements, Systems Thinking itself continuously improves.This "all-at-once" representation of these components enables recognition and discussion of specific system characteristics in light of the entire system, and in the specific environment in which the system is located [135].

In the context of this study, the explanatory and descriptive power of systemigrams was vital both for clarifying objectives and for providing respondents with a broad view of the system's operation [136].

Building Systemigrams for this Research

Building the systemigram in this research required a comprehensive understanding of the process being modelled as it depicted the operational level views of BI processes; describing the interactions between people,systems,tangible and intangible entities involved in incubation.

A summary of systemigram guidance and the principles for building a model is detailed in Table 3.4. This table aided in validating the essence of the final systemigram in chapter 4.

Table 3.4: Guiding Principles for building systemigrams [136]

Principle	Systemigram Guidance
Correctness	-Mainstay that supports the purpose of the system reads from top left to bottom right. -Ideally, there should be 15–25 nodes. -Nodes must contain noun phrases. - Links should contain verb phrases (to reduce trivial links).
Relevancy	- Remember that the model is really "theirs." - Remember that the model is not reality but a reflection of reality
Comparability	-It should compare to reality and the original system description.
Clarity	-The reader should be able to read the sentences in the diagram. -Exploit topology to depict why, how, and what (who, when, and where is built into system description).
Systematic Design	- The systemigram should be a system in its own right - Every node (except for the beginning and ending nodes) have an input and an output

With the guidance principles in mind, the steps followed in building systemigrams in this research are detailed in Table 3.5;

Table 3.5: Creation steps of a systemigram [136][140]

Step	Detail
1.Capture problem from stakeholder's perspective	This step can be based on many presumptions and often is the perceived problem by the stakeholders. Thus, every attempt should be made not to extrapolate about the nature of the situation but only use this step to collect perspectives of the problem using words, pictures, stories, etc.
2. Describe problem situation	Both the logic and the environment of the situation are taken into account at this point. It is best that methods in triangulation are used to assure validity in expressions. Triangulation uses different sources of information in order to increase the validity of a study. Using multiple sources, the observer seeks correlating information in at least three independent sources .
3. Express the text as structured text	The structured text identifies the key elements of the process with attention to systems thinking modelling and analysis requirements
4. Draw the systemigram from the structured text	A systemigram is a network, having nodes and links, flow, inputs and outputs, beginning and end. Key concepts, noun phrases specifying people, organizations, groups, artifacts, and conditions are nodes. The relationships between these nodes are verb or prepositional phrases indicating transformation, belonging, and being.
5. Partition the systemigram into individual story scenes	This is done so the systemigram and reality can be compared and contrasted. The differences become the basis for discussion: how things work, might work, and what are the implication?
6. Determine if the scenes of the story are feasible	At this step, the identification of feasible and desirable changes are deciphered from the previous step Desirable asks if the change is technically an improvement to the system. Feasible asks if the change fits the culture.
7. Update systemigram as necessary	Update the systemigram based on the previous step

Causal Loop Diagrams (CLDs)

While systemigrams provide a holistic view of the entire system, a useful way to capture and condense the underlying structure or issues of systems is CLD [141]. A causal loop diagram represents the way in which a system works and consists of four basic elements: the variables, the links between them,the signs on the links (which show how the variables are interconnected), and the sign of the loop (which shows what type of behaviour the system will produce).

The primary purpose of the CLD is to depict causal hypothesis, so as to make the presentation of the structure in an aggregate form. The CLD helps the user to quickly communicate the feedback structure and underlying assumptions [142]. CLDs are an important tool for representing the feedback structure of systems. Long used in academic work, and increasingly common in business, CLDs are excellent for [141]:

- Quickly capturing hypotheses about the causes of dynamics
- Eliciting and capturing the mental models of individuals or teams
- Communicating the important feedbacks one believes are responsible for a problem or behaviour

By using CLDs to create stories about complex issues in the incubation space, the understanding of the interrelationships within the system's structure became more explicit. The resulting diagrams also provided a visual representation that was used to communicate that understanding.

Table 3.6 shows the steps taken in correctly developing CLDs in the study.

Table 3.6: Steps in Causal Loop Diagraming: Population Example [141] [142]

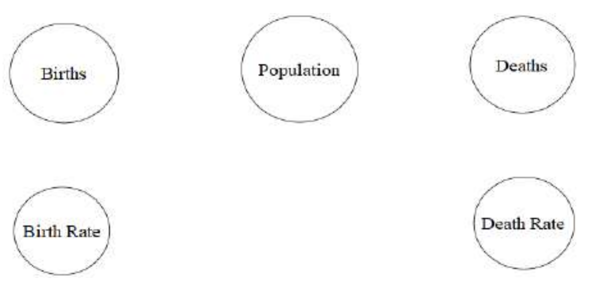
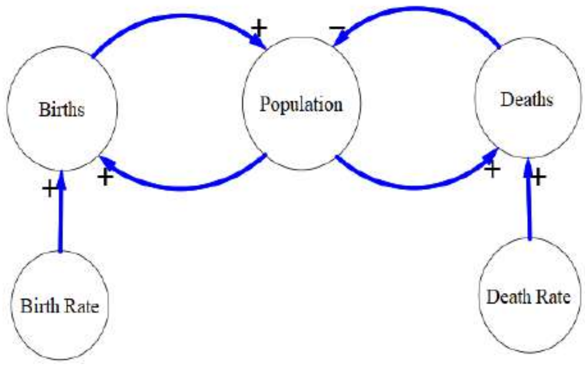
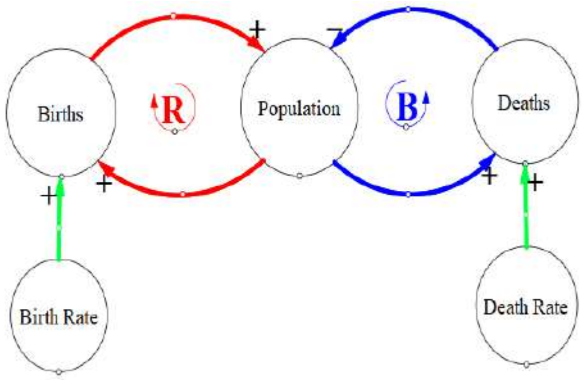
Diagram	**Step**
	• ***Decide on variable names:*** Like in systemigrams, variables are nouns and should be something that can vary over time. Determining the correct variables affects the entire CLD model.

Diagram	Step
	• ***Draw the Links with their polarities:*** If variable B moves in the same direction as variable A, the link from variable A to B would be labeled with a **Positive polarity(+)** e.g As the births increase, there is an increase in the population . If variable C moves in the same direction as variable D, the link from variable C to D would be labeled with a **Negative polarity(-)** e.g As the deaths increase, there is a decrease in the population.
	• ***Label Loops:*** Once all of the links in the CLD have been completed, one would want to determine what type of behaviour loops will produce e.g The loop between births and population; As the births increase, there is an increase in the population. Consequently a population increase causes an increase in births **(Reinforcing Loop)**. The loop between deaths and population; As the deaths increase, there is a decrease in the population.Consequently a population increase causes an increase in births **(Balancing Loop)**

System Archetypes

Systems archetypes have been developed as specific ways or typical ways in which systems tend to organize themselves. As diagnostic tools they provide insight into the underlying structures from which behaviour over time and discrete events emerge [143] [144]. As prospective tools, they aided in examining the incubation space and creating an alert of future unintended consequences. The following three archetypes were used;

Table 3.7: System Archetypes [143]

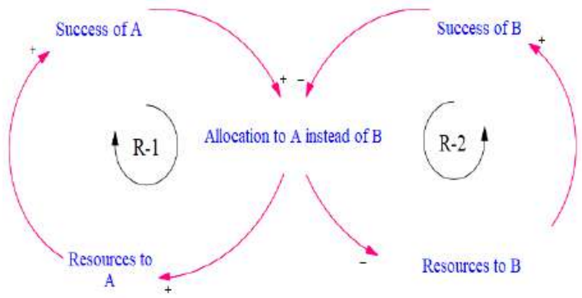
<table>
<tr><th>Archetype</th><th>Description</th></tr>
<tr><td>

Figure 3.9: Success to the successful [145]</td><td>

- In the ***Success to the Successful*** archetype, if one person or group (A) is given more resources, it has a higher likelihood of succeeding than B (Assuming they are equally capable). The initial success justifies devoting more resources to A, B's success diminishes, further justifying more resource allocation to A (R2).

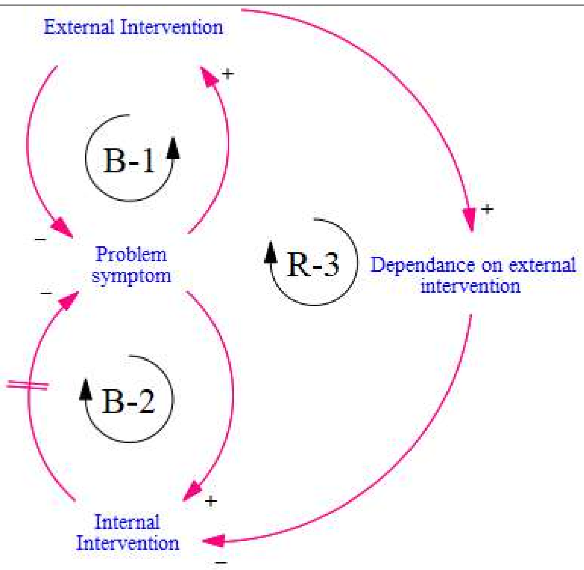
</td></tr>
<tr><td>

Figure 3.10: Shifting the burden [145]</td><td>

- In the ***Shifting Burden*** Archetype, a problem is 'solved' by applying a symptomatic solution (B1) which diverts attention away from the fundamental solutions (R1). A Shifting Burden degrades into an addictive pattern in which a side effect gets so entrenched that it overwhelms the original problem symptom.

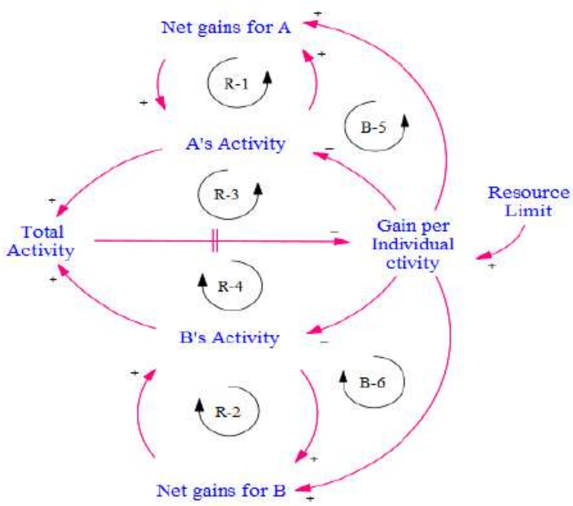
</td></tr>
<tr><td>

Figure 3.11: Tragedy of the commons [145]</td><td>

- A ***Tragedy of the Commons*** archetype occurs when multiple agents acting in rational self interest escalate their actions such that they deplete a shared, erodible resource. Each individual's action does not create a noticeable dent, but all the 'commons' acting together amplifies the damage, leading to a situation that none of them are happy about. This occurs because each actor that engages in the tragic behaviour reaps benefits, while the costs are shared by all in the system.

</td></tr>
</table>

3.2.1.3 From Models to a Framework

It is important to note, the end goal of the research is not to model the incubation system as it is but rather to develop a conceptual framework that can be used by incubators to address issues revealed by the conceptual models (Refer to section 1.4 and section 3.1. For this reason it is important to note the difference between a model and a framework. The following definitions were used in this research.

- **Model:** a schematic representation of a system, made of the composition of different logical, quantitative and qualitative elements which are used to help people know, understand, or simulate an existing or future state or situation [146][147].
- **Framework:** An organized structure of ideas, concepts and practices used for the realization of a defined result or goal.[146][147].

The following steps were taken for the realisation of the final conceptual model. Some of the steps overlap with previous steps in the methodology but are still highlighted here.

Table 3.8: Steps in developing the conceptual Framework [148]

Step	**Relevance and Importance**
1. Describing the intended uses of the framework of change	-Conveys the purpose and direction of the initiative or effort (i.e., the outcomes sought and how to get there)
2. Describing the appropriate scope or level of the framework	-Ensures the right level of implementation is accounted for in the design of the framework including context and conditions
3. Identifying ALL components to include in the framework	-Ensures all relevant Inputs, outputs, activities, processes and workflows are accounted for in the development of the framework -Describes the underpinning principles of the framework (This includes the 4IR Design principles)
4. Drafting a picture of the framework using the identified components	-Establishes the sequence (what occurs before what) and relationships of the components and elements of the framework
5. Checking for completeness of the framework	-Ensures feedback in terms of: •Usefulness of the elements of the framework •Completeness of the framework

3.3 Reliability and Validity

Reliability: Consistency in qualitative data in the patterns and dynamics of the subject of study it reflects [129]

The reliability of the methodology was condensed into three items:

- ***Selection of experts:*** The key criterion and characteristics used in the stakeholder analysis included individuals' sectoral experience, competencies and skills. This has been highlighted in section 3.2.1.1
- ***Panel Size:***The panel size was made such that it accounted for a variety of experts while ensuring an adequate respondent rate.
- ***Conducting the process:*** A key strength of SSM is its iterative nature. Interviews and preliminary data analysis was doe iteratively with input from the panel of experts as required.

Validity: accuracy with regard to the characteristics and dynamics of the entities or situation being studied [129]

The validity of the methodology and findings of this research were determined based on:

- ***Internal Validity:*** Extent to which a research design and its implementation enable accurate conclusions about cause-and-effect and other relationships among variables studied in a research project.
- ***External Validity:*** Extent to which the results of a research study are applicable to other contexts, especially in real-world situations.
- ***Criterion Validity:*** Extent to which the results of a measurement instrument correlate with the results of a measure of a presumably related characteristic; also known as predictive validity if the related characteristic is assessed at a future point in time.
- ***Content Validity:*** Extent to which a measurement instrument includes a representative sample of the content domain being measured; most often used for measures of academic achievement.

To ensure internal validity the strategies below were be employed:

- ***Reflexivity:*** A conscious attempt was made to identify personal, social, political, or philosophical biases that might have influenced data collection and interpretation and the appropriate steps were taken to minimize such influences.
- ***Triangulation:*** Data collection was done through multiple forms related to the same research question, with the goal of finding consistencies or inconsistencies among the data.

To ensure external validity the strategies below were be employed:

- ***Thick description:*** Qualitative research strategy in which an observed situation is described in enough detail that readers can construct some of their own interpretations [129]
- ***Respondent Validation:*** Qualitative research strategy in which a researcher seeks validation from study participants about conclusions and interpretations drawn from collected data [129]

The validity of the answers and results was also ensured by planning and testing the research settings prior to the start of the study. Criterion validity was be examined by comparing recommendations in the responses to industry evidence from reports and databases. The content validity was estimated as a measurement of the extent to which recommendations were related to the competencies of the experts selected.

3.4 Ethical Considerations

There were five areas in the research process where ethical considerations were pertinent, namely prior to conducting study; beginning the study; collecting data; analysing data; and reporting, sharing and storing data. How ethical considerations were considered during these phases of the study are detailed in Table 3.9.

Table 3.9: Ethical Considerations

Areas	**How the issues were addressed**
Prior to conducting the study	•Submitted a proposal for approval to University Ethics Committee – ethics protocol number H20/05/30 •Identified and obtained approvals of potential participants prior to the interviews
Beginning the study	•Contacted the participants and informed them of general purpose of the study •Obtained appropriate consent
Data Collection	•Discussed purpose of the study and how data will be used •Withheld sharing personal impressions •Avoided disclosing sensitive information •Involved participants as collaborators •Followed to the questions and prompts stated in an interview guide
Data Analysis	•Reported multiple perspective •Avoided rushing to develop sub-themes •Included the category of emergent themes •Report contrary findings from different interviews •Used neutral labels such as respondent 1 or 2 and nameless cases to ensure privacy of participants and the institutions
Reporting	•Reported honestly as per the interview •Used unbiased language appropriate for audiences of the research •Provided copies of interview transcripts to the participants •Stored data and material for the number of years that are defined in the university ethical codes •Provided credit for ownership to researcher, participants and supervisor

Chapter 4 Data Processing and Analysis

This chapter presents the analysis of data and findings gathered in the study as discussed in chapter 3 particularly subsection 3.2.1. Data collected to perform the analysis and deduce outcomes was extracted from the interview response transcripts and the results are organised in two sections;

1. ***Round one processing:*** This section focuses on the thematic and content analysis results from the process described in subsubsection 3.2.1.1 (Developing a Rich Picture).
2. ***Round two processing:*** This section focuses on the results of the development of models from the process described in subsubsection 3.2.1.2 (Establishing the Root Definition and developing purposeful activity models). For processes followed for both refer to section 3.2.1.2 and section 3.2.1.2 respectively.)

Figure 4.1 summarises the results presentation process; including high level inputs and outputs of each round of data processing.

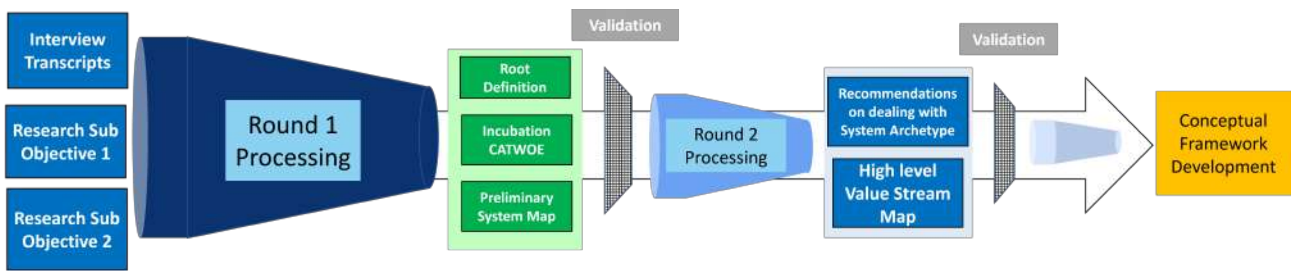


Figure 4.1: Summary of Thematic and content analysis process

4.1 Profile of Respondents

The study used 7 subject matter experts, hereto referred to as respondents, within Johannesburg. Table 4.1 indicates the job roles held by the respondents and the years of experience in the current role.

Table 4.1: Respondent roles and years of experience

Respondent Number	Dimension	Response
Respondent 1	Role	Incubation Analyst
	Years of Experience	7+ Years
	Organisation Classification	Academic Incubator
Respondent 2	Role	Incubation Manager
	Years of Experience	10+ Years
	Organisation Classification	Virtual Incubator
Respondent 3	Role	Incubator Mentor
	Years of Experience	5+ Years
	Organisation Classification	Graduated SMME
Respondent 4	Role	Incubation Manager
	Years of Experience	10+ Years
	Organisation Classification	Virtual Incubator
Respondent 5	Role	Senior Account Manager
	Years of Experience	10+ Years
	Organisation Classification	Development Finance Institution
Respondent 6	Role	Senior Incubation Manager
	Years of Experience	10+ Years
	Organisation Classification	Government Enabling Agency
Respondent 7	Role	Incubation Auditor
	Years of Experience	5+ Years
	Organisation Classification	BI Research Organisation

Names of the respondents and organisations have been kept confidential as described in the methodology chapter.

4.2 Round 1 Processing:Thematic and Content Analysis

The flow of section 4.2 is described in Figure 4.2 below detailing the inputs, result presentation and the expected outcomes after processing;

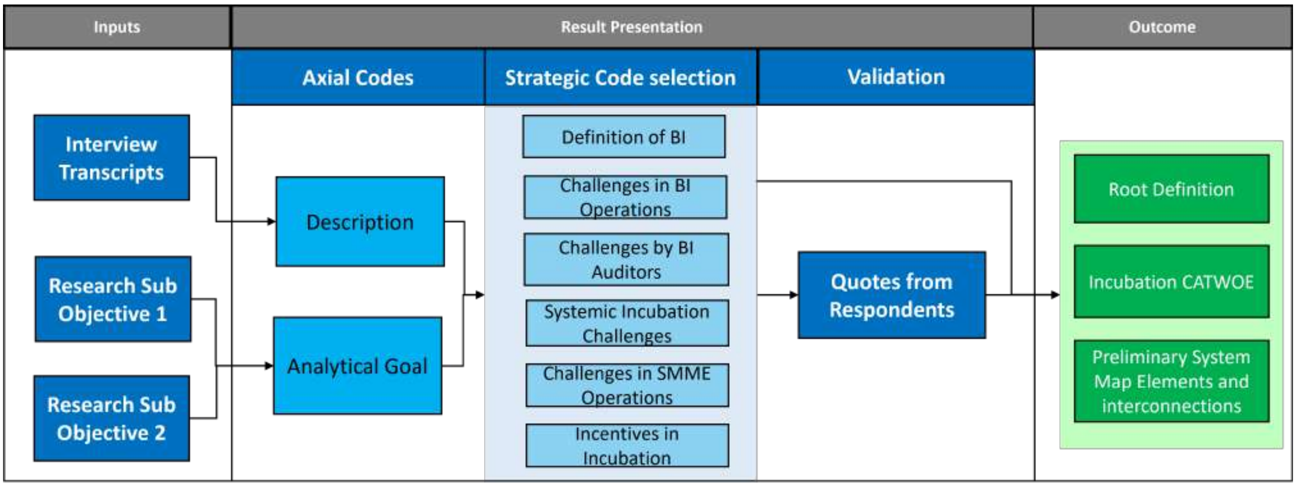


Figure 4.2: Inputs,analysis process and outputs of Round 1 Processing

Interview transcripts were used to conduct content and thematic analysis as detailed in section 3.2.1.1 and thus resulted in the description of the axial codes that emerged from the analysis. The two sub objectives stated in section 1.5 guided the analytical goals of these developed axial codes. Subsequent subsections will show content and thematic results on the axial codes. This will follow the following structure;

1. Presenting a frequency bar chart of the level 2 code
2. Presenting paretos on the level 3 and 4 codes
3. Presenting the accompanying coding scheme with details on the primary and secondary focus codes shown in the pareto (Refer to section 3.2.1.1)

A brief description of the results and direct quotes from the respondents will then be highlighted where applicable for validation. Results on the organisational structure become more apparent in the preliminary incubation space map and in the construction of incubation systemigram.

4.2.1 Axial code description

Table 4.2 shows the 6 axial codes developed in the study, their descriptions and their analytical goal.

Table 4.2: Axial Code Description and Analytical Goal

Axial Code	Description	Analytical Goal
Definition and function	The identity, functions and objectives of incubators and their supporting systems	Establishing an understanding of who incubators identify themselves as and what they see as their role and function
Best Practices	Recommended processes, management routines and workflows used within the incubation space	Determining replicable best practices that can be made standard practice for effective incubation
Organisational Structure	The organisational building blocks more so in terms of operational staffing and governance	Establishing the operational framework of the organization
Challenges	The internal and external barriers that inhibit the success and impact of Business Incubation	Identifying common and unique challenges within incubation
Success Factors	The internal and external enablers of success and positive impact of Business Incubation	Identifying common and unique success factors within incubation outside of best practices
Emergent	Prominent unexpected themes arising from the interviews	Capturing aspects that do not directly relate to the 5 themes but have significant impact on business incubation

The count of the Axial Codes in the data expressed as percentages is shown in Figure 4.3.

Figure 4.3: Percentage frequency of Themes from all Respondent Data

From Figure 4.3, challenges had the highest count while organisational structure had the lowest count. It is important to point out that organisational structure as a theme was more implied especially in relation to the other themes. Examples of this are when a respondent described a challenge they faced in terms of governance or when they described the structure of their organisation as a success factor.

4.2.2 Definition and Function

Responses within axial code 1 (Table 4.2) filtered and grouped at a second level are illustrated in Figure 4.4. At this level, the majority of responses were about the definition and function of Business Incubators. Respondent 4 and 6 also gave the definition and function of Government Departments and Government Entities as having the mandate to drive the development of incubators and SMMEs in various sectors. Respondent 5 provided additional insight on the definition and function of incubation schemes, being a Senior Manager overlooking an SMME development scheme.

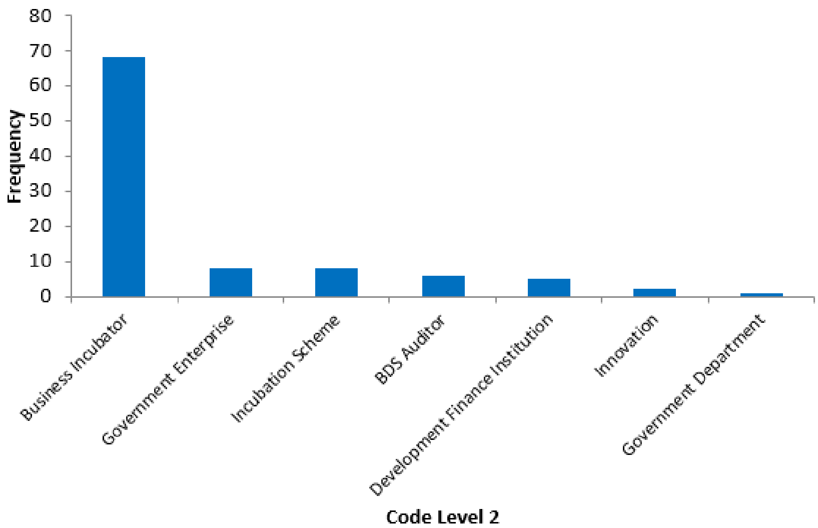


Figure 4.4: Definition and Function Code Level 2

Figure 4.5 shows the subcodes used to describe Business Incubators while Table 4.3 presents the descriptive listing of the codes used for grouping. Based on the responses obtained, business incubators identify themselves primarily by the service offerings to entrepreneurs and SMMEs. This was expressed by Respondents 1, 2, 3, 4 and 6. Offerings included;

- Prototype and Idea Development
- Funding
- Structured Programmes

- Skill and Knowledge Training

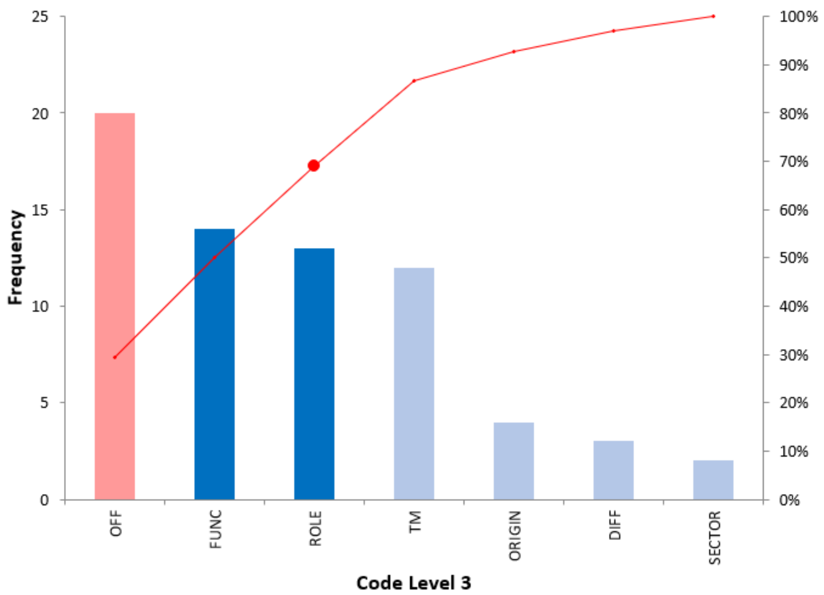


Figure 4.5: Definition and Function Sub-subthemes

Table 4.3: Codes used for the Definition and Function of Business Incubators

Number	Descriptive Label	Code
DF	***Definition and Function***	
DF-BI	**Business Incubation**	
DF-BI(01)	Business Incubator Offering	DF-BI-OFF
DF-BI(02)	Function of Incubation	DF-BI-FUNC
DF-BI(03)	Role of Business Incubators	DF-BI-ROLE
DF-BI(04)	Target Market of Incubation	DF-BI-TM
DF-BI(05)	Origin of Business Incubation	DF-BI-ORIGIN
DF-BI(06)	Entity Differentiation	DF-BI-DIFF
DF-BI(07)	Sector Specific Definition of Bis	DF-BI-SECTOR

The subtle difference between the Function and Role subcodes was that function described the duty and purpose of Business Incubators while Role described the part played by Business Incubators within the Incubation and SMME spaces.

- **Function:** "*Our job is to give you knowledge, skills and competencies across these categories. What you then do with that is you use that to run your business and to assess whether you run it well or not.*" (***Responent 7***)
- **Role:** "*No, they shouldn't. They shouldn't be seen as educators, but sometimes they find themselves playing that role but they're not and that is why I want to say there's people that you can't educate at the incubator because you're not an educator.*" (***Respondent 2***)

4.2.3 Best Practices

In relation to best practices. (Axial code 2, Table 4.2) the highest proportion of responses were about best practices of Business Incubators (BI) as illustrated in Figure 4.6. Only one respondent (Respondent 7) mentioned best practices among funders.

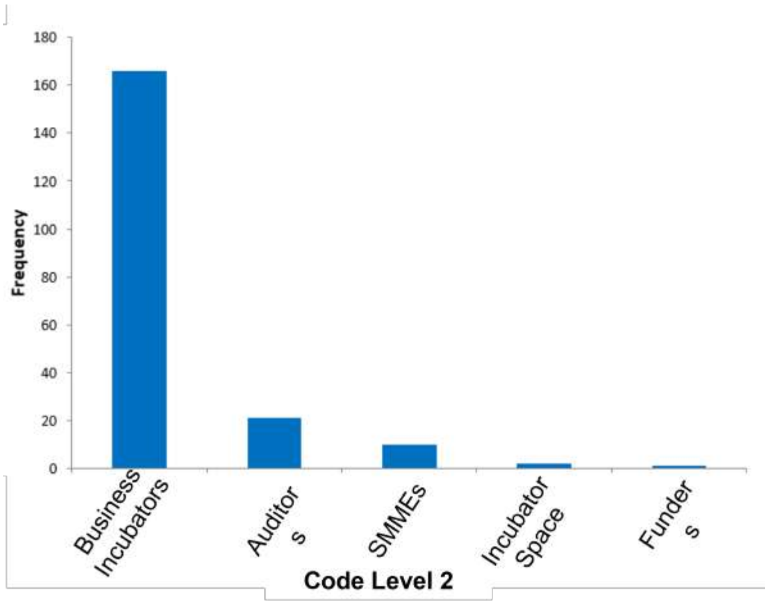


Figure 4.6: Best Practices within the Incubation space

Figure 4.7 shows the dominant subcodes being in Business Incubator Operational Processes, their methodology and the recruitment of entrepreneurs.

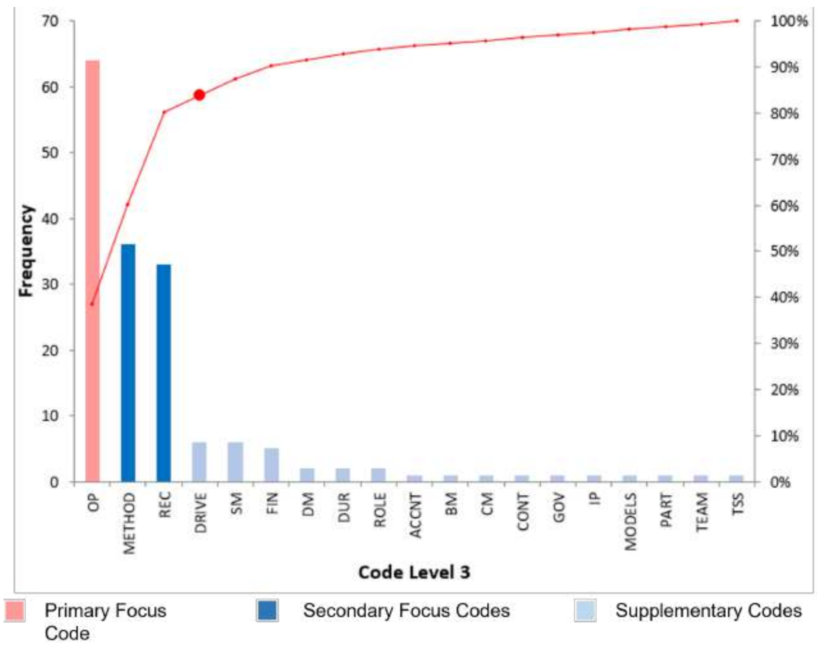


Figure 4.7: Best Practices in Business Incubation

Table 4.4: Codes used for Best Practices in Business Incubators

Number	Descriptive Label	Code
BP	**Best Practices**	
BP-BI	Best Practices done by Incubators	
BP-BI(01)	Operational Processes	BP-BI-OP
BP-BI(02)	Methodology	BP-BI-METHOD
BP-BI(03)	Recruitment of Entrepreneurs	BP-BI-REC
BP-BI(04)	Drivers of Incubation	BP-BI-DRIVE
BP-BI(05)	Incubation Success Measure	BP-BI-SM
BP-BI(06)	Financial Processes	BP-BI-FIN

Although literature shown in subsection 2.1.2 highlights recruitment as part of incubator operational processes, it was decided to separate the recruitment from operational processes in the analysis as a theme.This was because recruitment was frequently mentioned on its own by respondents. As a function, most incubators did not have a strong say on recruitment as this was a decision left to funders and not all incubators had the in-house functionality for recruitment. It was still considered best practice in incubation rather than an activity for Funders since when required, the exercise of recruitment was carried out by the incubator. Best practices in operational processes included;

- Duration of incubation
- Feedback from incubatees
- Key Metrics of Measure
- Aspects of Enterprise Supplier Development (ESD)

In terms of Methodology, respondents mentioned the effectiveness of Pre-Incubation and the use of the Lean approach to Business, conducting feasibility studies as well as having a Fail fast and fail forward approach.

"*Now the reason why we follow a structured pre-incubation programme is to test hypotheses, to really see if the entrepreneur or the idea, because some of the companies are start ups that come into our incubators at the idea stage. If we find that the idea can be monetised and the entrepreneur in pre-incubation is able to sell the service or the product, we then move it into incubation and where we then put it into the incubation programme for a minimum period of 2 years.* "(***Respondent 6***)

4.2.4 Success Factors

Figure 4.8 shows that a success factors were broadly classified in 4 main categories. A majority of the responses described success factors around SMMEs and entrepreneurs. This implied that incubators knew what it took to make SMMEs succeed and how they (BIs) enabled them to succeed.

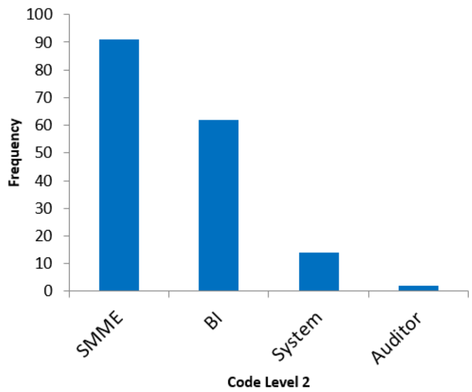


Figure 4.8: Success Factors Code Level 2

4.2.4.1 SMME Success Factors

Figure 4.9 shows that the critical factors of success are Clusters and Entrepreneurial Traits. Business Validation was another high frequency success factor mentioned by respondents 3, 4 and 6 as the validation of an idea or product was an indication of the market demand.

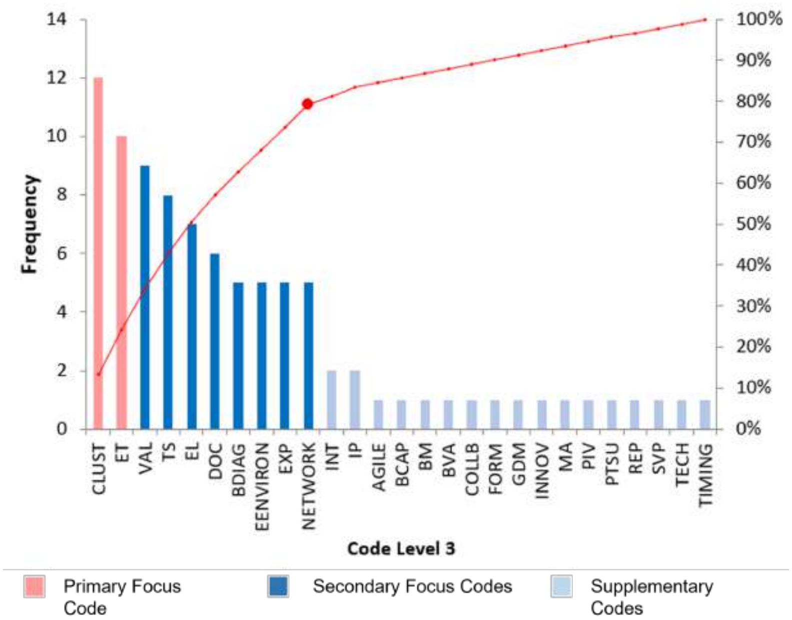


Figure 4.9: Success factors of SMMEs

Table 4.5: Codes used for Success Factors in SMMEs

Number	Descriptive Label	Code
SF	***Success Factors***	
SF-SMME	***Success Factors in SMMEs***	
SF-SMME(01)	SMME Clusters	SF-SMME-CLUST
SF-SMME(02)	Enterpreneurial Traits	SF-SMME-ET
SF-SMME(03)	Business Validation	SF-SMME-VAL
SF-SMME(04)	Technical Support	SF-SMME-TS
SF-SMME(05)	Education Levels	SF-SMME-EL
SF-SMME(06)	Documentation	SF-SMME-DOC
SF-SMME(07)	Business Diagnosis	SF-SMME-BDIAG
SF-SMME(08)	Enterpreneurial Environment	SF-SMME-EENVIRON
SF-SMME(09)	Experience in running businesses	SF-SMME-EXP
SF-SMME(10)	Networking among SMMEs	SF-SMME-NETWORK

Entrepreneurial traits were highlighted by Respondents 1, 2, 4 and 6 and were predominantly soft skills such as confidence, risk taking and self drive. It should be noted that clusters were solely identified as a success factor by Respondent 5 based on the success of their incubation scheme.

"*Individuals, especially SMMEs haven't got access to all the experts they'd need whereas in a cluster you can now have access to good financial management and you can have access to a business manager sort of person, so that's really the power of a cluster. So the power of a cluster then is getting a, you know, group of companies who would not have access to those resources to have access to really good resources so that for SMMEs is very powerful especially. And they learn from each other.*" (***Respondent 5***)

4.2.4.2 Business Incubator Success Factors

Figure 4.10 shows the most frequently mentioned success factor for Business Incubators was their methodology. This was interesting as previous research on the success factors of business incubators had not taken incubation methodology into account as seen in section 2.1.4.2 [45]. This showed a shift at the perspective from the respondents of what qualified as a successful incubator from looking at just what affected the internal operational success of incubation to the impact and outcome of incubation.

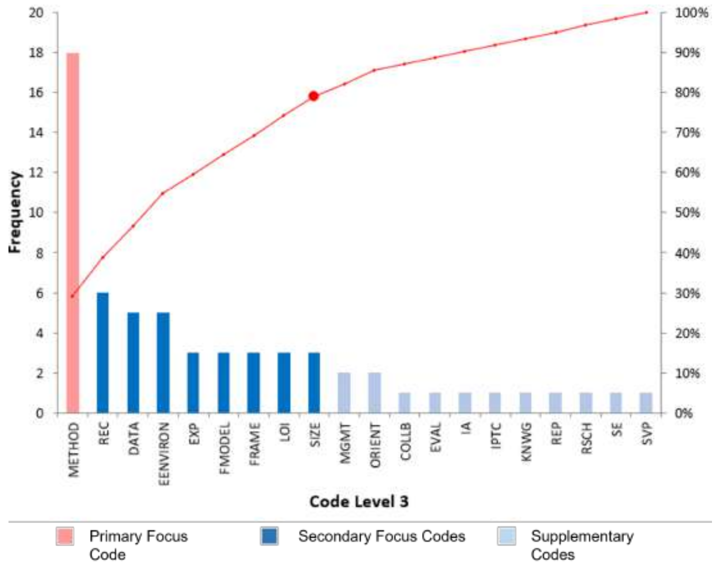


Figure 4.10: Success factors of Business Incubators

Table 4.6: Codes used for Success Factors in Business Incubators

Number	**Descriptive Label**	**Code**
SF	***Success Factors***	
SF-BI	***Success Factors in Business Incubators***	
SF-BI(01)	Methodology	SF-BI-METHOD
SF-BI(02)	Targeted recruitment of SMMEs	SF-BI-REC
SF-BI(03)	Eliciting the correct Data	SF-BI-DATA
SF-BI(04)	Enterpreneurial Environment	SF-BI-EENVIRON
SF-BI(05)	Experience of Incubator Managers	SF-BI-EXP
SF-BI(06)	Incubators Financial Model	SF-BI-FMODEL
SF-BI(07)	Incubator framework and guidelines	SF-BI-FRAME
SF-BI(08)	Level of Investment by funders	SF-BI-LOI
SF-BI(09)	Size of Business Incubator	SF-BI-SIZE

Most respondents mentioned following the lean business plan and the lean start up approach in the development of Minimal Viable Products by their incubatees. They also encouraged failing fast and failing forward approach in testing ideas and products. Encouraging business validation was also deeply engrained in most of their methodologies not just for their business plans, but also in their product development.

"*Our job is to give you knowledge, skills, um, competencies across these categories. What you then do with that is you use that to run your business and if you, whether you run it well or not, because also sometimes the business is not viable from the start, it was a great idea, you did the market research but it didn't work. Now the business has to close but the entrepreneur maybe in a year or month they either pivoting or starting another business.So it's, it's also like fast, help them fail fast type of thing and also its success. Yes! Fail fast, don't waste the resources, don't waste their time, don't waste our time.*" (***Respondent 7***)

4.2.5 Challenges

Challenges expressed by respondents were classified into 6 categories as shown in Figure 4.11. The category with the lowest frequency was Government. This can be attributed to many challenges being expressed as systemic challenges and not directly facing the government.

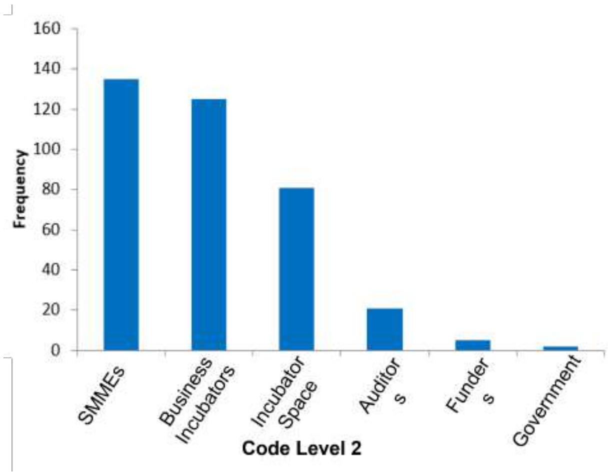


Figure 4.11: Challenges expressed in the Incubation Space

4.2.5.1 SMME Challenges

Figure 4.12 shows the dominant challenges facing SMMEs were either operational, financial in nature or pertaining access.

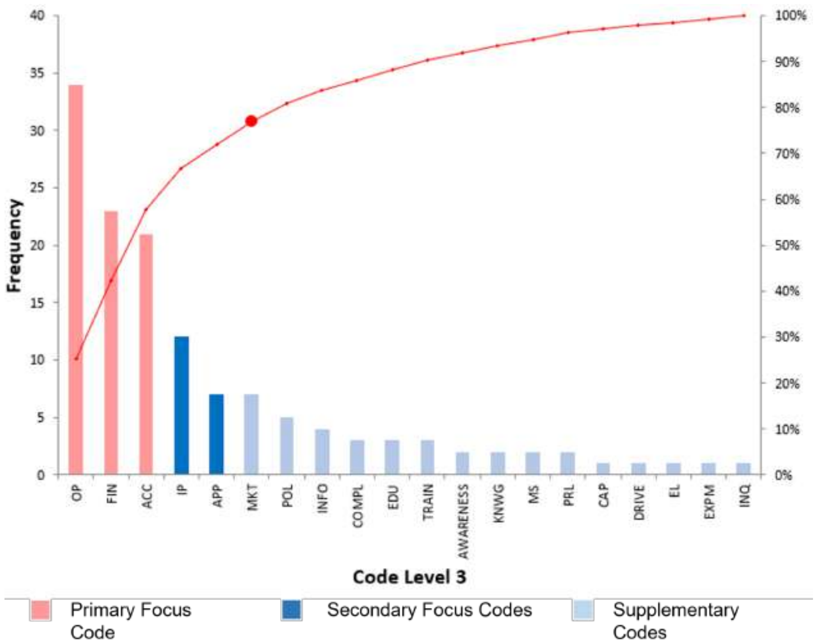


Figure 4.12: Challenges expressed by SMMEs

Access was used as a separate code as it contained aspects such as access to information, experts and markets. The major operational challenge facing SMMEs was Skill Level. This was well highlighted by Respondents 1, 2, 3, 4 and 5. Skill level not only meant technical skill concerning the business idea or venture but also aspects such as financial/accounting skill level and even interpersonal skill level which could prove vital in securing work. This lack of skill level was compounded even more as SMMEs could not afford to hire skilled employees in these areas.

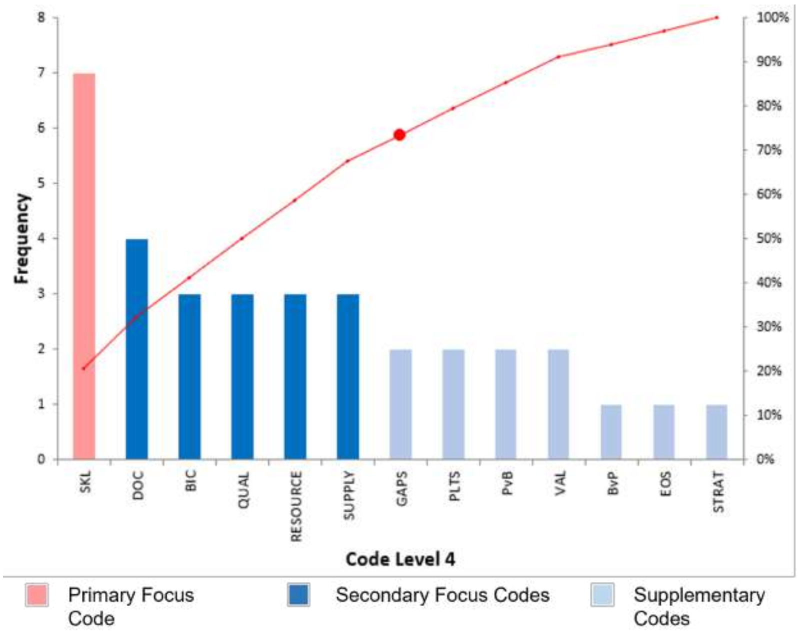


Figure 4.13: Challenges in SMME Operations

Table 4.7: Sub Codes used for Operational Challenges in SMMEs

Number	Descriptive Label	Code
C	**Challenges**	
C-SMME	***Challenges Facing SMMEs***	
	Operational Challenges	
C-SMME-OP(1)	Skill Level	C-SMME-OP-SKL
C-SMME-OP(2)	Access to Markets	C-SMME-OP-ACC(MKT)
C-SMME-OP(3)	Documentation	C-SMME-OP-DOC
C-SMME-OP(4)	Quality of Products	C-SMME-OP-QUAL
C-SMME-OP(5)	Resources	C-SMME-OP-RESOURCE
C-SMME-OP(6)	Access to Opportunities	C-SMME-OP-ACC(OPP)
C-SMME-OP(7)	Supply Chain	C-SMME-OP-SUPPLY
C-SMME-OP(8)	Better Informed Customers	C-SMME-OP-BIC
C-SMME-OP(9)	Access to Experts	C-SMME-OP-ACC(EXP)

"Everyone wants to do everything and, and then they come and they can't. Some can design technically, wonderful, but then when you start talking about, okay, go out and validate that,

you know, you really propositioning, they don't have the people skills, they don't have the energy to go out, they don't have a sales bone. They don't have the business acumen, you know? " (***Respondent 2***)

"*To expect someone to be a financial director, an analyst plus a production director plus a marketing expert, you know, SMMEs haven't got the resources often for that that's where as I said earlier, clusters can be a big way of helping.*" (***Respondent 5***)

4.2.5.2 Business Incubator Challenges

Similar to SMMEs, the major challenges facing BIs were operational in nature. This is in line with previous research highlighted in section 2.1.4.2 where most challenges defined were operational [16] [70] [24]. Other prominent challenges mentioned lay in the recruitment of entrepreneurs and SMMEs and in the financial aspects of running an incubator as seen in Figure 4.14.

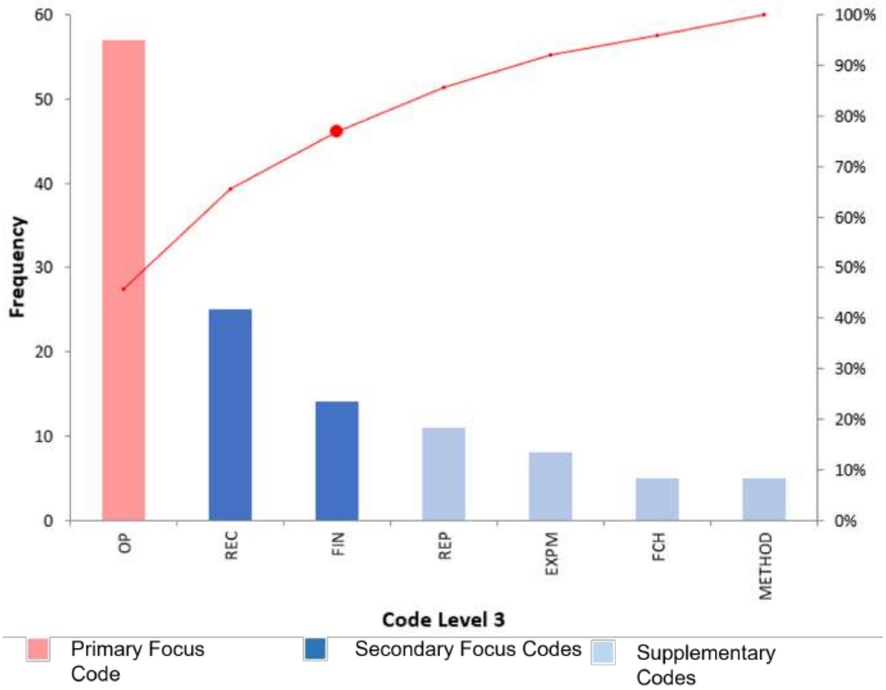


Figure 4.14: Challenges expressed by Business Incubators

Figure 4.15 shows the two critical challenges facing Incubators were their Pipeline and their governance. Pipeline in this context meant the flow of SMMEs and Entrepreneurs through the incubators to joining the value chain while governance meant the directing and management of the incubators.

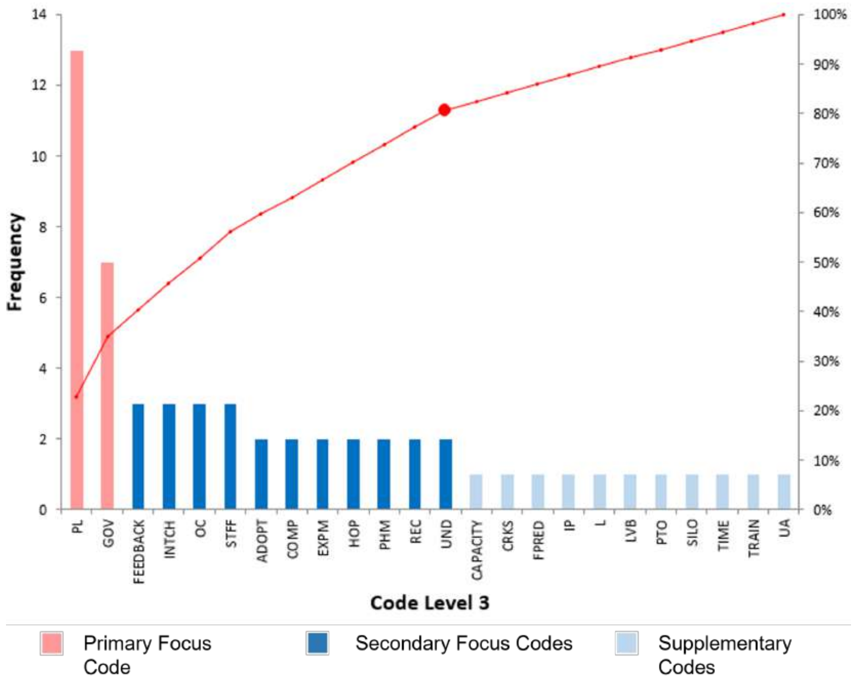


Figure 4.15: Challenges in BI Operations

Table 4.8: Sub Codes used for Operational Challenges facing Business Incubators

Number	**Descriptive Label**	**Code**
C	**Challenges**	
C-BI	***Challenges Facing Incubators***	
	Operational Challenges	
C-BI-OP(1)	Incubation Pipeline	C-BI-OP-PL
C-BI-OP(2)	Governance of the Incubator	C-BI-OP-GOV
C-BI-OP(3)	Feedback from Incubatees	C-BI-OP-FEEDBACK
C-BI-OP(4)	Internal BI Challenges	C-BI-OP-INTCH
C-BI-OP(5)	Operational Costs	C-BI-OP-OC
C-BI-OP(6)	Staffing of Incubators	C-BI-OP-STFF
C-BI-OP(7)	Process and Technology Adoption by SMMEs	C-BI-OP-ADOPT
C-BI-OP(8)	Competition with other Incubators	C-BI-OP-COMP
C-BI-OP(9)	Expectation Mismatches with SMMEs	C-BI-OP-EXPM
C-BI-OP(10)	Incubator Hopping	C-BI-OP-HOP
C-BI-OP(11)	Phase Misplacement of SMMEs	C-BI-OP-PHM
C-BI-OP(12)	Recruitment Processes	C-BI-OP-REC
C-BI-OP(13)	Funder's Understanding of the process	C-BI-OP-UND

As shown, pipeline had the highest frequency and was an issue expressed by all respondents and is experienced at different stages and in various ways.

"*So we have a big problem with pipeline, pipeline being the entrepreneurs we get in...* " (***Respondent 1***)

"*So I can tell you our guys here never took that, I think that's part of our forms there's very few questions around the entrepreneurial orientation that are not being used effectively and unfortunately the impact is probably that you cannot get to one of the reasons why people take too long in incubation, why incubation fails*" (***Respondent 2***)

"*I'm saying this because you'd find that there's a lot of entrepreneurs that get into incubation hubs but they stay in incubation hub and they don't run and become entrepreneurs and let their businesses grow...It also clearly shows that the person's business is not viable enough for them to move out of the incubation hub*" (***Respondent 3***)

"*That's how SMMEs, and for me, by the way, it's painful because as I say, I develop them like this particular company, this one I didn't even have to develop them. It's much more painful when I develop someone to get to that point, right, of being ready to supply Organisation X and then when they supposed to go to a Organisation X now, eh, procurement processes don't know.* " (***Respondent 4***)

"*Another challenge, um, that we've also started to realise is, getting the entrepreneurs out of the incubators and into global supply chains or, private sector supply chains because, remember, an incubator is just as good as its ability to exit an entrepreneur into a market segment. So, what we've seen is that many, many private sector firms are not sometimes too keen to stow work on entrepreneurs in incubators*" (***Respondent 6***)

" *So, and that's another thing that we're slowly realising that maybe performance, ja, they can give performance and grow and say, and look at research obviously because research in a lot of cases and maybe not in Africa so much but does show like if the entrepreneur is growing, they are likely to run their businesses better and this will result in, honestly, either revenue growth or sustainability of the enterprise. But the BDS providers sometimes don't have a direct link, um, to the revenue unless they hand over them, put them at the corporate and help them get business, you know, which very few of them do.* " (***Respondent 7***)

4.2.5.3 Auditor Challenges

Figure 4.16 shows that major challenge expressed by Auditors was in regards to Data. This was worth exploring since policies and recommendations in the space rely on the data available for analysis.

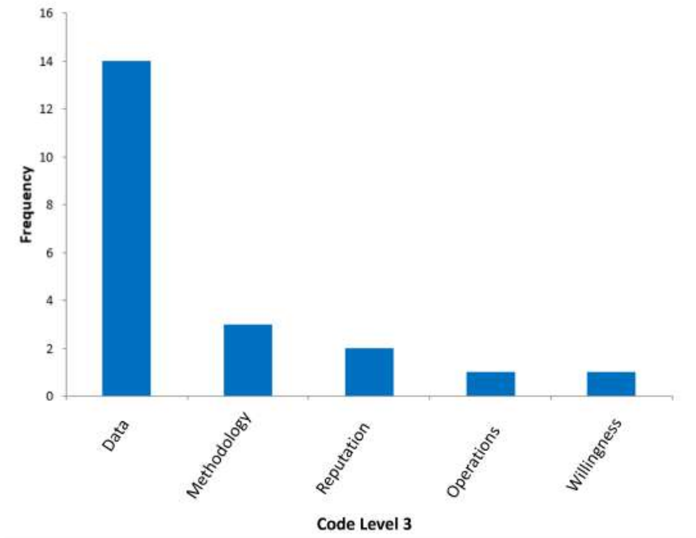


Figure 4.16: Challenges expressed by Incubator Auditors

The major challenge in data pertained its collection. Missing documentation, restrictive implementation of policies as well as general access to SMME information made it difficult for auditors to collect data for useful insights into the space especially post incubation.

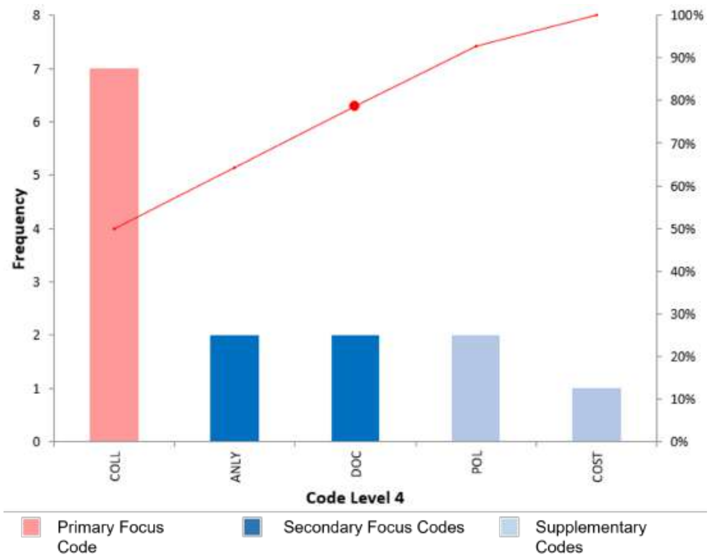


Figure 4.17: Challenges in Data

Table 4.9: Sub Codes used for Data Challenges facing Incubation Auditors

Number	Descriptive Label	Code
C	**Challenges**	
C-AUDITOR	***Challenges Facing Auditors***	
	Data Challenges	
C-AUDITOR-DATA(1)	Data Collection	C-AUDITOR-DATA-COLL
C-AUDITOR-DATA(2)	Data Analysis	C-AUDITOR-DATA-ANLY
C-AUDITOR-DATA(3)	Data Documentation	C-AUDITOR-DATA-DOC
C-AUDITOR-DATA(4)	Policies around Data	C-AUDITOR-DATA-POL
C-AUDITOR-DATA(5)	Costs of Collecting and Analysing Data	C-AUDITOR-DATA-COST

"*We tried to work with one X in the North West and like we worked with, for example, the provincial head quarter but then there are, I think, 15 to 20 other incubator offices and that's where the data was and they needed to get 15 people to agree and share data but even then it's like, okay, maybe let's, we need to go to the entrepreneurs and get permission from them to share their data with us so, I think, in addition to it, it's a strenuous thing with POPI you trying to get data. I think in that project that might have been the case because we needed to get to the entrepreneurs to agree to that before we could start.*" (***Respondent 7***)

4.2.5.4 Systemic Challenges

Figure 4.18 shows that Culture was the most frequently stated systemic challenge. Culture in this context meant the general ideas and social behaviour of various stakeholders within the system. It is worth pointing out that these included corporate culture and SMME attitudes towards incubation.

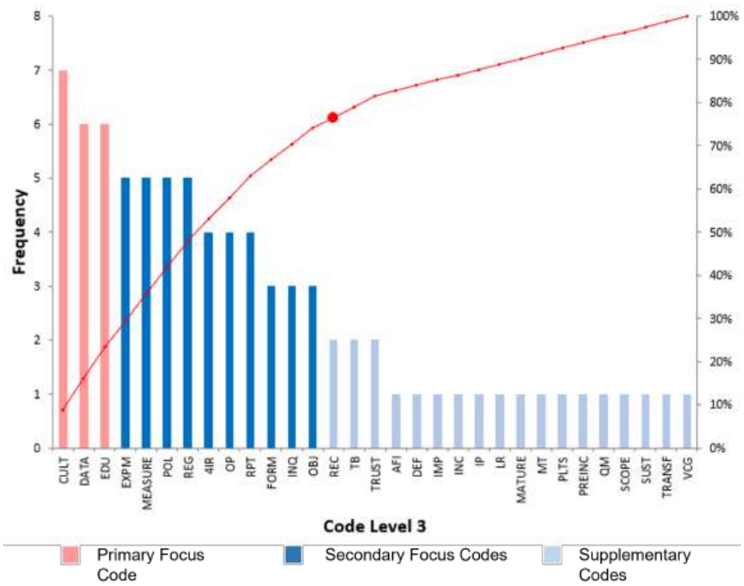


Figure 4.18: Challenges experienced generally in the Incubation space

Table 4.10: Codes used for Challenges Facing Incubation System

Number	**Descriptive Label**	**Code**
C	**Challenges**	
C-S	***Challenges Facing Incubation System***	
C-S(1)	National Culture	C-S-CULT
C-S(2)	Data collection and Analysis	C-S-DATA
C-S(3)	Education	C-S-EDU
C-S(4)	Impact Measurement	C-S-MEASURE
C-S(5)	Policies	C-S-POL
C-S(6)	Regualtions in Incubation	C-S-REG
C-S(7)	4IR Adoption	C-S-4IR
C-S(8)	Incubator Operations	C-S-OP
C-S(9)	Incubator Reporting	C-S-RPT
C-S(10)	Formalisation of SMMEs	C-S-FORM
C-S(11)	National Inequality	C-S-INQ
C-S(12)	Defintion of objectives of incubation	C-S-OBJ

In their study on key success factors, Buys and Mbewana [45] determined that culture was not to be considered a success factor since the space was still in its early stages. Culture being brought up as a challenge could be an indication of a level of growth and maturity in the space and could potentially now be used as a success factor should it be correctly addressed. Respondent 6 was the biggest advocate of this issue.

"*But I think it's a cultural issue, my own view. It's not a Organisation X view, it's my view it's a cultural issue, it's how we've been respect to big firms in South Africa and, uh, we have marginalised smaller firms to the periphery, uh, and in the main we pay a lot of lip service to supporting small businesses and start ups*" (***Respondent 6***)

"*I think it's a broader problem challenge that we have in South Africa, it's nothing to do with the incubators, more to do with corporate not having the appetite to really work with a small firm*" (***Respondent 6***)

4.2.6 Emergent

It was interesting to note that incentives was a frequent emergent theme as seen in Figure 4.19. Incentives as a subtheme was explored from multiple perspectives with different respondents highlighting different view points such as from the perspective of SMMEs, BIs and corporate South Africa. Each perspective had its own incentive and corresponding response.

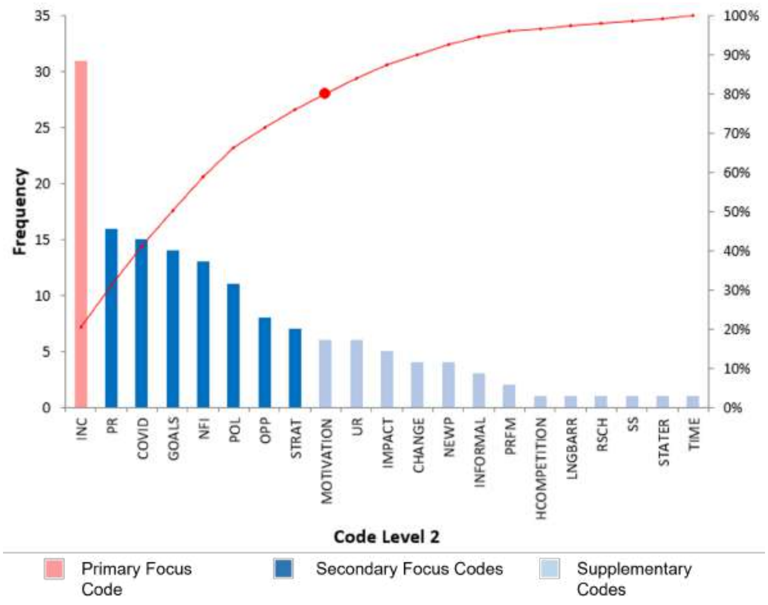


Figure 4.19: Emergent Themes in the study

Table 4.11: Codes used for Emergent Themes

Number	Descriptive Label	Code
E	**Emergent Themes**	
E(01)	Incentives in Incubation	E-INC
E(02)	Personal Reflections of Respondents	E-PR
E(03)	Covid Influences	E-COVID
E(04)	Divergent Goals	E-GOALS
E(05)	Need for Incubation	E-NFI
E(06)	Unintended consequences of Policies	E-POL
E(07)	Opportunities	E-OPP
E(08)	Strategies in Business Incubation	E-STRAT

"*So then there's also this question of, if these entrepreneurs were not incentivised by the idea of incubator and multiple rounds of funding and all of that, which companies, um, kind of forced to give as a result of, um, enterprise and supply of development, would they have been entrepreneurs in the first place and are they suited to be entrepreneurs?* " (***Respondent 1***)

"*The BDS providers want continued business from the corporates and because of that, um, the level of self reporting that we've seen that puts them at a place where they do put themselves or make themselves look good*" (***Respondent 7***)

"*I think there's, there's still a big trust deficit in South Africa in particular between, uh, corporate South Africa and Government and Government support of incubators but I think the same is even in private incubators, if you look at private incubators that are linked to corporates normally those incubators are just seen as, ESD score, point scoring initiatives with no real value to the entrepreneur that is there.*" (***Respondent 6***)

"*For a long period of time corporates would rather do things themselves and not use smaller businesses into the supply chain to do certain things for them which they, which cost them maybe much more money where incubatees or graduates or a small firm is, like I said, is more agile to supply or to provide more and better value for that.* " (***Respondent 6***)

4.2.7 Outcomes of Round 1 Processing

The key findings of the first round of processing were as follows:

- Based on Figure 4.5, incubators defined themselves mostly through the service offerings they provide to SMME beneficiaries. Most incubators offer ideation and business training as their primary service offering. Other offerings include product development and patenting services but these are not offered by all business incubators.
- Identified challenges facing incubators in Figure 4.14 and Figure 4.15 were consistent to what was detailed in previous research and literature and were primarily around their operations. The biggest challenge expressed in their operations was pertaining the incubation pipeline.
- As respondents detailed the success factors and challenges of incubators highlighted in subsubsection 4.2.4.2 and subsubsection 4.2.5.2 they often gave detail of the operational processes of incubation. This would be used as a leverage point in the development of the preliminary incubation map.

4.2.7.1 Root Definition and CATWOE in the Incubation Space

From responses obtained in the research and the notion that incubators primarily define themselves by their service offering, the root definition of an incubator was defined as below;

"*An Incubator (Virtual, Digital or public) is an entity that develops training programs that address challenges experienced by SMMEs and entrepreneurs*"

The CATWOE of the incubation space based on the results is detailed in Table 4.12

Table 4.12: Defining CATWOE for the Incubation Space (Author's own description)

	Mnemonic	Description	Incubation Context	Rationale
C	**Customers**	The individual(s) who receive the output from the transformation	-Entrepreneurs -SMMEs	From the data collected as well as literature, SMME and Entrepreneurs are considered the beneficiaries of incubation
A	**Actors**	Those individuals who would DO the activities of the transformation if the system were made real	-BDS practitioners, -Incubators	BDS providers and incubators execute the incubation service
T	**Transformation**	The purposeful activity expressed as a transformation of input to output	-SMME/Entrepreneur incubation	The incubation process shows the transformation of a struggling SMME/entrepreneur into one with a better likelihood of survival
W	**Worldview**	The big picture and wider impact of the transformed system or process	Incubation goals	The various incubation goals be they ESD or ESG goals were explained to encompass the larger purpose of incubation
O	**Owners**	The wider system decision maker who is concerned with the performance of the system	-Incubator Funders, -Government agencies	The key decision makers in the incubation space determined from the data were the incubator funding and governance bodies
E	**Environmental Constraints**	The key constrains outside the system boundary that are significant to the system	-Government policies -Procurement processes	Government rules and policies particularly ESD, BBBEE and POPIA policies as well as procurement processes seemed to predominantly dictate the operations of business incubation

4.2.7.2 Preliminary Mapping

In subsection 2.1.2, incubators are mostly seen to operate based on a linear approach with the process being modelled as shown in Figure 4.20.

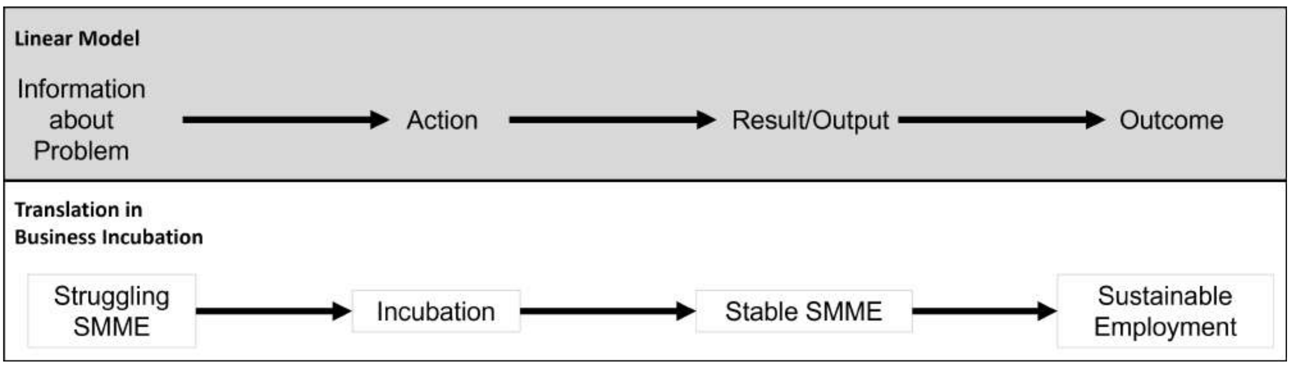


Figure 4.20: Incubation through the perspective of a linear model [149]

Essentially what is expected of the incubator space is a cohesive flow, with struggling SMMEs and entrepreneurs being the input resulting in stable SMMEs as the output, with the outcome of sustainable employment in society. The South African Handbook on incubation took into account feedback from the process and identified a more circular model of incubation as seen in Figure 4.21 [149].

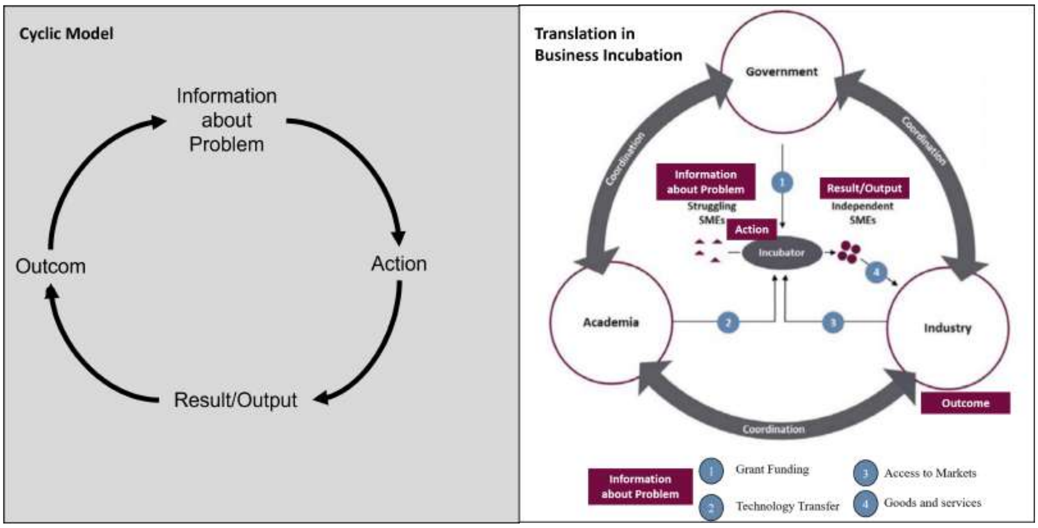


Figure 4.21: Incubation through the perspective of the cyclic model [149]

The literature review showed that there is very limited research especially within South Africa as to process of incubation i.e "How" they actually go about executing their roles. Lalkaka [29] subsection 2.1.2 took a more external approach and defined the different parties and stakeholders involved in the incubation process. This was the closest model/map found detailing the actual process of incubation taking into account both internal and external factors.

The shortcomings of these models and maps on incubation was that they only detailed the "What" of the incubation processes i.e its components. These maps and models have led to research questioning the component ("What") and the purpose ("Why") of incubation with research such as; Investigating the role of Business Incubators [35] [150], Investigating the benefits of Business Incubators [151], Investigating and comparing the effect of sector specific business incubators versus mixed sector business incubators in improving SMME performance [1], Investigating the key success factors of business incubation [45], Discovering the current challenges of business incubators [20].

From literature and responses from the Respondents, insights to the complex space incubators operate and how they operate was obtained as shown in Figure 4.38.This map not only showed the parties and stakeholders in the incubation space but also highlighted what they actually do and how they influence the incubation process (shown through different colours in the key). Literature mostly gave the components of the diagram while the respondents detailed the value flow in the space as well as additional components not identified in literature.

The model consists of elements (incubation space stakeholders), their interactions (value flows) and types of their relationships (provision or reception).

- ***Elements*** – these are mainly key stakeholders of the ecosystem. These stakeholders interact between each other via value flows. Demand and supply is what connects the system. For instance, government needs to improve economic development of the region and create local jobs. With this aim it provide policy infrastructure, grants and financial support. Universities on the on hand receive the same grants from the governments, but also produce inventions and technologies. They seek incubator's support in technology commercialization.
- ***Processes (or value flows)*** – the various inputs and outputs were brought together in the incubation space through the provision of value-adding services to other stakeholders. 7 types of value flow were distinguished: resources (mainly physical resources), financial capital, knowledge (tangible and intangible), branding, innovation, culture and policy. These are elaborated in section A.4. Arrows from elements show that element provides the value flow while arrows into elements show that element receives value flow.

Preliminary Map

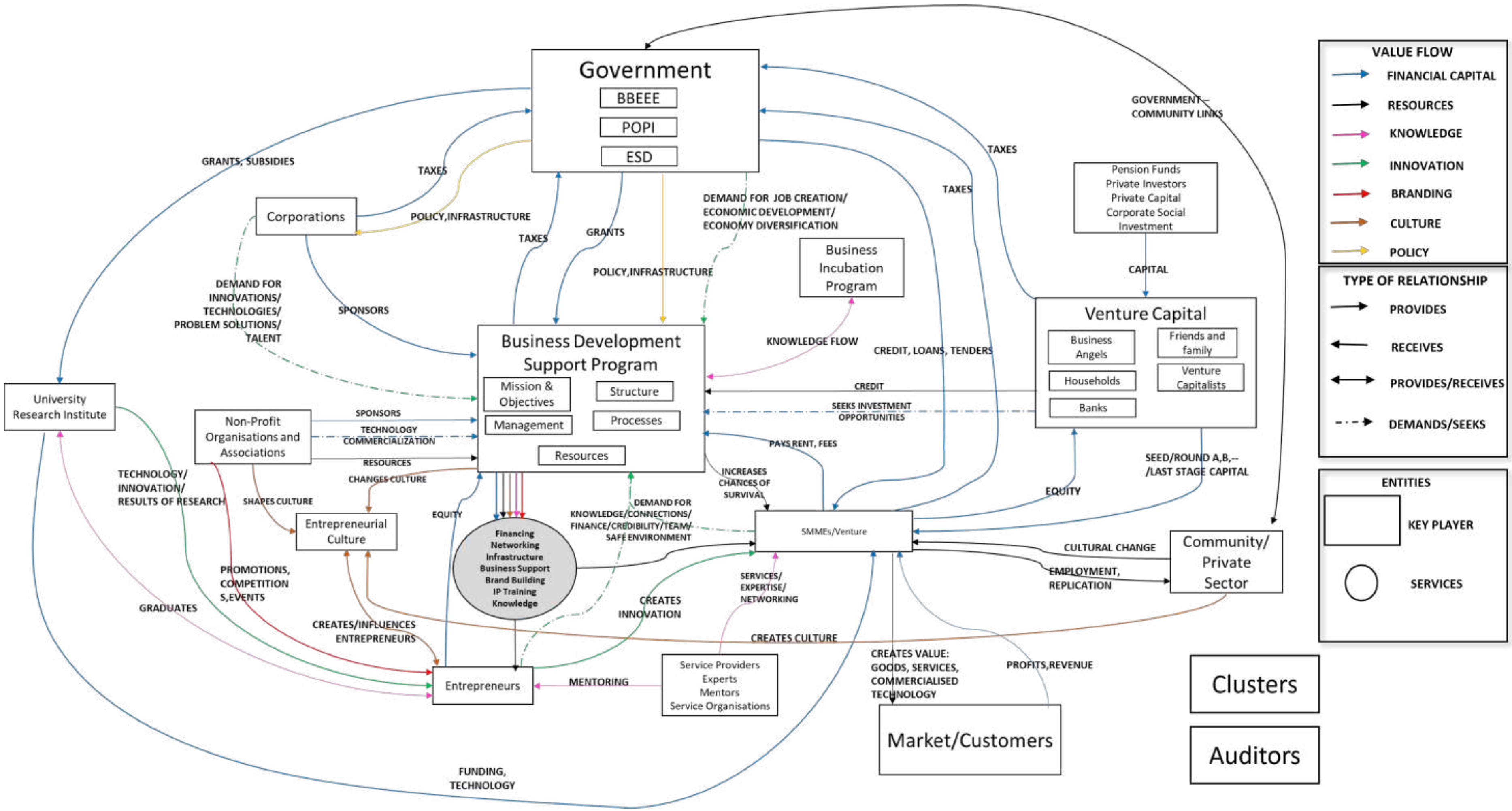


Figure 4.22: Preliminary Map of the Incubation Space from respondents and readings [41],[5]

4.3 Round 2 Processing

The outcomes, insights and descriptions in section 4.2; the root definition, CATWOE and preliminary map, formed the basis for the second round of interviews (Refer to section 3.2.1.1). The flow of this section is described in Figure 4.23 below detailing the inputs, result presentation and the expected outcomes after processing;

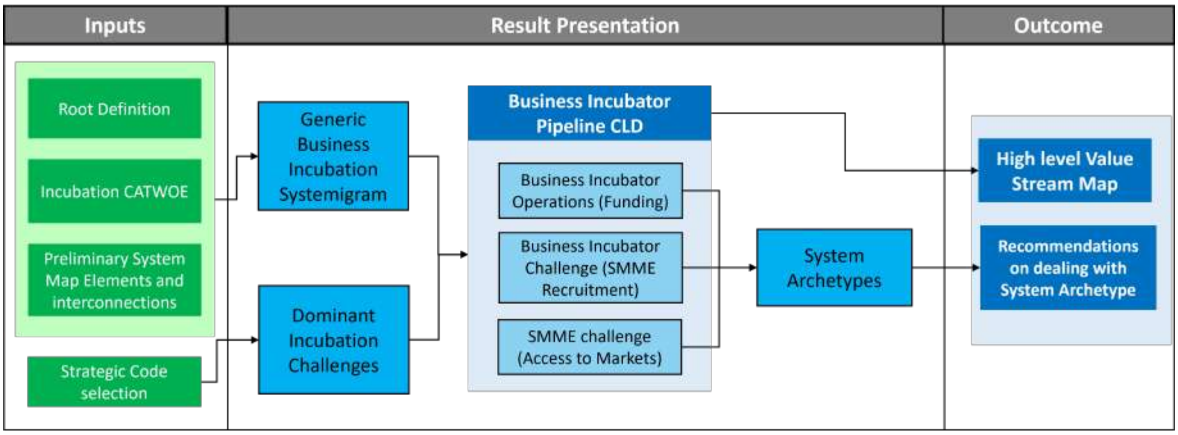


Figure 4.23: Inputs,analysis process and outputs of Round 2 Processing

Through these interviews with respondents, the incubation systemigram was developed and validated. The systemigram was developed from the view point of the operations of a single incubator rather than the entire incubator space. The data obtained in Business Incubator Challenges (subsubsection 4.2.5.2) helped in determining the operations of incubators particularly their pipeline of beneficiaries in and out of incubation as the main focus area. By combining insights from the systemigram as well as content analysis results on pipeline, the business incubator flow CLD was developed. Introspection and critical review of the model led to the identification of critical aspects of the process flow. These were; Incubator recruitment, absorption into the value chain post incubation and funding within the incubation space. These aspects were then fitted into system archetypes to help analyse their behaviour. The outcomes of round 2 processing were the development of a Value Stream Map (VSM) from the business incubator flow CLD and the identification of recommendations from literature on how to address the system archetypes identified in the flow.

4.3.1 Systemigram Mapping

The systemigram was to be used in order to understand and map the status quo of incubator operations. The root definition described in subsection 4.2.7 was used as the mainstay of the systemigram and from it branched other aspects of the systemigram namely operations, identity and governance, Funding Goals and Reporting and Government.

4.3.1.1 Root Definition: The Role of Business Incubators

The role of incubators was described as developing training (which entails either Skills Development, Enterprise Development or Supplier Development) to address expected SMME challenges faced by SMME beneficiaries and arranged as shown in Figure 4.24.

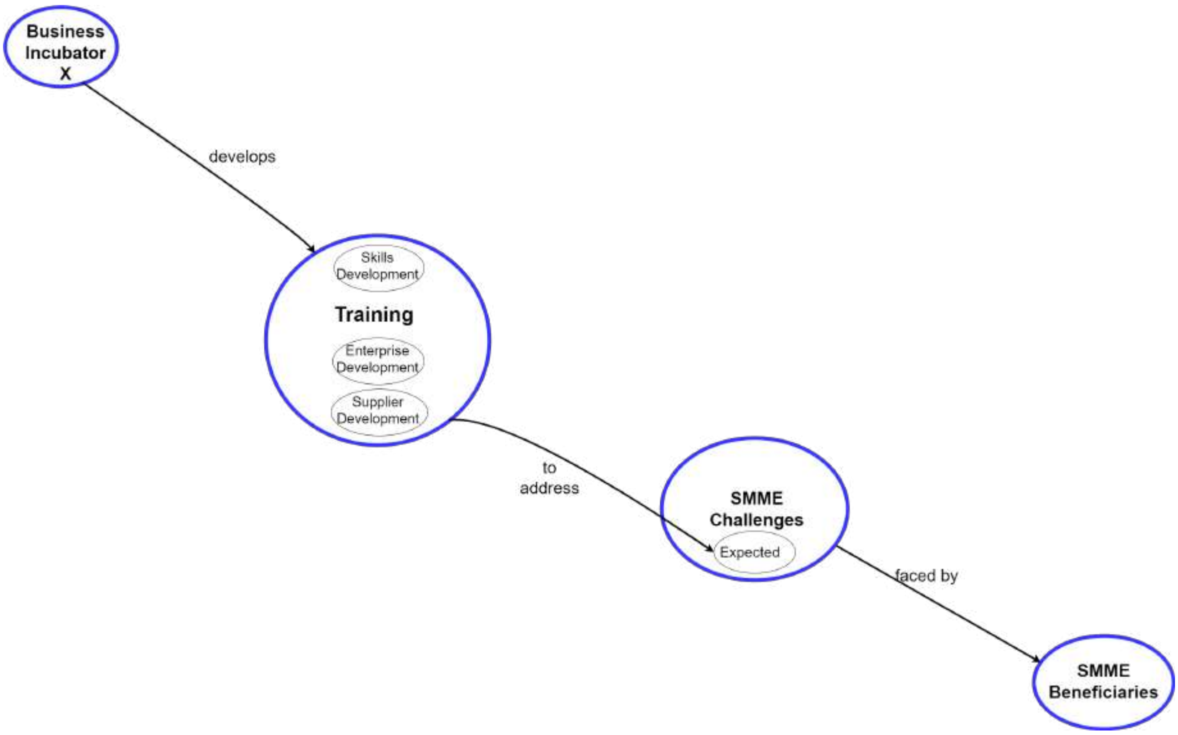


Figure 4.24: The role of Business Incubators

- ***Skill Development*** - the process of identifying beneficiary's skill gaps and ensuring the development of these skills. Skills identified include the ability to develop and execute business plans as well as product development and marketing.
- ***Enterprise Development*** - the process of investing time and capital to help beneficiaries establish, expand or improve business. Enterprise development focuses more on helping beneficiaries earn a living or find a way out of poverty, leading to long-term economic growth for themselves, their families and their communities [152].

- ***Supplier Development*** - the process of ensuring beneficiaries work with targeted suppliers on a one-to-one basis to improve their performance for the benefit of the buying organisation, leading to improvements in the total added value from the supplier in question in terms of B-BBEE rating, product or service offering [152].

It should be noted that term "*expected challenges*" was deliberately used and included the ideation of business ideas, seeking funding and operational business challenges experienced by beneficiaries.

4.3.1.2 Operations

The operations of incubators takes the mainstay of the role of incubators and expands on it by describing the marketing of incubators and their offerings as well as the unexpected challenges experienced SMMEs bring to them. These can be seen in Figure 4.25 through the two statement ;

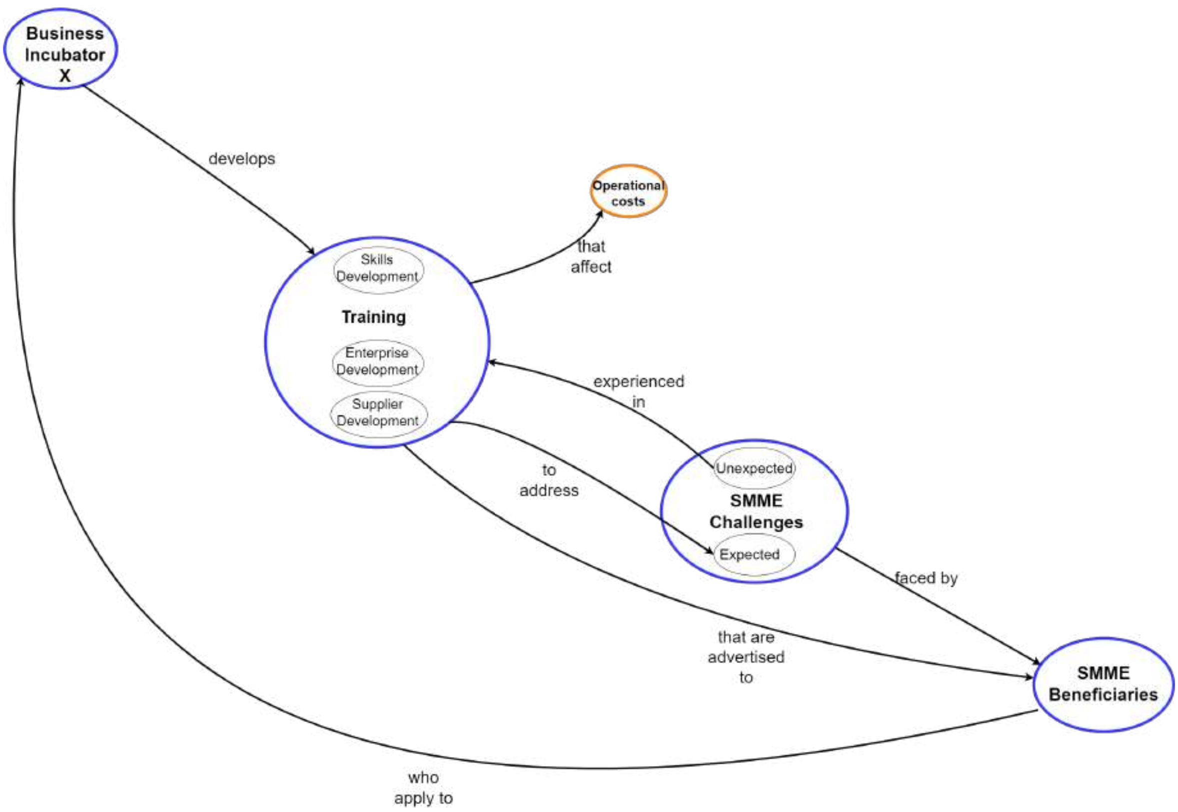


Figure 4.25: The operations of Business Incubators

- ***Marketing and Recruitment:*** Business Incubator X develops Training that is advertised to SMME beneficiaries who apply to Business Incubator X

- ***Unexpected Challenges:*** Unexpected SMME challenges experienced in Training affect operational costs of Business Incubator X

Unexpected challenges raised by respondents included the English and computer proficiency of some of the beneficiaries, child support for women beneficiaries, food provision as well as security and transport of beneficiaries to and from training programmes.

"*Some people actually come early because they want to get the biscuits that we put out because they haven't had a meal that day, you know? So we need to cater for meals during the day, um, we need to cater for transport, we need to take into account the fact that we can't give homework a lot of the time because some people just don't have data at home or they don't, some people don't have a laptop.*" ***(Respondent 1)***

"*Okay, I can actually get you some stats, because, what we try to do, we looked at areas like, English, just understanding English you'll find that that's an issue so we looked at like English proficiency.*" ***(Respondent 2)***

4.3.1.3 Identity and Governance

It is worth pointing out that the identity of the incubators i.e whether digital, virtual or public tied in more with their governance rather than their role or operations.

- ***Digital Incubator:*** an incubator that supports digital ventures at every stage of their business, ensuring desirable and feasible technology, as well as viable business models with sound operations.
- ***Virtual Incubator:*** incubators focused on providing a process for developing early stage ideas into viable ventures and products. They offer formal and informal learning opportunities and connect entrepreneurs to an ecosystem of related services.
- ***Public Incubator:*** incubators started by the government and run on public funding.

Governance was defined as the system by which incubator activities were directed and controlled and was concerned with structure and internal processes for decision making, accountability, control and behaviour at the top of incubators [153]. Ownership of the incubator whether by a university, corporate or the DSBD described the governance structure of the incubator. This is expressed in Figure 4.26.

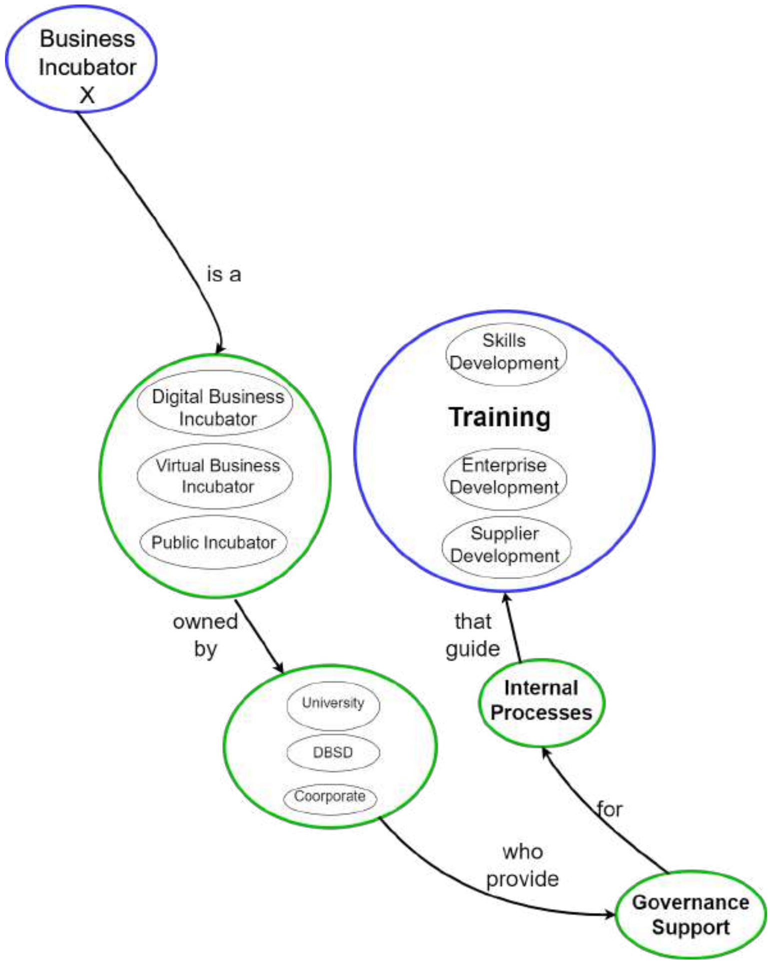


Figure 4.26: Identity and Governance within Business Incubators

4.3.1.4 Funding: Goals and Reporting

It should be made clear that funding in this regard refers to funding of the BIs and their activities. While incubators may follow a separate governance structure as shown in Figure 4.26, they report to funders who; depending on whether they are local or international funders, either follow Enterprise Supplier Development (ESD) goals or Environmental Sustainable Goals (ESG) respectively.

- ***ESD*** - set of affirmative action and local content development measures aimed at promoting economic transformation (See subsubsection 4.3.1.1)
- ***ESG*** - International goals focused on the Environmental, Social and Governance non-financial factors and are more humanitarian in nature.

These goals are used to establish beneficiary entry criteria into the incubators. Entry criteria can be very multifaceted but the two main determinants from respondents were operational costs and the goals of the funders. Available funding attracts incubators and this effect coupled with the reporting structure of incubators form incentives as described in subsection 4.2.6

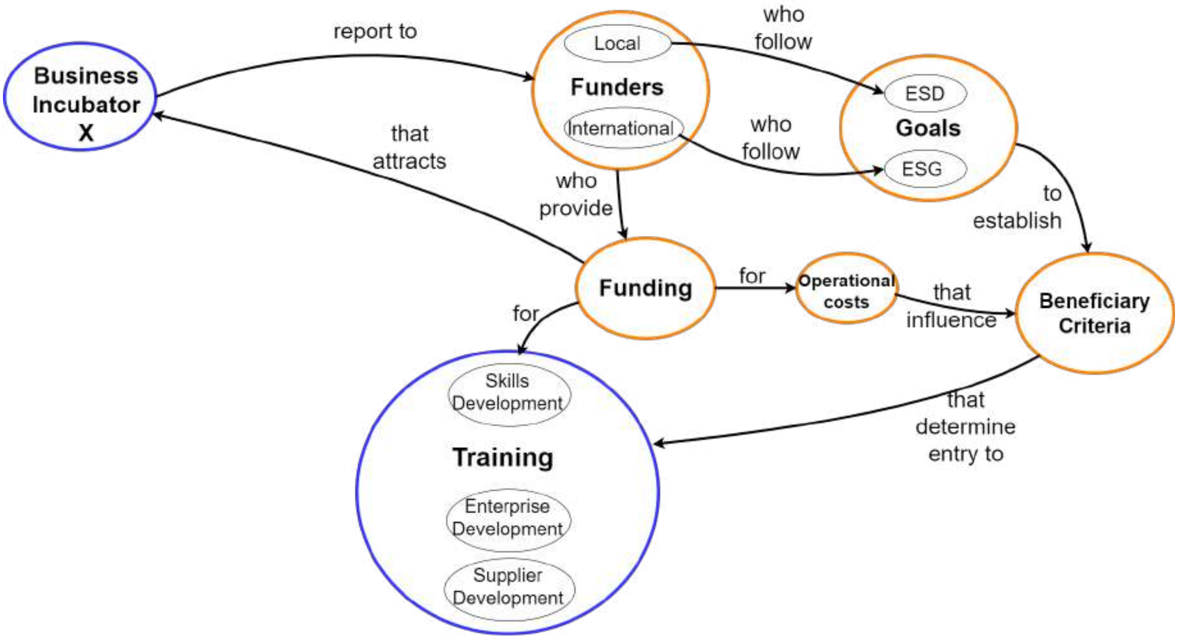


Figure 4.27: Funding within Business Incubation

4.3.1.5 Government

Government's role within the BI space was seen more as a policy developer. The policies developed are then used to either determine ESD goals, emphasize their use in the beneficiary criteria or directly help SMME beneficiaries through affirmative action and protection of personal information. The major policies described by respondents were Broad-based Black Economic Empowerment (BBEEE) and Protection of Personal Information Act (POPIA).

- ***BBEEE:*** a policy aimed at reconciling South Africans and address the inequalities of apartheid by attempting to integrate black people in the workspace and support black businesses [154].
- ***POPIA:*** a policy created to promote the protection of personal information processed by public and private bodies [155]

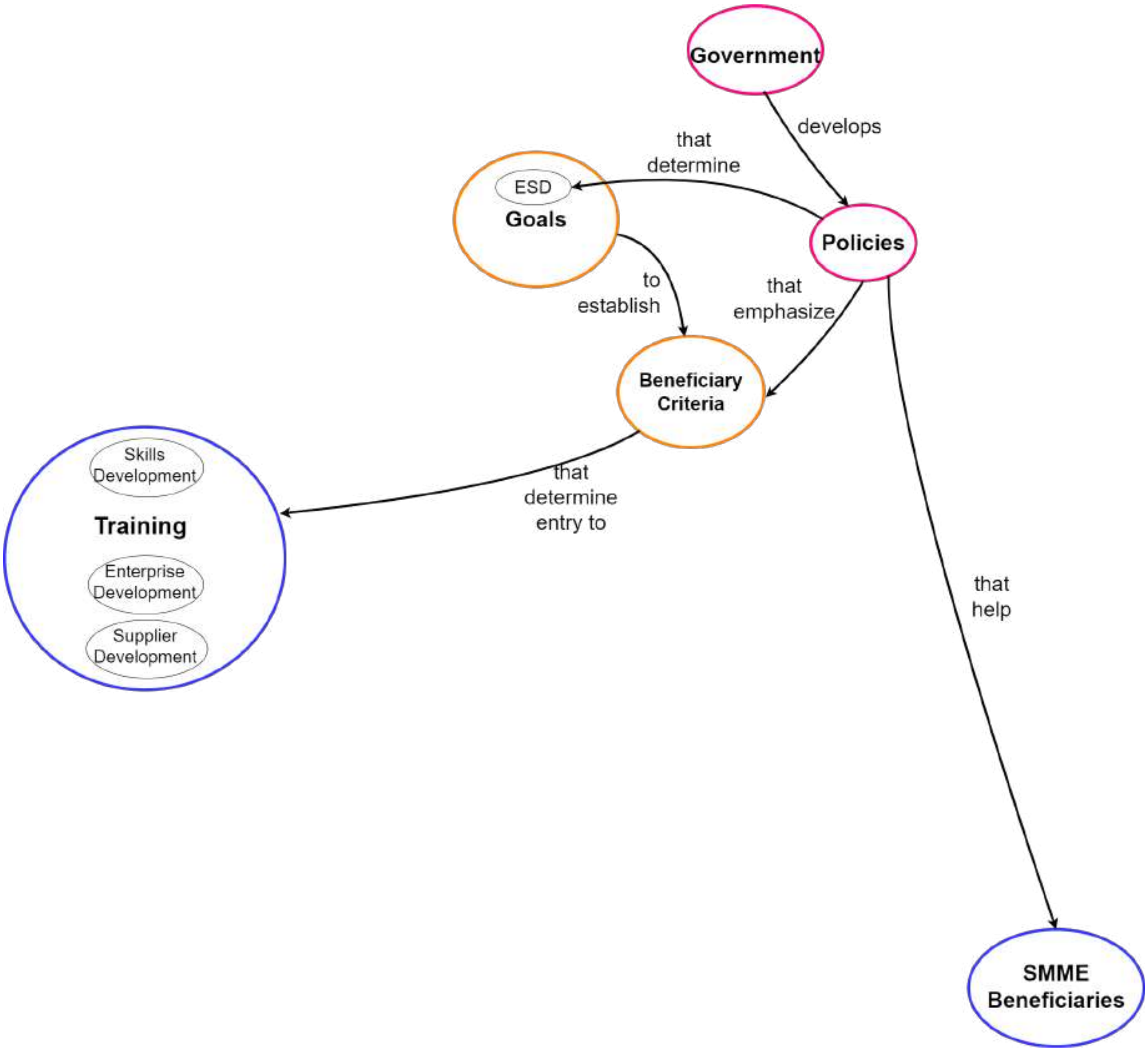


Figure 4.28: Influence of government on Business Incubators

4.3.1.6 The complete systemigram

The systemigram in Figure 4.29 was created to be as generic as possible so that it could form the story of most Incubators in the country. The established rules and principles detailed in section 3.2.1.2 were used to develop the systemigram.

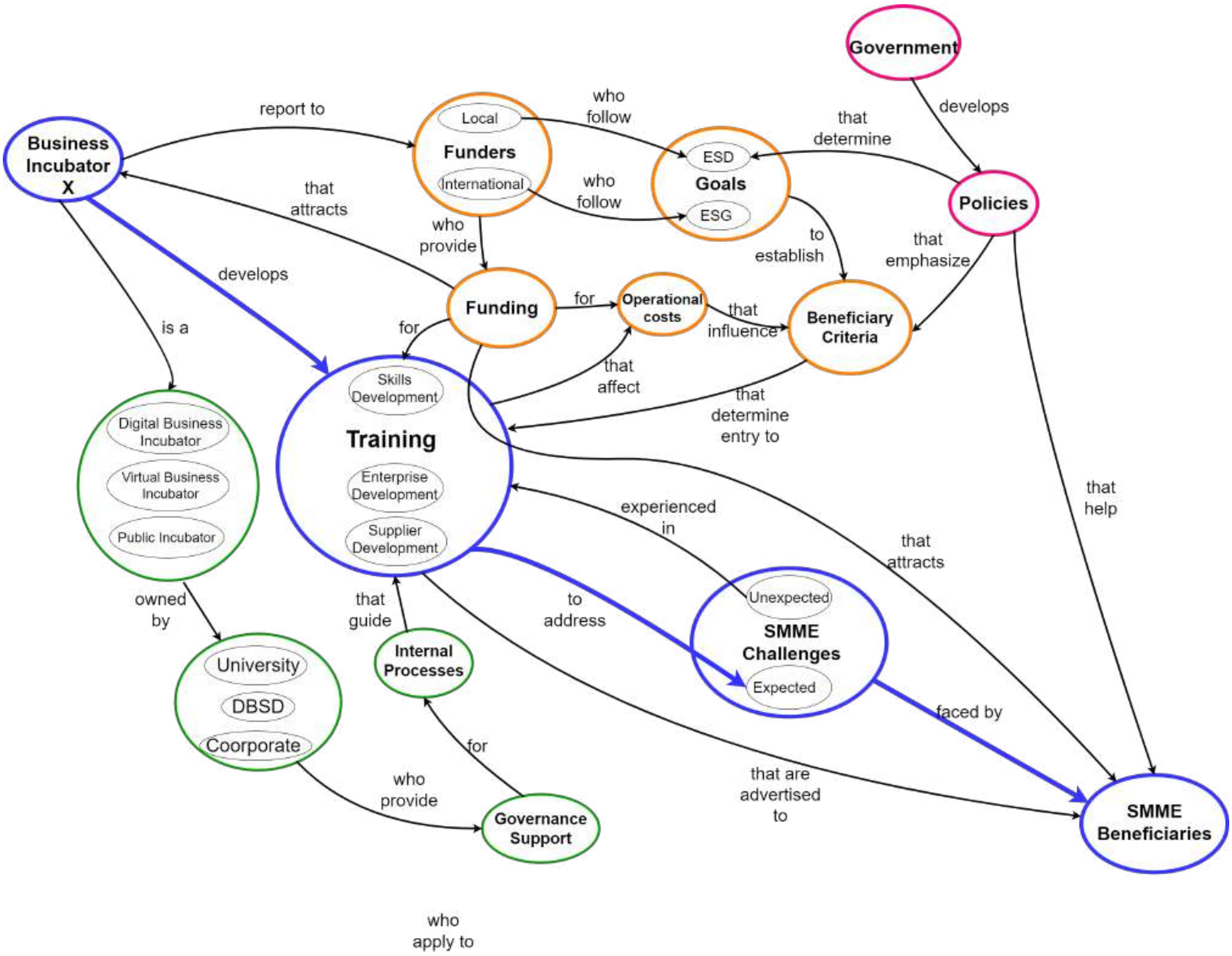


Figure 4.29: Translating the BI space into a Systemigram

The role of incubators as obtained from the root definition was used for the mainstay of the system story, shown from the top left hand bubble, ***Business Incubator X***, across the diagram down to the lower right hand bubble, ***SMME beneficiaries***. The remainder of the diagram was fashioned from the operations, funding goals and identity and governance of incubators as well as government's influence on them as detailed in the sections above. These stories were governed by the themes and subthemes highlighted and defined in section 4.2 and give a clearer picture on how incubators operate.

4.3.2 Causal Loop Diagrams

By combining insights from the systemigram on how an incubator operates as well as content analysis results on pipeline, the business incubator flow CLD was developed. The systemigram and this CLD are linked in that the systemigram describes the system while the CLD shows the actual complex flow through the system.

4.3.2.1 Flow in the incubation process

Flow particularly in the case of pipeline is used to describe progress toward a long-term goal that involves a series of discrete stages. In the case of developed model in Figure 4.30, it is the progression of beneficiaries from recruitment through to their exit.

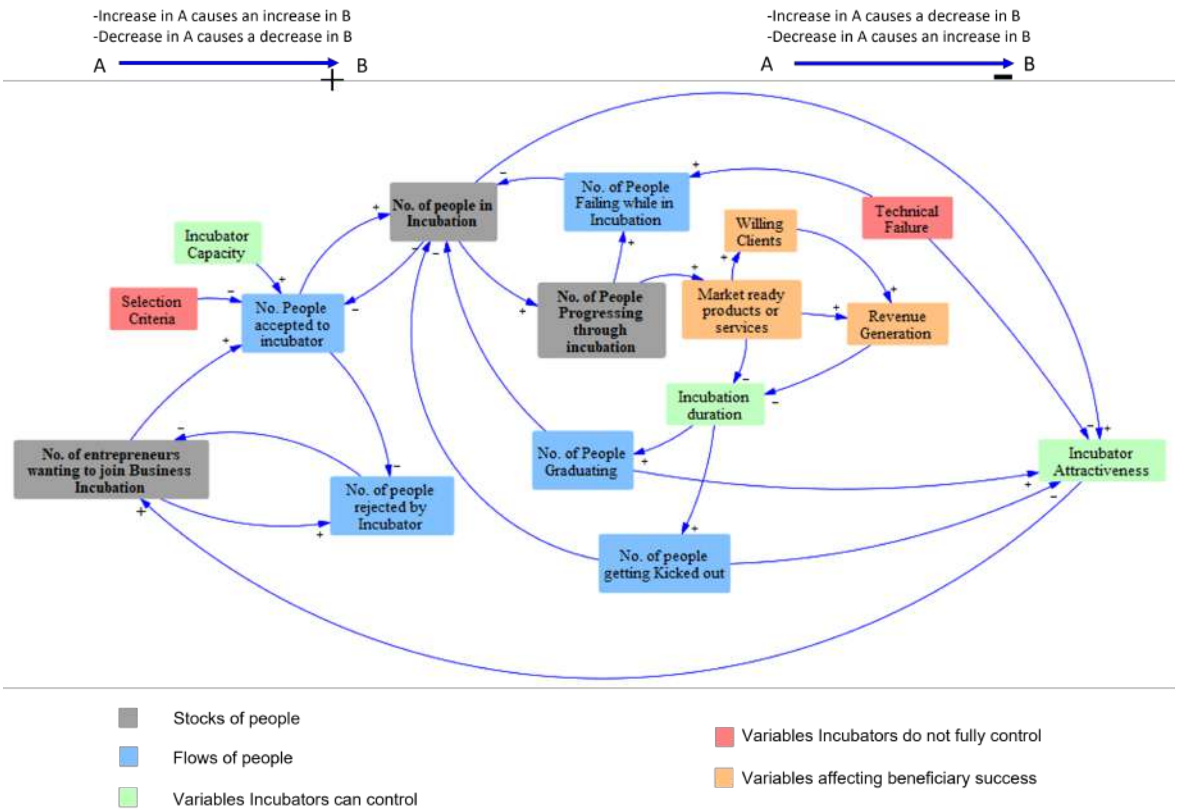


Figure 4.30: The CLD of the flow in the incubation process

Factors such as funding were not considered in this model as it solely focused on the movement on people through incubation. The issues which Respondents described can arise through three lenses; the intake, the outlets and the appetite of incubation.

The intake process in the developed CLD sees the flow of people wanting to join incubation into the number of people within incubation; these two variables can be though of as stocks.

The flow of people is represented by the number of people who either get accepted or rejected by the the incubator and is governed by selection criteria and the incubator's capacity. Issues arising from the intake primarily revolve around the selection criteria and the incubator's capacity.

The outlet process in the CLD starts from the number of people within incubation through to the number of people progressing through the incubation process. The flow of people out of incubation can take three forms;

- ***Graduation:*** This is when a beneficiary either successfully develops a business idea that is ready for market or completes the training offered by the BI programme.
- ***Failing while in Incubation:*** This occurs when a beneficiary experiences technical failure within incubation and cannot complete the programme. Technical failure is described as people dropping out of the programme because of personal constraints such as financial and time constraints or their business idea not being feasible.
- ***Getting kicked out:*** This occurs when a beneficiary takes a very long time in incubation. Their idea may or may not be successful when this occurs.

Issues arising in the outlet phase of incubation raised by respondents revolved around the incubation duration and technical failure. It is worth pointing out that failing while in incubation is influenced by technical failure while graduation and getting kicked out are influenced by incubation duration. Incubation duration is in turn influenced by market ready products and services, willing clients and their revenue generation.

"*So, um, we had a programme where we had an extremely high drop-off rate but this was because the, the criteria set for the beneficiaries was essentially, um, entrepreneurs who, any, any beneficiary who has a household income of less than, I think it was something like R2000 a month*" ***(Respondent 1)***

"*It will be issues of comfort also from the entrepreneur's perspective. It would be issues of entrepreneurs not even taking their businesses to market because in an incubation hub they only, they can only help you to a certain point but for you to sell the business you need to go out in the street. So the comfort of being in an incubation hub, sitting there nicely on your table and drinking coffee it's a cool idea, you know? It's cool, come see me at my office, right? So a lot of people get stuck staying in that situation. I mean, looking at, uh, it's a similar thing to go back to varsity and you'd ask yourself, why are political student leaders always in varsity, you know? So it's the same thing, you know? The mere fact that one gets to enjoy the benefits of being a leader in a student organisation, it traps them to not* *think of the outside world and that's exactly what happens in incubation hubs and I think, wrong mentality that we've taken, especially South Africans, where we are too comfortable in uncomfortable situations.*" ***(Respondent 3)***

Of note is that respondents pointed out that even though they might get a successful graduate, they viewed their assimilation into strong value chains as their success and that procurement processes should be explored.

"*The biggest company is only 1 that is making over fity million rand or it has a turnover of R50,000,000, per annum When they came to us it was like how can we help you because you, I mean, 50, eh, 50M turnover to me it sounds like you're okay! And then I went into their facility, I saw their facility, world class facility, and then it was like, "Well, the unfortunate part is as you can see, our facility is not busy, right? We've got only one client. The 50M that we make is from one client and our facility most of the time they sit and idle, right? So I'm coming to you to say, I don't want to see my facility sitting and idle. I cannot even run them for 8 hour, an 8 hour shift. With an 8 hour shift half the time they are sitting. So I want to utilise this 8 hour shift, I want to open another shift and another shift. Imagine how much money I can make if I can do that. So I'm a black owned, eh, maybe we are not that well-known out there but we are making electronics, eh, for companies in Switzerland that's why we can make so much money, right?" So a company like that it was like, oh, all the skills are there but people just don't know us. After doing the assessment I was like but you've got a strong marketing team, you've got this, you've got that but the same company I was like, okay, but at the same time you can supply Organisation X. Why are you not supplying Organisation X, right? And that's when you also realise that it's not, you know, as much as Organisation X can come and complain that we don't have black, eh, companies, you realise that even where they are it's not easy for them to just enter into Organisation X.Because in a Organisation X they will have a procurement process that must be followed every single time when they need to source products and services. Often small companies like that they just get eliminated by the procurement processes. Simple as that.*" ***(Respondent 4)***

The final aspect of CLD is in the "appetite" for incubation i.e the pull of beneficiaries into incubation and this is vital process. The major variable here is the the incubator's attractiveness. In this model, incubator attractiveness was looked at from the perspective of the beneficiaries and is influenced by the number of people within incubation, technical failures within incubation, the number of graduates and the number of people getting kicked out. Incubator attractiveness may potentially be the driver of all the other issues concerning incubator pipeline.

4.3.2.2 Key findings from the Incubation flow CLD

Figure 4.30 represents the final CLD diagram developed. Its development was as a result of iterative modelling with inputs and validation from respondents' second round interviews and literature within the space [5] [16] [24].Taking the final CLD and overlaying it with the challenges incubators faced identified in round one processing (See subsubsection 4.2.5.2), the areas highlighted in Figure 4.31 were determined to require further understanding of their underlying behaviour since most challenges clustered around them;

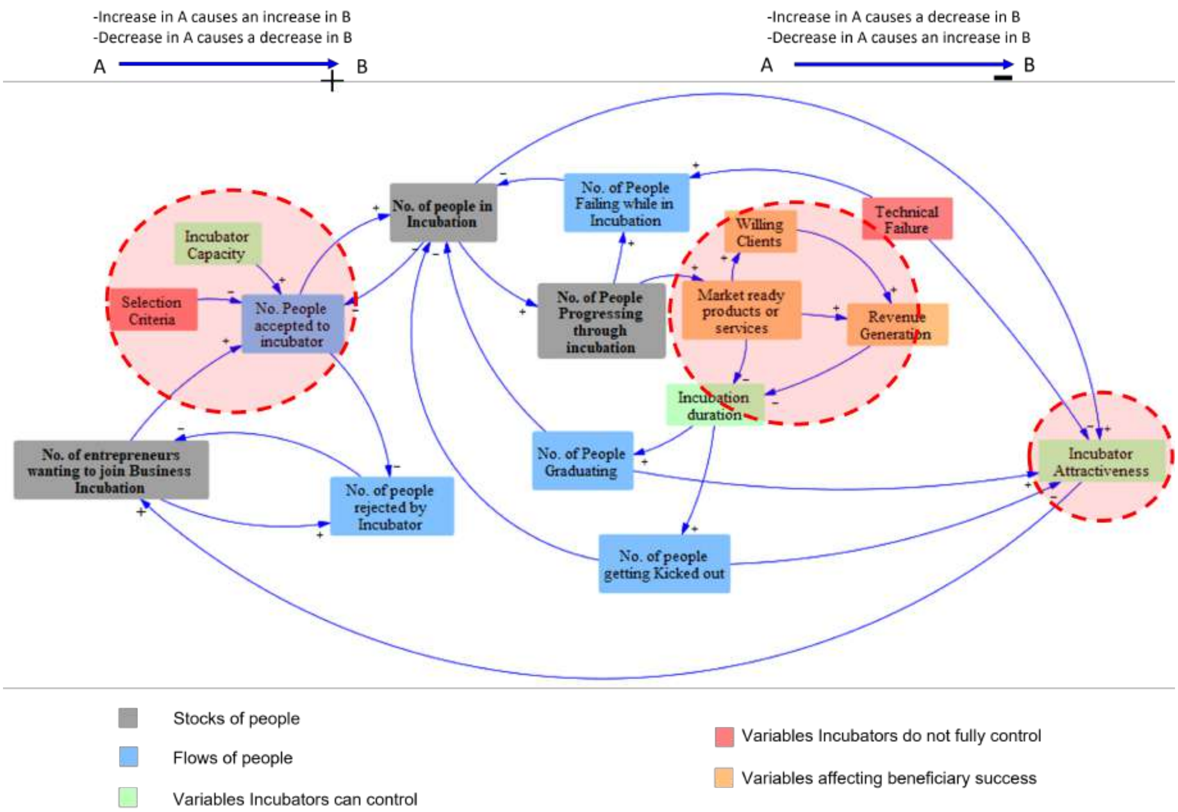


Figure 4.31: Areas of concern in the CLD of the flow in the incubation process

Broadly categorised, these areas were;

- The intake recruitment of beneficiaries
- The assimilation into value chains of graduated beneficiaries
- The true drive for incubator attractiveness

These areas were further elaborated below.

The intake recruitment of beneficiaries

Figure 4.31 shows two key variables in the recruitment of entrepreneurs and SMMEs into incubators (No. of people accepted into incubation); selection criteria and the incubator's capacity. From both rounds of interviews, it was noted that incubator capacity was not a current key challenge as it was scarcely mentioned. The selection criteria however was. Incubators were finding it difficult to source what they deemed as quality entrepreneurs. It was noted that incubators tend to select beneficiaries who are more likely to succeed in any case;

"*So sometimes like you do get entrepreneurs that are selected because they were going to succeed in any case, and my portfolio is dependent, right? So that's the other either the case for measurement or against it because when you start comparing and benchmarking then, then people are like, why are we taking entrepreneurs who, like who need to work hard for them to succeed because, ai, this one is higher risk so let's take the ones that are likely to succeed in any case and then we can attribute their success to ourselves and the truth is maybe it's not.*" (***Respondent 7***)

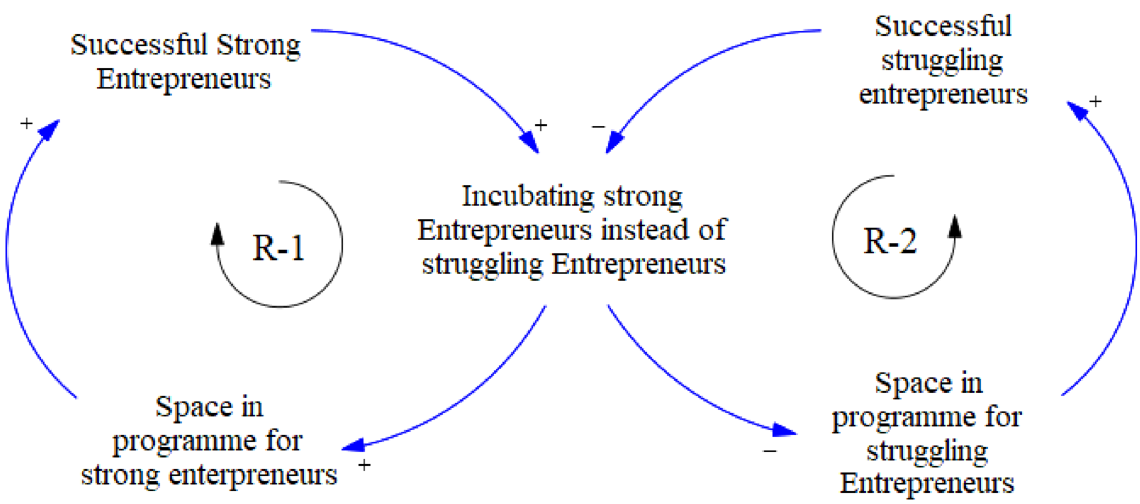


Figure 4.32: CLD of the SMME Recruitment Process

The recruitment process of incubators can thus be described using the "Success to the successful" archetype as shown in Figure 4.32. This archetype shows competition for resources between two groups, in this case two SMMEs. SMME A, the group that starts out as more successful, is rewarded with more resources and becomes even more successful. SMME B, the group that is less successful to begin with, gets trapped in a downward spiral.

On one hand, this behavioural loop is what has led to questioning the effectiveness and true impact of incubation in terms of assisting struggling SMMEs;

"*So what then also happens is that, um, the impact from that you can argue that these entrepreneurs because they're, I mean, they were on their way to do great things anyways, whatever impact stems from that, um, is not real impact, it's probably correlation, you know? That's the downside of that.*" (***Respondent 1***)

While on the other hand, not being selective in recruiting successful SMMEs has meant not getting quality entrepreneurs out of incubation;

"*As you can imagine, what you put into the programme will, directly correlates to what you get out, right? Like Harvard graduates the best of the best because they take the best of the best right now there are so many incubators so we're competing for, um, for lack of a better word, quality entrepreneurs so that's a very big struggle.*" (***Respondent 1***)

The assimilation into value chains of graduated beneficiaries

One of the challenges explicitly mentioned by respondents was the absorption of incubated SMMEs into core value chains.

"*For a long period of time corporates would rather do things themselves and not use smaller businesses into the supply chain to do certain things for them which they, which cost them maybe much more money where incubatees or graduates or a small firm is, like I said, is more agile to supply or to provide more and better value for that.*" (***Respondent 6***)

Figure 4.31 shows that 3 variables are necessary in order for an incubatee to be deemed successful; Market ready product, willing clients and revenue generation. While incubators may ensure the achievement of these three aspects, the stumbling block then becomes the procurement processes.

"*Because in a Organisation X they will have a procurement process that must be followed every single time when they need to source products and services. Often small companies like that they just get eliminated by the procurement processes. Simple as that.*" (***Respondent 4***)

Procurement involves every activity involved in obtaining the goods and services a company needs to support its daily operations, including sourcing, negotiating terms, purchasing items, receiving and inspecting goods as necessary and keeping records of all the steps in the process [156]. The core objectives of procurement being [157];

- Value for money (efficiency) in the acquisition of required goods, works or services

- Integrity – avoiding corruption and conflict of interest
- Accountability
- Equal opportunities and treatment for providers

In South Africa, procurement is of particular significance in the public sector and has been used as a policy tool due to the discriminatory and unfair practices of the past [158]

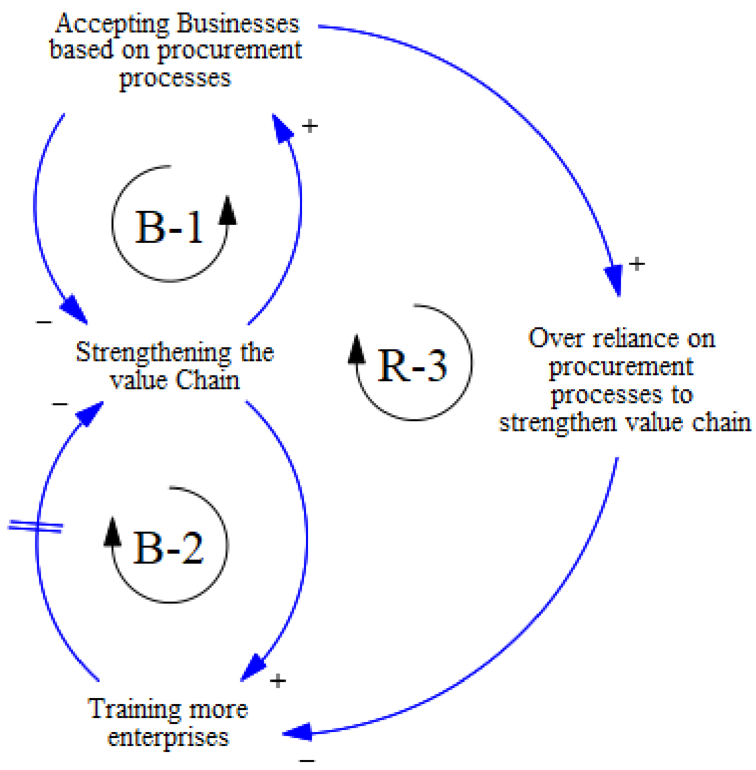


Figure 4.33: CLD of the Procurement Process inhibition on SMMEs

The behaviour shown by the Procurement processes in Figure 4.33 is akin to the "Shifting Burden" archetype. This system archetype usually starts with a problem symptom that requires almost urgent attention, in this case strengthening of the integrity of value chain in industries. The solution that is most obvious and easy to implement usually relieves the problem symptom quickly; this is the reliance on procurement processes to ensure quality in the value chain. However the symptomatic solution has a long-term side effect that diverts attention away from the more fundamental solution to the problem which in this case is training more quality driven enterprises.

4.3.2.3 The true drive for incubator attractiveness

One of the key drivers of the incubation space identified in Figure 4.31 was incubator attractiveness. The CLD shows that attractiveness is driven by the number of beneficiaries within incubation (whether successful or unsuccessful) and drives the number of people wanting to join incubation. Figure 4.27 provides a different perspective on the importance of incubator attractiveness which is it attracts funding for the incubation which helps the operations of the incubator. It can thus be inferred that the primary incentive which drives incubator attractiveness which in turn drives flow through the incubator is the funding available. It is worth noting that among the challenges identified facing incubators was the issue on funding.

"*Like Harvard graduates the best of the best because they take the best of the best, right now there are so many incubators so we're competing for, um, for lack of a better word, quality entrepreneurs so that's a very big struggle. And then also, you know, we're competing for funding.*" ***Respondent 1***

From the interviews, the current behaviour of incubators was that they act as the individual parties and running their own incubation programmes is their core objective. The common resource they all pull from and what they are competing for is funding available in the space as seen in Figure 4.34. This fits the archetype of the "Tragedy of the Commons".

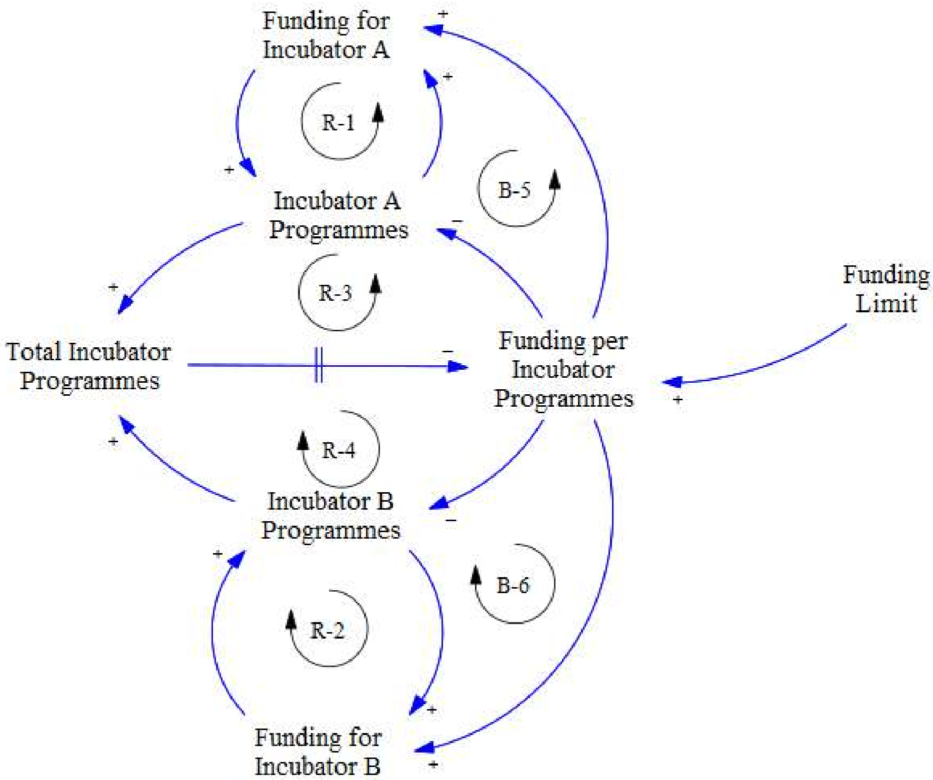


Figure 4.34: CLD of the competition of funding between BIs

The "Tragedy of the Commons" is a complex, multiplayer structure where individual parties focus on their own objectives without concern for the collective impact of everyone's actions [145]. The structure deserves special attention because it represents a "macro" view of a dynamic produced by lots of individual actors at a "micro" level. In this case, Incubators act as the individual parties and running their own incubation programmes is their core objective. The common resource they all pull from is funding available in the space as seen in Figure 4.34.

To detect a "Tragedy of the Commons" situation in action, look for two key factors:

- **A common resource that two or more players have relatively free and equal access to.**

  "*In South Africa because of the Enterprise and Supplier codes, corporates are meant to spend a lot of money on, um, BDS. So most of the corporates have to spend, um, I think, 3 percent of net profit after tax, so it, it was sometimes millions and billions of Rands that it was just compliance based. We need to make sure that we're spending this and a lot of people were just then saying, who's the best BDS provider, a Incubator X, a Incubator Y or Incubator Z, okay, here's money, proposal, give it to me, go support 50 of our entrepreneurs or go, in fact, do what you want to do, just give us a report at the end.*" ***Respondent 7***

- **The absence of any overall oversight or management responsibility of a single governing authority**

  "*It's important with a new industry not to regulate it too strictly to allow for it to kind of grow and develop organically but at the moment, I think, we need some kind of regulator just to step in and maybe say, okay, this is allowed, that's not allowed, um, here we're taking advantage or whatever just because the amount of money that is available in the sector right now*" ***Respondent 1***

These two factors are also supported by the set up of the funding system as highlighted in subsubsection 4.3.1.4. The CLD in Figure 4.34 helps to better understand the funding of incubators which has an impact on their operations (Refer to Figure 4.25).

4.3.3 Outcomes of Round 2 Processing

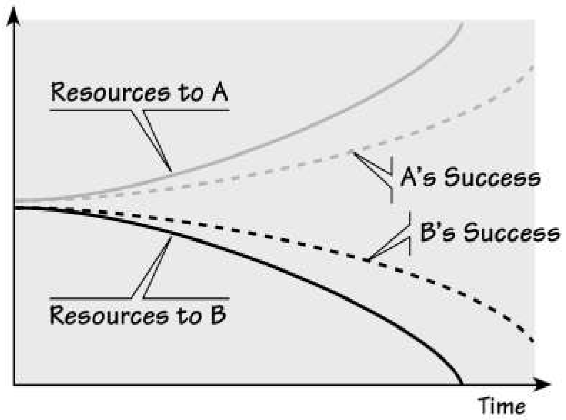
Highlights and key learnings of Round 2 Processing were;

- The development of the systemigram allowed respondents who were focused on a specific aspect of incubation to see the integration of that aspect into the overall direction of the incubator's overall purpose and goal.
- The visual interfaces enabled respondents to synthesize the content more readily, using systemigrams and CLDs as virtual experimental tools to draw links between system objectives that are not specifically stated in the incubator's overall strategy.
- The process led to helpful insights about the institutional structures assumed by incubators, and initiated respondent discussions about how to integrate efforts.

4.3.3.1 Prescriptive measures on managing the behavioural loops

Table 4.13 provides graphical representations of the different system archetypes behaviour and the recommended prescriptive actions to be taken to address them. These were used as guides in developing the final conceptual framework. It should be noted that the graphs presented in the Table 4.13 are a representation of the behaviour the various system archetypes would present and are not obtained from any simulation run of the models.

Table 4.13: System Archetypes Behaviour over time and Action Steps[143], [145], [159]

Behaviour over time graph	**Prescriptive Actions**
 Figure 4.35: Success to the successful graph [145]	***Success to the successful*** [145][159] • Evaluate the current measurement systems to determine if they are set up to favor established practices over other alternatives. • Identify goals or objectives that will refocus the definition of success to a broader system.

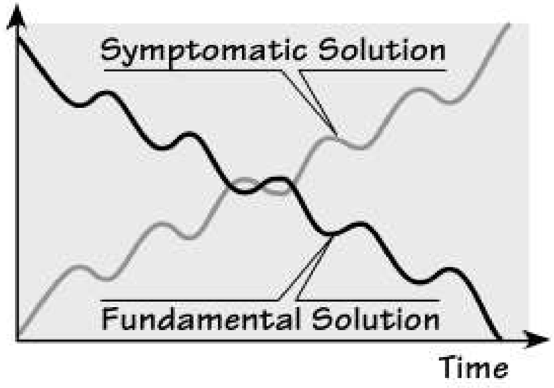
<table>
<tr><th>Behaviour over time graph</th><th>Prescriptive Actions</th></tr>
<tr><td>


Figure 4.36: Shifting the burden graph [145]
</td><td>
Shifting the Burden[145] [159]
Focus on the fundamental solution. If necessary, use the symptomatic solution only to gain time while working on the fundamental solution.
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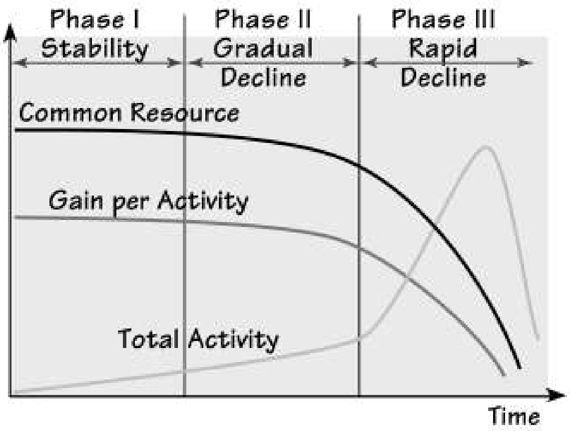

Figure 4.37: Tragedy of the commons graph[145]
</td><td>
Tragedy of the commons [145][159]
Establish methods for making the cumulative effects of using the common resource more real and immediate to the individual players.
</td></tr>
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4.3.3.2 High level Value Stream Map

section 4.2 highlighted the biggest challenge identified in incubator operations as the pipeline of beneficiaries through incubation. In order to address this challenge based on the prescriptive actions detailed in subsubsection 4.3.3.1, it was determined that principles of operations management systems described in section 2.2 were to be employed. A high level Value Stream Map (VSM) was chosen as the appropriate starting tool since it provides a consolidated sequence, flow and timelines of all the activities and operations required for effective service delivery [79] and would help in scoping what would be included the development of the framework that would address the main research objective. Figure 4.38 shows the resulting VSM.

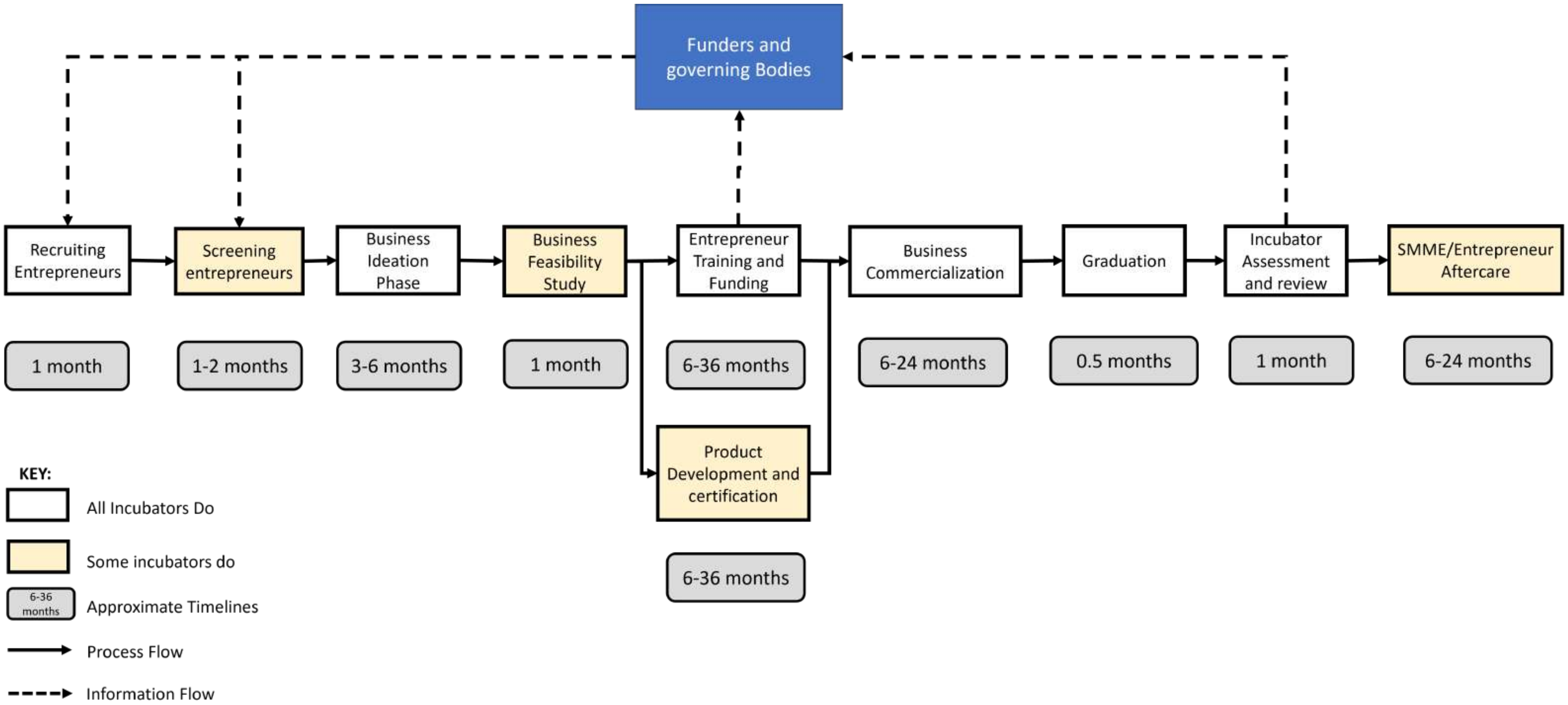

Figure 4.38: High level Value Stream Map of the Incubation process with approximate timelines (Authors own composition [149][160][161])

Chapter 5 Development of the Framework

The main purpose of the chapter is the fulfilment of sub-objective 3 stated in section 1.5; Proposing ways in which operational processes can be improved so that their contribution to their objectives can be assessed. This was done following the steps shown in Figure 5.1

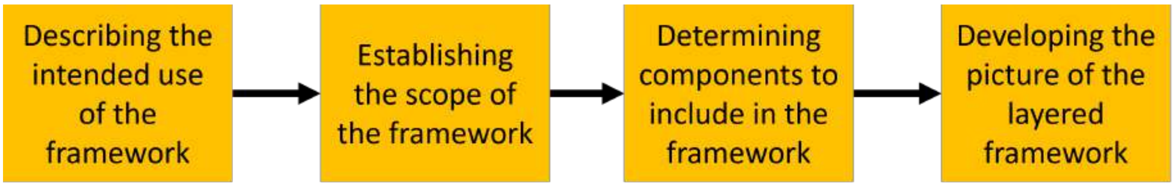

Figure 5.1: From Models to framework

This chapter begins by defining the intended use of the framework following the objectives of the research. The scope of the framework will then be defined using the VSM as a tool for the identification of critical areas of the process that the framework must address. This is followed by the identification of components to include in the framework. Given the challenge is more on the operational processes of incubation, this step will rely on components, concepts and theories identified in section 2.2. The model will finally be linked together in one diagram.

5.1 Describing the intended use of the framework

The main objective of the research stated in section 1.5 is to develop a way to assist Business Incubators improve their operational processes so that their contribution towards their objectives can be assessed. Results from section 4.2 highlighted that incubation pipeline was among the main challenges affecting incubators and section 4.3detailed how this problem became manifest in daily incubator operations. From the analysis, identified critical areas in the process drastically affecting operations are shown in Figure 5.2

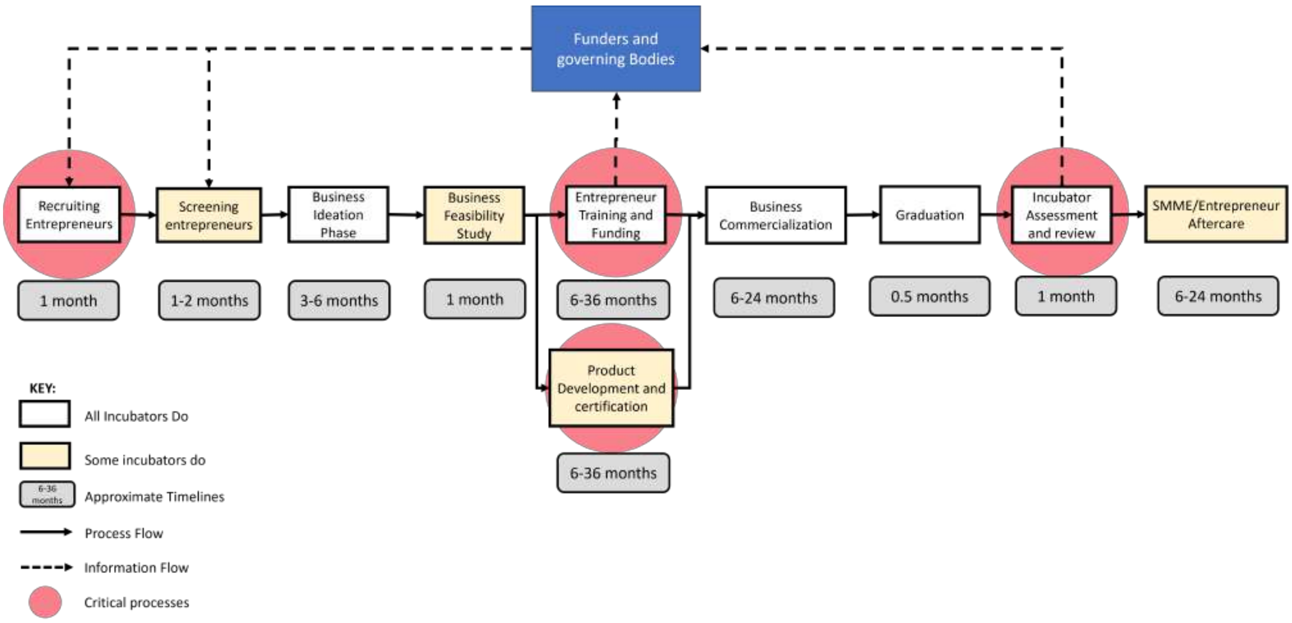

Figure 5.2: Business Incubation Value Stream Map(Authors own composition)

These areas are highlighted since they heavily impact incubator attractiveness. Taking incubator attractiveness from the funder's perspective, rather than looking at the outcome of incubation and basing performance solely on that, a framework to better assess the ongoing operations of the incubator would be more useful. The intended use of the framework is thus to;

- Provide a standard guiding framework that will enable uniform performance measurement of ongoing incubator operations.
- Provide a clear operations framework that will improve incubator pipeline flow

5.2 Scope of the framework

The framework is intended to be used internally by an incubator to manage its operations and help drive performance. Based on the outcomes of data analysis, the framework should primarily target areas highlighted in Figure 5.2.

In Scope

Aspects included in the scope of the framework are;

- Internal training operations of business incubators
- Internal organisational levels of work within incubators

The framework will utilise concepts and theories from Operations Management on the maximising flow ,design principles of 4IR as well as insights obtained from the analysis (See section 2.2, subsection 2.3.2 and chapter 5 respectively).

Out of Scope

Aspects not included in the scope of the framework are;

- The operations of support structures external to the incubators
- The operations of SMME and entrepreneur beneficiaries in incubators

It is also important to note that new principles and theories around Operations Management systems were not introduced or developed. Rather they were leveraged in the development of the framework and applied to the context of Business Incubation.

Risk Mitigation

The biggest risk in the development of the framework was the incorrect use of concepts, theories and principles of Operations Management Systems. This was because key concepts shown in chapter 2 have their roots in manufacturing for industrial process optimization and not necessarily services [162]. In order to avoid misusing these aspects the following measures were taken;

- Drawing from examples of correct use of concepts and theories from literature (See section A.2)
- Using insights and ideas from respondents to better address their service specific problems and characteristics.

5.3 Components included in the framework

The framework utilises the aspects of service processes explained in subsubsection 2.2.1.1 as its foundation and considers their integration to the key five characteristics of the service package detailed in subsection 2.2.1. From this understanding, the following components and terms were identified and used;

- ***Levels of work:*** This is the level of complexity that an individual can effectively function at as defined by Stratified Systems Thinking. It identifies levels of work, differentiated on the basis of complexity and time-span of decision-making [26].
- ***Strategy:*** This is the top-down reflection of what the whole group or business wants to do [25].
- ***Integrated Performance measures:***This is the measure of the intended outputs of the service process that cut across functional areas.
- ***Validation:***This is the structured process of confirming, validating and prioritising planned and adhoc work
- ***Planning:***This is the process of turning a strategic plan into a detailed map that outlines exactly what action the execution team will take on a monthly, weekly, or sometimes even daily, basis [26].
- ***Scheduling:***This is the process of allocating resources and capacity based on the detailed plan to the correct areas[26] [79].
- ***Execution:***This is the delivery of the actual intended work [26]. In the case of incubation, this is the actual training of the SMME and entrepreneur beneficiaries

By breaking down the framework into the fundamental elements that make up a service process, elemental performance measures of the incubation process can be taken. The integration of these components with the elements of operational excellence (see section 2.2.4) will be highlighted in the subsequent sections.

5.4 The layered framework

5.4.1 Strategy and Work Management

Strategy and Work management follow the principle of doing the right work at the right time in the right way to deliver the required performance [79]. Work Management comprises the Validation Planning, Scheduling and Execution of work while strategy is made up of setting targets and goals. For the case of incubators two other elements included were; Recruitment and Performance Review. Performance review in this regard was taken as the monitoring and feedback step undertaken by auditors on the incubators. This is structured as shown in Figure 5.3.

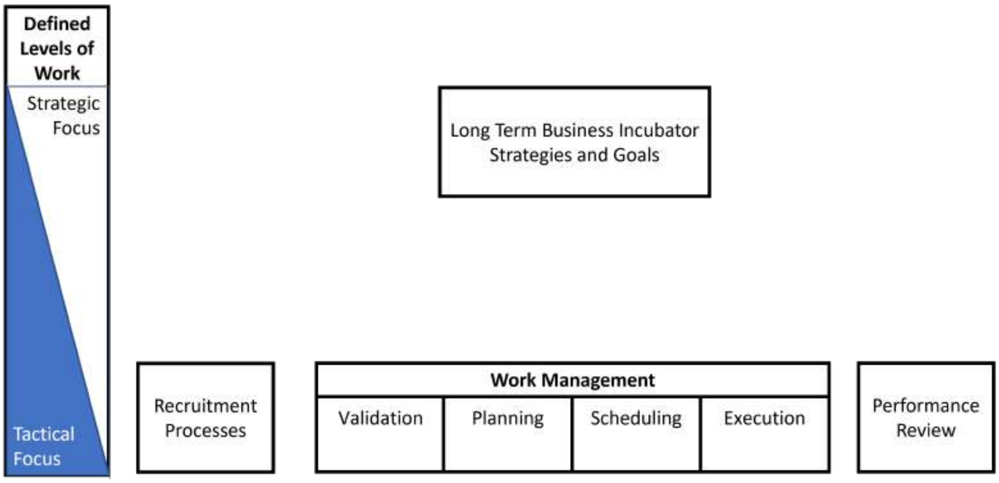

Figure 5.3: Strategy and Work Management elements of the framework

Strategy and work management are inextricably connected with strategy being the over-arching plan to reach an objective and work management being the means of getting there [25].Figure 5.4 shows the difference in terms of strategy and work management .

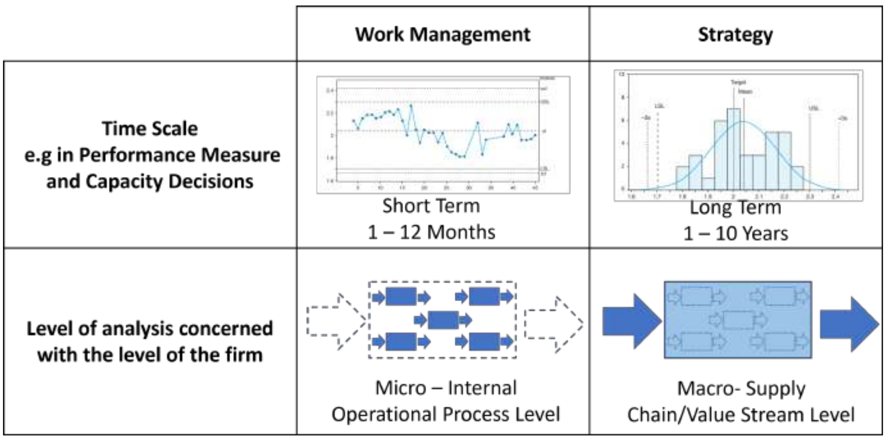

Figure 5.4: Difference between work management and strategy [25]

5.4.2 Defined Levels of work

Stratified Systems Thinking identifies 5 levels of work [25] [78]. Each level has a specific value-adding theme that provides a unique contribution to the stream of work within organisations, and no level is more important than another. Finding the right fit between individuals and work levels is crucial in determining success for both individuals and organisations. Although there are five levels of work identified in Stratified Systems Thinking, they occur within three main organisational domains namely [78]:

- ***Transactional:***Levels 1 and 2 where focus is on adding value for the present. These levels are therefore viewed as action-oriented / execution roles.
- ***Operational:***Levels 3 where themes focus on setting mid-term goals, objectives and directions, and developing the plans, procedures and processes used by the transactional levels.
- ***Strategic:***Levels 4 and 5, where themes focus on long-term strategic functioning and sustained viability of organisations

The transition between the different levels in the incubation space is shown in Figure 5.5.

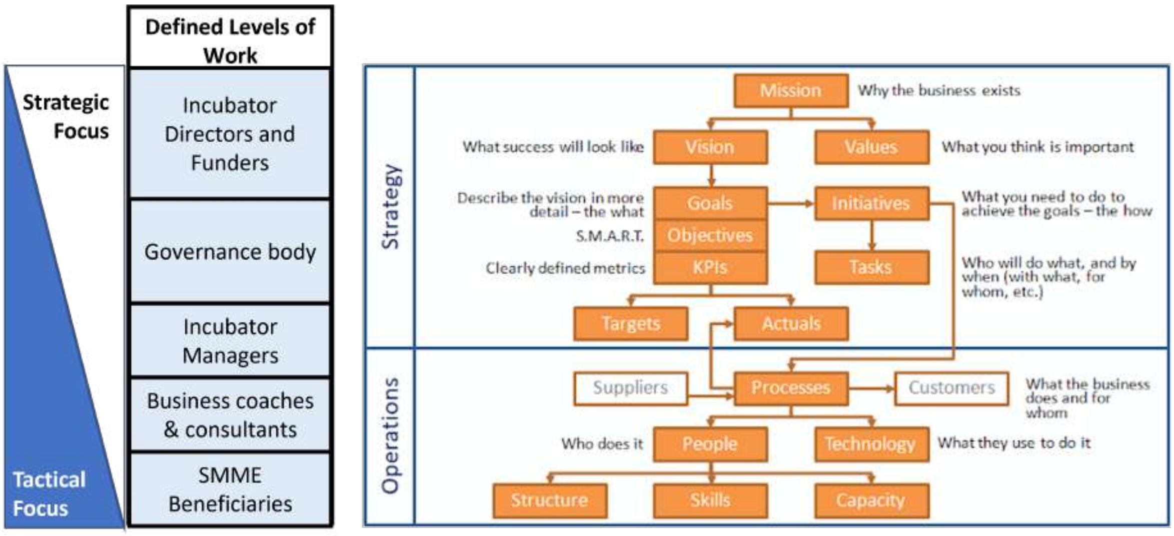

Figure 5.5: Defined levels of work elements of the framework

As seen in Figure 5.5, Incubator directors and funders were categorised as level 5s given their roles are more strategic in nature. SMME beneficiaries were considered level 1s for the framework as their roles in the process are more tactical in nature. The role of incubator managers falls between strategy and operations.

The purpose of this delineation in the levels of work is to establish clear roles and responsibilities from a tactical to a strategic view across incubators. Having clear role definitions aids performance measurement as it dictates accountability enabling each level to be measured according to what it is accountable for [78] [79].

5.4.3 Integrated Performance Measures

Performance measurement is generally defined as regular measurement of outcomes and results, which generates reliable data on the effectiveness and efficiency of programs and is used for setting the direction of improvement [25]. An integrated approach was considered as the approach to performance measurement. It should be noted that what the actual performance measures in incubation should be were not detailed but an approach to their development is suggested.

Figure 5.6 shows the integration of performance measures between strategy and work management.

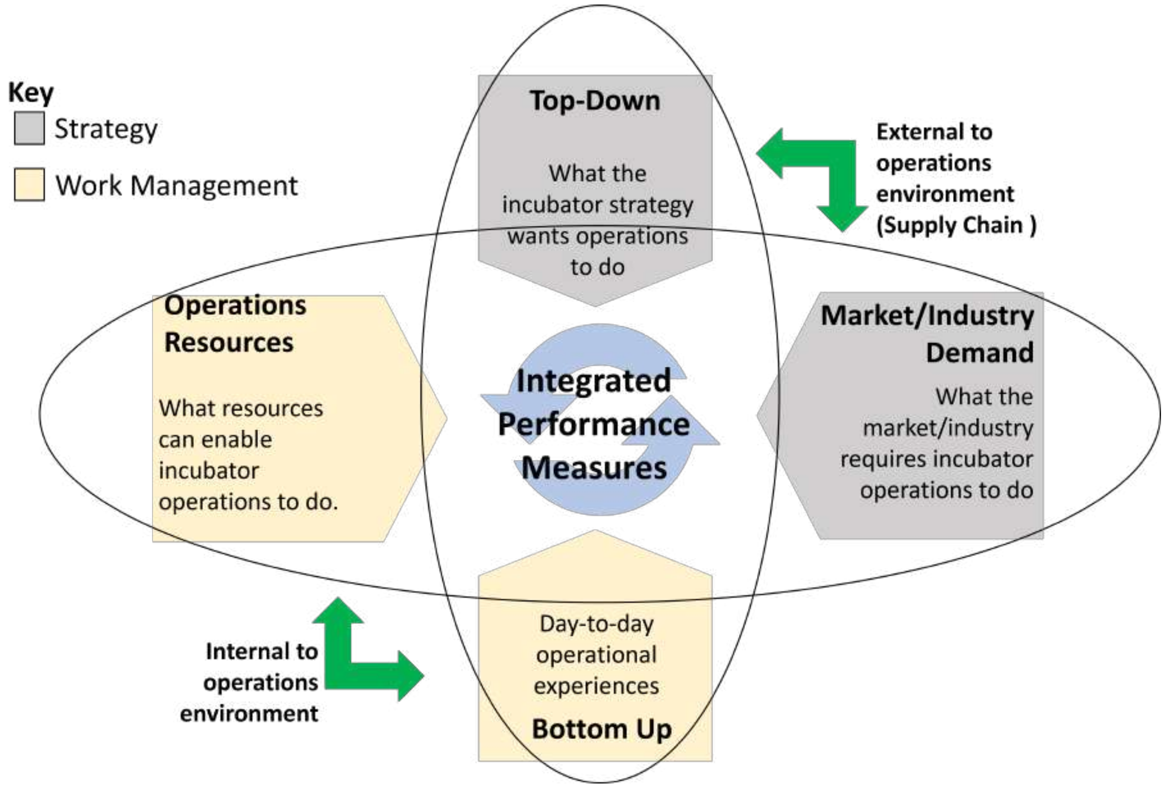

Figure 5.6: How integrated performance measures bridge the gap between strategy and work management (Adapted From Lewis and Slack [25])

From the diagram, integrated performance measures can be seen as being critical to the the link between strategy and work management. Performance measures are also tied to the defined levels of work as shown in Figure 5.7. This approach leverages the strength of the defined roles and accountabilities. By doing so, it answers the latter two questions performance measures should answer.

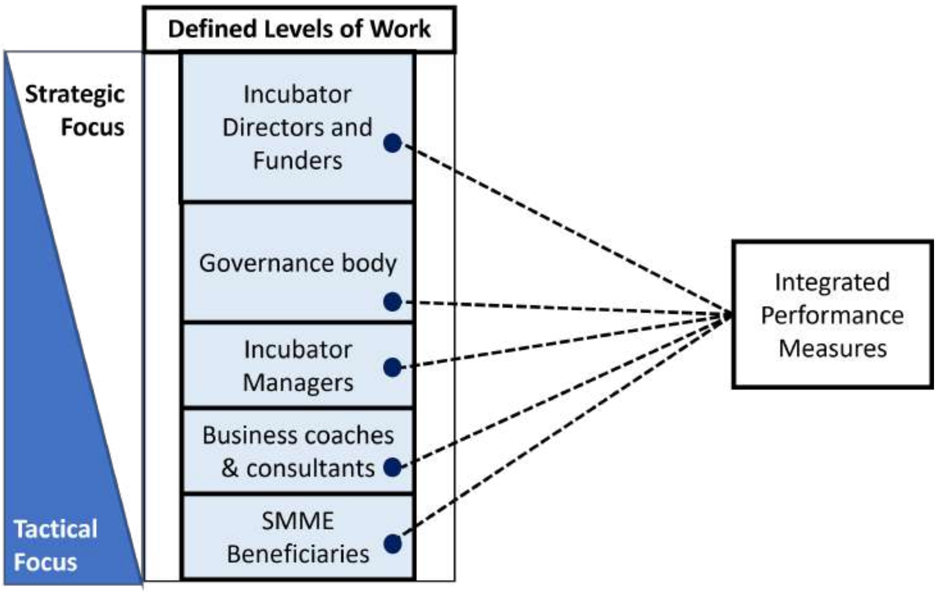

Figure 5.7: How integrated performance interlink with the defined levels of work

This integrated approach recognizes that measurement should be process oriented and cut across functional areas. The greatest benefit of integrated performance measurement is that it creates visibility of operations across all functions while holding the correct role accountable for the performance measure [25]. This approach to performance measurement not only helps with changing how reporting and benchmarking is done, but also in the quick identification of problem areas within the incubation process i.e whether there is an issue in either strategy, planning, scheduling or execution. Measurement is also not just on the outcome which is a lagging indicator but on the various aspects that contribute to the output (Leading indicators). This rationale is consistent with Hacket and Dilts model on performance shown in subsection 2.1.3 [19] where performance is a function of underlying leading indicators.

5.4.4 The complete framework

Figure 5.8 shows the complete framework for implementation.

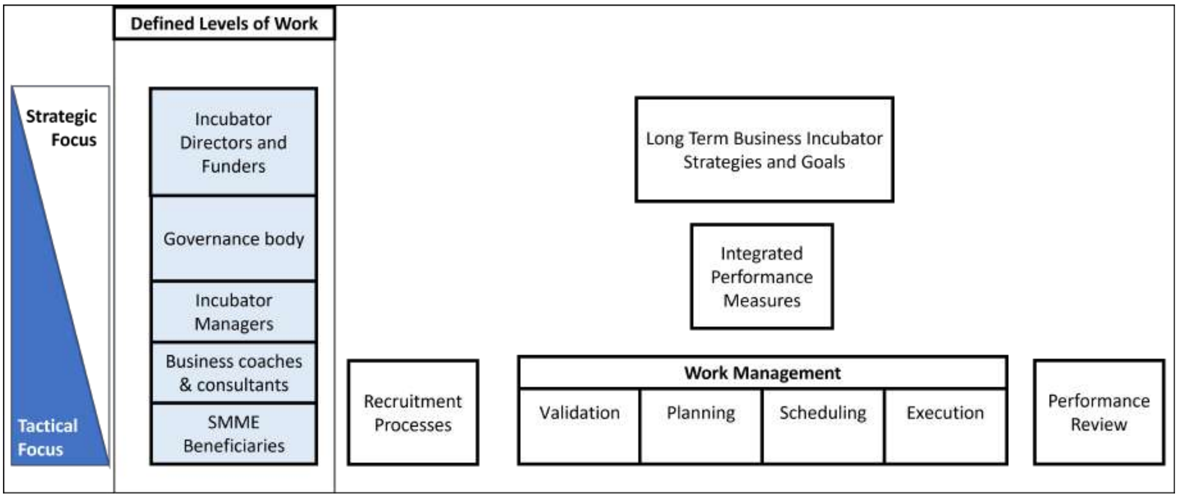

Figure 5.8: The complete conceptual framework

- ***Leadership:*** This is addressed through the defined levels of work. Leadership was taken from the perspective of having the ability to make the right decisions based on clarity of purpose. Having the right defined roles aids with this.
- ***Skills and Capabilities:*** This is addressed through the defined levels of work and the differentiation between work management and strategy. With the framework, the right skill and capability level can easily be determined for each role.
- ***Operations Management System:*** The framework in itself can be thought of as a high level representation of an Operations Management System as it gives highlevel integrated requirements, responsibilities and business processes that enable the orchestration of the firm's operations
- ***Data:*** One is able to elicit useful data for the incubation process by looking at the various elements of the framework, i.e Work Management, Strategy elements and to the right level of detail based on the defined levels of work.

The frame work creates visibility of flow through the incubation pipeline. As previously mentioned, the model also encourages a paradigm shift in terms of performance measurement and reporting from the solely looking at the outputs and outcomes of incubation to the actual processes that drive the delivery of the outputs and outcomes. This in turn could shift the perspective of incubator attractiveness from solely the output to the process of incubation, with the process performance being made visible.

Chapter 6 Discussion

The critical research question stated in chapter 1 is to develop a framework so that incubators in South Africa can measure that their operations are set up and operating effectively. This chapter is a discussion on the results obtained towards the achievement of this objective within both rounds of processing detailed in chapter 4 and the created framework in chapter 5. As such the chapter is divided into four sections. The first section discuss the results and implications of the data analysis process. The second section discusses the framework, highlighting how the design principles of 4IR through the framework address some of the issues found in the data processing. The third section critiques the final conceptual framework against the preliminary conceptual framework and the last section explicitly states how the objectives of the research were met and the critical question answered.

6.1 Results and implications of the data analysis process

6.1.1 Round 1 Processing

One of the key findings in the first round of processing is based on Figure 4.5, where it is established that incubators define themselves mostly through the service offerings they provide to SMME beneficiaries. Other insights from the same graph include the subtle difference between role and function as defined by the respondents. Literature found on incubation suggests that there is no agreed definition of incubation with the term used to describe a wide range of organisations [27] [28] [29]. This nuance in the distinction between their role and function could be a contributing factor to this.

Another key finding is that the identified challenges facing incubators in Figure 4.14 and Figure 4.15 are consistent to what is detailed in previous research and literature and are primarily around their operations. These includes issues around the process of obtaining feedback from incubatees being strenuous, time consuming and costly, staffing of Incubators, expectation mismatches between stakeholders and competition for funding with other Incubators. Other challenges facing incubators in literature [1] are not directly categorised under incubator challenges, but fall under challenges experienced by SMMEs in Figure 4.12 and Figure 4.13. These include the skill Level of entrepreneurs and SMMEs and access to experts. These spoke to the issues of quality of entrepreneurs and access to science and technology expertise and facilities identified in literature [16] [70] [24].

The third key finding is that as respondents detail the success factors and challenges of incubators highlighted in subsubsection 4.2.4.2 and subsubsection 4.2.5.2 they often give detail of the operational processes of incubation. It is also observed that incubators attempt to address the challenges SMMEs face in subsubsection 4.2.5.1. These challenges would later be grouped as expected and unexpected challenges for the development of the systemigram in section 4.3.

Though it is not stated as a key finding in section 4.2, it is worth highlighting that the success factors of SMMEs in subsubsection 4.2.4.1 could be seen as either enabling factors for the success of incubators or services provided by incubators that enable SMME success. A mix of primary and secondary focus success factor codes in Table 4.5 such as Entrepreneurial Traits, Education Levels, Experience in running businesses were among the enabling factors for successful incubators. They were also key factors considered in the recruitment of beneficiaries into incubation programmes. Secondary focus success factor codes such as Technical Assistance, business diagnosis and business validation are clear value add services which incubators provide to SMMEs as per their definition and function in subsection 4.2.2.

It is important to highlight the challenges facing auditors of the space as it was determined that they dealt primarily with the training, reporting and monitoring of incubator programs. Figure 4.16 shows that the biggest challenge they faced was in with Data particularly its collection as shown in Figure 4.17. This is a key concern because in order to make any operational improvements or gain any valuable insight, the correct data is required. Respondents stated that most SMMEs and entrepreneurs who came into incubation did not have good documentation structures and that it was difficult to enforce good documentation practices. Restrictive implementation of policies as well as general access to SMME information also makes it difficult for auditors to collect data for useful insights on the impact of incubators especially post incubation. This makes the tracking of the progress of incubation difficult for both incubators and auditors.

6.1.2 Round 2 Processing

The agreed root definition of incubators formed a good basis for the second round interviews. Respondents expanded the definition of training programmes to encompass distinct types of training. These were; Skills development, Supplier Development and Enterprise Development as seen in subsubsection 4.3.1.1. This gave further insight on the typology of business incubators within South Africa. The expected challenges described during the interviews for the systemigram affirmed previously stated challenges in Round 1 Processing under subsubsection 4.2.5.1 (Challenges SMMEs face).

The visual interface development process of the systemigram in Figure 4.29 based on the root definition enabled respondents to synthesize the content more readily. They were also able to draw links between system objectives that were not specifically stated in the incubator's overall strategy. Respondents who focused on a specific aspect of incubation were also able to see the integration and impact of that aspect into the overall direction of the incubator's overall purpose and goal. The process led to helpful insights about the institutional structures assumed by incubators, particularly aspects around funding as shown in Figure 4.27.

From the results obtained in the development of CLDs, subsection 4.3.2, it is evident that incubator objectives and goals are heavily influenced by funders and vary based on whether they follow ESD or ESG goals. It is also determined that the main problem within incubator operations is their beneficiary pipeline with pipeline being defined as the progression of beneficiaries from recruitment through to their exit. From the CLD, three observations are made;

1. The intake recruitment of beneficiaries favours strong successful beneficiaries and follows the "*Success to the Successful*" system archetype (section 4.3.2.2)

2. The assimilation into value chains of graduated beneficiaries is stifled by procurement processes and follows the "*Shifting the Burden*" system archetype (section 4.3.2.2)

3. The true drive for incubator's to make themselves attractive is to obtain funding for their operations and follows the "*Tragedy of the Commons*" system archetype (subsubsection 4.3.2.3)

It is observed that incubator's attractiveness to funders is evaluated through the measurement of their outcome and not necessarily their processes. This is interesting to point out as among the biggest success factors incubators identified are their methodologies and processes to incubation. Several issues emerge from this approach of measurement as it not only incetivises the intake of only strong beneficiaries, but also creates unhealthy competition among incubators and encourages skewed reports on the actual outcomes of incubation both of which were challenges identified by incubators.

6.2 Framework Development

The framework shown in chapter 5 consists of three integral aspects; Strategy and Work Management, Defined levels of work and Integrated Performance Measures. The objective of the framework is to cause a paradigm shift in the performance measurement of incubators from the evaluation of outcome to the evaluation of process was to be developed in response to the CRQ. The framework encourages the incorporation of ongoing performance measures based on the elements of a service process according to defined levels of work, looking at them happening concurrently rather than as separate processes. Though the framework utilises concepts and theories from Operations Management Systems, its underlying principles are based on the 4 design principles of the fourth industrial revolution.

6.2.1 Principle 1: Interconnection

Interconnection as defined in subsection 2.3.2 enables the generation and collection of data thus aiding functionality and identifying key areas that can benefit from improvements. The interconnection of people and processes is relevant to the functionality of the framework in the context of business incubation. This principle is thus the foundation of the thought process for the framework and takes the form of internal incubator interconnection.

Internal incubator interconnection refers to the interconnection of service elements within the internal processes of incubation. Some of the challenges highlighted in subsubsection 4.2.5.2

such as mismatches in expectations and failing feedback processes with SMME beneficiaries and with funders as seen in Figure 4.15 are symptoms of a lack of this principle in the operations of incubators. It is imperative for the elements of strategy and work management within the framework be set up in a way that allows their interconnection. Across the work management elements, this interconnection is seen in their sequencing as outputs of processes within the elements act as inputs for processes in the next element. For example the output data from validation element directly affects input data for the planning element. In the case of the interconnected relationship between strategy and work management (See subsection 5.4.1, data and information collection is driven by the incubators strategy but generated by a work management element which is more tactical in nature, thus the top down arrangement of the framework. This is illustrated in Figure 5.3.

Though the framework looks at implementation within a single incubator, it could be argued that the adoption of the framework by multiple incubators would help in strengthening interconnection within the space. This would be because incubators would all have a common frame of reference for their operational set up and processes. Synergies and benchmarking exercises on the specific process elements and possibly defined levels of work would also be made possible.

6.2.2 Principle 2: Information Transparency

Transparency in the context of 4IR as described in subsection 2.3.2 is the ease of observing both the actions taken and the data on those actions. It is an essential design principle because clear and easily accessible data and information provides a fast and powerful method to extrapolate knowledge.

As much as the generation and volume of data and information through interconnection is important, eliciting the right information and to the right level at the right time is far more valuable. Challenges to this expressed in the study are however the silo mentality experienced within departments in incubators and the interference of work between the organisations levels of work. Good implementation of interconnection is thus achieved through information transparency between the defined levels of work.

The movement of simply having levels of work to defined levels of work starts with the arrangement of the levels of work based on Stratified Systems Thinking and whether they roles are strategic or tactical in nature as shown in Figure 5.5. Matching the levels of work to the categorisation of the data based on the elements of strategy and work management helps with information transparency since the data collected is compartmentalised based on the elements and levels of work as seen in the final framework in Figure 5.8.

Defining levels of work responsibilities and accountabilities ensures people know their roles in implementation and can thus elicit the correct information pertinent to their role. The structure also helps guide the incubation process to give out the right data as per the framework elements. This approach ensures that complex inputs and outputs are aligned in a simple, easy to understand manner that can be implemented. This approach to implementation also enables the realisation of visible integrated performance measures.

6.2.3 Principle 3: Decentralised Decision Making

The decentralization of decisions explained in subsection 2.3.2 stems from the ability of cyber-physical systems to make choices independent of people. Decentralised decision making in the context of the framework is the ability to utilise information and drive better "level-independent" decision making.

The transparency afforded by the framework as explained previously provides targeted, useful information needed to make appropriate decisions for the appropriate level of work. The framework uses integrated performance measures as the core feedback mechanism between strategy and work management as shown in Figure 5.4 thus making them the "useful information" in this context. Incubator staff can thus make decisions based on their strategic function or tactical function within each element since the performance measures are linked to the levels of work as shown in Figure 5.7.

An issue expressed by incubators is the interference of funders and their goals directly affecting the operations of the incubators. This approach empowers incubator staff and managers to make independent decisions for their level of work but still aligned to the overall strategy while minimising interference from funders. This not only helps the smooth operational running of incubators but could also potentially give incubators freedom in terms of scalability of their operations.

6.2.4 Principle 4: Technical Assistance

From its description in subsection 2.3.2, the principle of technical assistance focuses on the interaction between humans and a digital environment. In the context of the framework, technical assistance is viewed in light of interaction of "Humans" i.e people and stakeholders within incubators and the operations of the incubator.

With this in mind, the approach to technical assistance in the framework took inspiration and principles from the key concepts and methodologies of maximising flow shown in subsection 2.2.2)i.e Lean thinking, Theory of Constraints and Six Sigma. The framework focused on the core strength of each of these methodologies shown in Figure 2.10 and demonstrated them as listed below.

- ***Reducing Service Waste:*** The framework reduces the service waste of unclear communication through its defined levels of work. It also addresses the waste of duplication by having data categorised through its distinct elements of strategy and work management.
- ***Identifying Constraints:*** The categorisation and arrangement of the framework elements helps in the quick identification of the elements that are constraints to the flow of the incubation process. Operational Gap Assessments on each element can thus be quickly conducted.
- ***Reducing Variability:*** The integrated performance measures help in the identification and determination of variability within the elements of the framework.The distinction in the defined levels of work also helps with this as once the variability has been identified, the correct level of work can be assigned to action and reduce it.

6.3 Critique of the final framework against the preliminary conceptual framework

The preliminary framework in Figure 2.21 in section 2.5 saw the leveraging of the 4IR design principles in 4 distinct ways in the performance measurement of business incubation.

- to monitor and expedite the opportunities and ideas SMMEs bring to the Business Incubators
- to monitor and track the invention and actuation processes within Business Incubators
- to escalate the challenges faced by both SMMEs and Business Incubators within Incubation
- to enhance the implementation of legislation and policy within the BI space

6.3.1 Monitoring and expediting opportunities and ideas SMMEs bring to the Business Incubators

The framework developed in chapter 5 not only gives the buckets in which performance measures should be taken but also the sequence in which work is to be done and by who (See subsection 5.4.1 and subsection 5.4.2). While primarily used by incubators on their operations, aspects of the framework can be adopted and integrated by SMMEs as part of their processes rather than them being simply "worked on" by incubators.

The monitoring and expediting opportunities and ideas SMMEs have is addressed by the aspects of the work management fields of the framework; Validation, Planning, Scheduling and Execution. By following this sequence, business incubators can ensure SMME opportunities are realised, and it creates a standard workflow that can then be monitored.

6.3.2 Monitoring and tracking the invention and actuation processes within Business Incubators

Similar to monitoring and expediting SMME opportunities, Business Incubators can leverage the work management aspects to monitor and track their own processes. This would be done by the Business Coaches and Consultants as shown in the layout of the framework (See Figure 5.8 in subsection 5.4.4). The added layer of detail in tracking and monitoring this would be the work management's incorporation into integrated performance measures that would be made visible to the Incubator managers and governance bodies. Layering the work this way creates clear work packages and visibility for the different levels in the hierarchy of incubators.

6.3.3 Escalate the challenges faced by both SMMEs and Business Incubators within incubation

This aspect is partially addressed by the performance review bucket in the framework as the review could retrospectively capture and highlight the challenges faced in work management (See subsection 5.4.3). While the retrospect is good for improving the next cycle, it would be preferred that escalations are made as work is ongoing rather than at the end of the work (be it training on the sides of incubators or service/product delivery on the side of the SMME). While going through the sequence of work management, it is assumed that as challenges are faced, they are escalated to the relevant next level within the framework. Though implicit in the flow of the framework, this aspect could be better elaborated and explicitly stated in the framework and not left to chance or assumption.

6.3.4 Enhancing the implementation of legislation and policy within the incubation space

The area in the framework where this is covered in is in the long-term strategy of the business incubators (See subsection 5.4.1). This again makes an assumption that funders and incubator directors are well aware of legislative policies within the space and convey these policies down the levels of work. Another area in the framework where this could potentially be covered is in the validation step of work management by the SMMEs, where they would first have to legally validate their venture or idea before implementation. It is acknowledged that this aspect is not sufficiently and explicitly covered by the framework and would rely heavily on training and educating payers in the space.

6.3.5 Merits covered by the final framework

- The framework covers elements of operational excellence introduced in subsection 2.2.4 in more detail compared to the preliminary conceptual framework (See subsection 5.4.4).By using the framework as a starting point, incubators can not only be used to measure their performance of, but also drive operational excellence.
- As stated in subsection 5.4.4, the frame work creates visibility of flow through the incubation pipeline for both Incubators and SMMEs and simultaneously shows the levels of work within an incubator. This encourages a paradigm shift in terms of performance measurement and reporting from the solely looking at the outputs and outcomes of incubation to the actual processes that drive the delivery of the outputs and outcomes.

6.4 Assessment against research objectives

For the realisation of an adequate response to the CRQ, three sub-objectives were outlined;

1. Characterize the goals and objectives of Business Incubators in South Africa
2. Describe the current operational processes of Business Incubators in South Africa by identifying areas of success and concern within current BI operational processes

3. Propose a way in which operational processes can be assessed so that their contribution to their objectives can be improved.

6.4.1 Sub-Objective 1: Characterize the goals and objectives of Business Incubators in South Africa

This was achieved through understanding the theme of ***Definition and Function*** in subsection 4.2.2 through content analysis during the first round of interviews. From the analysis, the following was established;

- Business Incubators primarily identify themselves by the service offerings to entrepreneurs and SMMEs.
- Based on how they identify themselves, Business Incubators have varying functions and roles with '*Function*' describing the duty and purpose of the incubator and '*Role*' describing the part played by the incubator within the Incubation and SMME spaces.

The definition and characterization of incubator goals was then expressed in the development of the systemigram through 'The Role of Business Incubators' in (subsubsection 4.3.1.1), 'Identity and Governance' in subsubsection 4.3.1.3 and 'Funding Goals' in subsubsection 4.3.1.4. From the systemigram branches, the following conclusions could be drawn;

- Incubators have a 'shared role' which they play within the entrepreneurial space in South Africa; ***Training*** SMME beneficiaries to address their business challenges.
- Training given by incubators can be categorised into Skill Development, Enterprise Development or Supplier Development
- Ownership of the business incubator by either Universities, the DSBD or Cooperates defined the governance structure of the incubator
- The goals of incubators are driven by the type of funding the incubator receives to run its operations.

6.4.2 Sub-Objective 2: Describe the current operational processes of Business Incubators in South Africa

Sub-objective two was realised through the content analysis of themes ***Best Practices*** in subsection 4.2.3 ***Success Factors*** in subsection 4.2.4 and ***Challenges*** in subsection 4.2.5. Best Practices by incubators followed four categories;

- Duration of incubation
- Feedback from incubatees
- Having Key Metrics of Measure
- Aspects of Enterprise Supplier Development (ESD)

It should be noted that while having key metrics of measure is determined as best practice, there is still no well established uniform standard in the space as to what those metrics should be.

Though Best practices relating to solely incubators were explored, success factors and challenges facing not only incubators, but SMMEs, incubator auditors and the incubation space as a whole were also identified. This was seen as pertinent as they all played a critical part in understanding the operations of incubators. The greatest success factors for SMMEs were SMME clusters and individuals entrepreneurial traits while for incubators and auditors having a methodology was seen as the greatest success factor. Operational Challenges as a subtheme was the highest for both incubators and SMMEs with Pipeline through incubation and skill level being more granular challenges they each faced respectively (See subsection 4.2.5). The biggest challenge facing auditors was data collection and for the incubation space as a whole system, the National culture towards entrepreneurship and data collection were the biggest challenges found in the research.

The definition of current incubator operations was expressed in the 'Operations', 'Government' and 'Funding Goals' branches of the systemigram in subsubsection 4.3.1.2, subsubsection 4.3.1.5 and subsubsection 4.3.1.4 respectively. The systemigram building process explained in subsection 4.3.1 not only helped in expressing sub-objective 1 and 2 individually but also helped in elaborating the interconnection these objectives had each other as shown in the final systemigram in Figure 4.29. This provided a more clear picture on how incubators operate in relation to their goals and objectives.

Given that the primary objective of the research was to develop a framework for Business Incubators so that their operational processes can be assessed for efficacy and effectiveness, focus was put on the theme of incubator pipeline. This led to the development of the Flow in the incubation process Causal loop diagram (Figure 4.30) in subsubsection 4.3.2.1. An overlay of Figure 4.30 with the content analysis on incubation pipeline in subsubsection 4.2.5.2 helped in identification of the impact challenges had on the flow of incubation in subsubsection 4.3.2.2. The emergent areas of concern within incubation pipeline were;

- The intake recruitment of beneficiaries
- The assimilation into value chains of graduated beneficiaries
- The true drive for incubator attractiveness

Causal Loop Diagrams showing the manifestation of challenges in these areas were then drawn up in section 4.3.2.2, section 4.3.2.2 and subsubsection 4.3.2.3 and while they could be be used for more detailed analysis, their use in the research was in defining the problem within incubation flow and the ramifications of not dealing with them. By defining the problems in this way, a systematic systemic way of assessing incubator operations could be developed.

6.4.3 Sub-Objective 3: Propose ways in which operational processes of incubators can be assessed so that their contribution to their objectives can be improved.

This sub-objective was achieved through understanding the of components of the final operational management framework detailed in chapter 5. These were;

- ***Levels of work:*** This is the level of complexity that an individual can effectively function at as defined by Stratified Systems Thinking. It identifies levels of work, differentiated on the basis of complexity and time-span of decision-making [26].
- ***Strategy:*** This is the top-down reflection of what the whole group or business wants to do [25].
- ***Integrated Performance measures:***This is the measure of the intended outputs of the service process that cut across functional areas.
- ***Validation:***This is the structured process of confirming, validating and prioritising planned and adhoc work

- ***Planning:*** This is the process of turning a strategic plan into a detailed map that outlines exactly what action the execution team will take on a monthly, weekly, or sometimes even daily, basis [26].

- ***Scheduling:*** This is the process of allocating resources and capacity based on the detailed plan to the correct areas[26] [79].

- ***Execution:*** This is the delivery of the actual intended work [26]. In the case of incubation, this is the actual training of the SMME and entrepreneur beneficiaries

These components were obtained from systems thinking and the operations management theories of lean, theory of change and six sigma (See chapter 2). Understanding these components in the context of 4IR design principles; interconnection, information transparency, decentralised decision making and Technical Assistance, and incorporating these principles as the foundation of thinking as discussed in section 6.2 resulted in the final framework.

6.5 Validity of results

The following aspects were demonstrated to ensure validity of the results:

- ***Reflexivity:*** A conscious attempt was made to biases that might have influenced data collection and interpretation. Rigorous and systematic coding, collaborative building and review of models and rigorous reference to literature were among the appropriate steps were taken to minimize such influences.

- ***Triangulation:*** Data collection was done through multiple forms related to the same research question, with the goal of finding consistencies or inconsistencies among the data throughout each of the analysis processes from codes to framework development.

- ***Thick description:*** Thick and detailed description of the data collected was done as presented in chapter 4 through codes and models.

- ***Respondent Validation:*** Validation from study participants about conclusions and interpretations drawn from collected data were done iteratively throughout the study in accordance with the methodology.

Chapter 7 Conclusions and Recommendations

The qualitative study undertaken was of an exploratory nature to answer the critical research question, ***How can a framework be developed so that incubators in South Africa can measure that their operations are set up and operating effectively?*** The intention was to understand the current state of business incubators in South Africa and from this develop a way in which their operational processes could be could be assessed so that their contribution to their objectives improved.

Given the nature of the study, the Soft Systems Methodology was employed to gather and analyse data. This took two rounds of interviews, the first from which content and thematic analysis was done on the data (See section 4.2 and subsection 6.1.1). This set up the foundation of the second round of analysis and was useful in the construction of the incubation systemigram as well as the incubator flow Causal loop diagram (See section 4.3 and subsection 6.1.2). The formation of these two models was the focus of the second round of interviews. From them, underlying behaviour within the space were determined (See subsection 4.3.2) and a framework to help improve operations developed (See chapter 5).

7.1 Key Findings of the research

1. The biggest challenge currently facing Business Incubators in South Africa is incubation pipeline flow. This can be see in 3 distinct ways;
    - The intake recruitment of beneficiaries into incubators
    - The assimilation into value chains of graduated beneficiaries
    - Funding as the true drive for incubator attractiveness
2. Business incubators currently predominantly report outcome indicators in terms of their performance i.e Number of beneficiaries assisted by the incubators, number of successful beneficiaries from incubators and turn over of beneficiaries. This is driven by the need to keep the incubator attractive to draw more funding.

7.2 Addressing the burning platform

As stated in section 1.5, the main objective was to develop a framework for business incubators so that their operational processes can be assessed for efficacy and effectiveness. This objective resulted from the identified burning platform in section 1.2 of the current inadequacies of performance measurement of business incubators and realised in the final framework shown in Figure 5.8 in chapter 5.

Though drawn and developed from a broader view of what actually occurs in the incubation space, the framework primarily addresses the challenge of incubation flow in the incubation space. This framework enables the capability of managing the flow pipeline by setting the four design principles of 4IR as the underlying foundation and utilising ideas and concepts from Operations Management. It also aims to cause a paradigm shift in the performance measurement of incubators from simply looking at the final outcome, to measuring the performance of the actual incubation processes.

7.3 Addressing the research objectives and answering the CRQ

The CRQ asked how a framework could be developed so that incubators in South Africa could measure that their operations were set up and operating effectively. The objective of the research was therefore to develop a framework for Business Incubators so that their operational processes can be assessed for efficacy and effectiveness. To adequately respond to this, the following sub-objectives were drawn

1. Characterize the goals and objectives of Business Incubators in South Africa
2. Describe the current operational processes of Business Incubators in South Africa by identifying areas of success and concern within current BI operational processes
3. Propose ways in which operational processes of incubators can be assessed so that their contribution to their objectives can be improved.

The research responded to each of these objective by;

1. Characterizing the goals and objectives of Business incubators through thematic analysis (See section 4.2 and subsection 6.4.1 for analysis and discussion respectively)
2. Describing the current state of incubators through systemigrams and causal loop diagrams infomred by thematic analysis (See section 4.3 and subsection 6.4.2 for analysis and discussion respectively)
3. Leveraging 4IR design principles and Operations Management theories to propose a conceptual framework for performance measurement (See chapter 5 and subsection 6.4.3 for analysis and discussion respectively)

The CRQ was therefore successfully answered through the development of a conceptual performance measurement framework driven to achieve operational excellence (See subsection 5.4.4 and section 6.2)

7.4 Research Limitations

1. The research focused on incubator managers, analysts and auditors and did not explore directly through interviews the perspective of SMMEs or incubator executive boards on incubation processes.

2. Owing to availability of the interviewees, responses were only obtained from entities operating within the Gauteng Province in South Africa

3. Given the research was heavily qualitative in nature, the causal loop models developed were used more to gain an understanding of behaviour in the incubation space and not for quantitatively defining the impact of the identified behaviour.

7.5 Recommendations

- The analysis utilised basic causal loop diagrams as a way to understand the behaviour of uninteded consequences the challenges experienced in incubation pipeline caused. The true calculated impact from developed causal loop diagrams can be developed to show more *'tangible impact'* i.e either monetary or population wise of behaviours within incubation.

- While the framework has been developed, it has yet to be tested in the operations of business incubators. It is thus recommended for for a pilot test in incubators.

- During practical application, given it is a change in how incubators view their and conduct their operations, proper change management training and considerations should be made

- Further research exploring the efficacy and effectiveness of performance measures of incubator operations should be done from the perspective of the SMMEs.

- Further research exploring the efficiency of incubators should be done for further opportunities to improve the incubation process in South Africa.

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Appendix A Appendix

A.1 Raw Data

The following is a link to a google drive folder with the transcripts from the research as well as the excel spreadsheet used for content analysis: https://drive.google.com/drive/folders/1-LDQWMpztCsDFzOm_ZtlQD68yjm_6Idc?usp=sharing

A.2 Methodologies of Maximising Flow

A.2.0.1 Lean Thinking

The concept of lean is about moving closer to uninterrupted flow in the sequence of operations that deliver perfect quality to the customer [163] [164]. 'Flow' is not only of physical products and services, but also the information and designs necessary to run operations and requires three things; **Waste** reduction, **Value** enhancement,**People** involvement.

The Lean Enterprise Institute summarises this by defining the core idea of lean as maximising customer value while minimising waste [164]. Most lean literature identifies types of waste that occur in a system as described in Table A.1:

Table A.1: The seven wastes in Lean [26][164][73]

Waste	Description
Over production	Producing more than the customer ordered.
Waiting	Time when no value is being added to the product or service
Transportation	The unnecessary multiple movement of materials, goods or parts that does not add value.
Inventory	Unnecessary raw material, Work in Progress (WIP) or finished goods.
Motion	Unnecessary movement of people that does not add value.
Over Processing	Additional steps or processes that do not add value to the customer
Defects	Work effort that needs to be scraped or that requires rework or repair for failing to meet customer expectation.

Bicheno [163] introduced a more service outlook on wastes as shown in Table A.2

Table A.2: The seven service wastes [163]

Waste	Description
Delays	Customers waiting for service, delivery, responses or in queues.
Duplication	Having to re-enter data, repeat details on forms, copy information across, answer queries from several sources within the same organisation.
Unnecessary movement	Queuing several times and poor ergonomics in the service encounter.
Unclear communication	Seeking clarification and confusion over product or service use
Incorrect inventory	Inability to get exactly what is required and using substitute products or services.
Opportunity lost	Failure to establish rapport with customers
Errors	Faults and defects in the service package bundle

The Five Lean Principles

There are five key lean principles as described in Table A.3. They emphasized the transition from purely lean manufacturing to lean enterprise, in other words emphasizing systems. The essence of these principles is shown in Figure A.1

Table A.3: The five principles of Lean [163] [165]

Step		Description
1	**Identify Value**	Find out what the customer values from a process, product or service
2	**Map the Value Sream**	Define the flow of activities from beginning to end of a process to eliminate any ”non-value added” activities
3	**Create Flow**	Organise value creating steps into a harmonised sequence so the process flows smoothly to deliver product or service to the customer
4	**Establish Pull**	Start each new activity only when there is a demand for it from the customer or from workers in the next stage of the process
5	**Seek Perfection**	Continue to refine the process until perfect value is created with no waste

Figure A.1: The five-step thought process for guiding the implementation of lean techniques.

Lean thinking in a service industries

A summary on some of the work and research conducted on lean thinking showing its application and benefits in service industries is detailed in Table A.4 below [166].

Table A.4: Application of the Lean in service industries [166]

Paper	Author(s)	Sector	Benefits
The Lean service machine	Swank, C.K.	Life Insurance and Annuities	Halved the time to issuance of policy, reduction in labour cost, reduction in errors
Applying Lean manufacturing principles to information intensive services	Apte, U. Goh, C.-H.	Insurance claim handling	Reduction in loss payout, pending claims volume, the closing age of claims and cycle time, high-quality information availability
Learning to walk before we try to run: adapting Lean for the public sector	Radnor, Z. Walley, P.	Eight case studies in Public Sector	Improved productivity, reduction in cost, delivery of high-quality service meeting customer requirements
Lean transformation in the pure service environment: the case of the call service centre	Piercy, N. Rich, N.	3 UK Call Centres	Reduction in NVA, reduction in average time to complete a customer enquiry, cost savings
A new Lean paradigm in higher education: a case study	Doman, M.S.	Higher education administrative processes	Small group of UG students quickly learnt and applied Lean to improve university administrative processes
Lean principles in IT services: a case study on implementation and best practices	Malladi, S., Dominic, P. Kamil, A.	Global software services company	Improved efficiency, reusing knowledge towards continuous improvement, and increase in productivity
From group work to teamwork: a case study of 'Lean' rapid process improvement in the ThedaCare information technology department	Holden, R.J Hackbart, G.	Community Health System's IT Department.	Improvement in first-call resolution, decrease in reopened requests
Lean management in the financial sector	Berger, R.	Banking	Save time, positive effect on budget. More efficient processes ensured that capacities increased at a lower rate than the volume of business
Lean Higher Education And Lean Research	Isaksson, R., Kuttainen, C. Garvare, R.	University education and research	Reduction in delivery time of knowledge, flexible speed of studies and packaging courses size as per need

A.2.0.2 The Theory of Constraints (TOC)

The theory of constraints is based on the underlying notion of ***synchronous manufacturing***, which refers to the entire production process working in harmony to achieve the profit goal of the firm [26] [167]. The theory views every organisation as a system or chain of activities whose success is governed by three basic measures [71] [168];

- ***Inventory:*** Money that the system has invested in purchasing things it intends to sell
- ***Operational expense:*** Money the system uses to turn inventory into sales
- ***Throughput:*** The rate at which money is generated by the system from sales

He further demonstrated that every system has at least one weaklink, or constraint. If that constraint can be found and overcome or controlled if it is unavoidable, the organisation is more likely to meet its performance goals. Conversely, by fixing issues which are not constraints, one could be allocating resources to the wrong area and making the situation worse [168].

Constraints

Constraints can be internal or external to the system [168]. An internal constraint is in evidence when the market demands more from the system than it can deliver. If this is the case, then the focus of the organization should be on discovering that constraint and following the five focusing steps to open it up (and potentially remove it. Types of internal constraints include;

- ***Equipment:*** The way equipment is currently used limits the ability of the system to produce more salable goods/services
- ***People:*** Lack of skilled people limits the system. Mental models held by people can cause behaviour that becomes a constraint.
- ***Policy:*** A written or unwritten policy prevents the system from making more.

An external constraint exists when the system can produce more than the market will bear. If this is the case, then the organization should focus on mechanisms to create more demand for its products or services.

The Five focus steps

Assuming the goal of a system has been articulated and its measurements defined, the steps shown in Figure A.2 should be taken:

Table A.5: The Five focusing steps of TOC [168] [167]

Step		Description
1	**Identify the constraint**	Establish whether the constraint is internal or external, where it occurs in the system and whether it involves resources, processes staff or policy.
2	**Exploit the constraint**	Make the constraint as effective as possible with the existing resources available
3	**Subordinate non-constraints**	Realign all the other non-constraint parts of the system to support the constraint even if this reduces the efficiency of non-constraint resources.
4	**Elevate the constraint**	If output is still inadequate, acquire more of this resource so it is no longer a constraint
5	**Repeat the process**	Identify the next most significant constraint and repeat steps 1 to 4 to minimise or eliminate it.

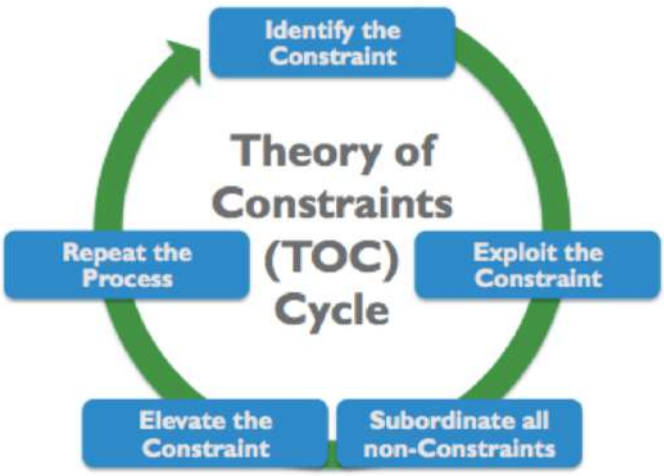


Figure A.2: The five-step process for the Theory of Constraints

The application of these steps in a situation where the system constraint is physical is usually obvious and straightforward.But often it's not a physical constraint. The nature of many constraints in organizations is policy constraints. In that case, the Five Focusing Steps break down into three questions:

1. What to Change.
2. What to Change to
3. How to Cause the Change.

Theory of Constraints in a service industries

A summary on some of the work and research conducted on the Theory of Change showing its application and objectives in service industries is detailed in Table A.6 below [169].

Table A.6: Application of the Theory of Constraints in service industries [169]

Paper	Author(s)	Sector	Objectives
Significant Enhancement of Academic Achievement through Application of the Theory of Constraints (TOC).	Goldratt, R., Weiss, N.	Education	To apply TOC to improve the quality of school education and productivity.
Managing Change: the Theory of Constraints in the Mental Health Service.	Ritson, N., Waterfield, N.	Health - Consulting	To modernize mental health services of the UK population through the merger of the only two service providers.
TOC Beyond Manufacturing.	Gillespie, M.W., Patterson, M.C., Bob, H.	Unspecified	Study the impact of TOC concepts in administrative functions, applying performance indicators.
Managing a community mental health agency: A Theory of Constraints based framework	Gupta, M., Kline, J	Health	Application of TOC for optimization and increased productivity of nonprofit organizations.
The theory of constraints in practice at Quality Engineering.	Motwani, J., Vogelsang, K.	Construction	Support improved performance and productivity of the delivery of the service provided by the company.
Applying the TOC five-step focusing process in the service sector: A banking subsystem.	Reid, R.A.	Banking	To improve credit approval processes and overcome the constraints of the system.
Applying the TOC TP: A case study in the service sector.	Reid, R.A., Cornier, J.R.	Restaurants	To evaluate the possibility of the successful use of TOC TP tools to improve the performance of a small business.
Applying the TOC Thinking Process: A case study in the government sector.	Shoemaker, T.E., Reid, R.A.	Public Services	To consider using TOC TP in a public service organization for service and optimization of the processes.
Theory of constraints in a service application: the Swine Graphics case	Spencer, M.S.	Food	To evaluate the implementation, benefits and feasibility of TOC as a tool for planning and control of production in the service.
Applying Goldratt's thinking process and the theory of constraints to the invoicing system of an oil and gas engineering consulting firm.	Taylor III, L.J., Thomas, E.E.	Consultancy	Improving the performance of billing system for increased business productivity.
A classified model for applying the theory of constraints to service organizations.	Siha, S.	Service Sector	To create a classification model for implementing TOC in different service organizations. Adequacy of vocabulary TOC to services and developing solutions to potential problems TOC.
Application of the Theory of Constraints in Banks.	Bramorski, T., Madan, M., Motwani, J.	Banking	A classified model for Applying the Theory of Constraints to Service organizations
The theory of constraints: a methodology apart? - a comparison with selected OR/MS methodologies.	Davies, J., Mabin, V.J., Balderstone, S.J.	Operational Research OR/MS	To study TOC TP tools in relation to traditional methodologies OR / MS for building multi methodological tools.

A.2.0.3 Six Sigma

Six Sigma can be described as the philosophy and methods use to eliminate defects in an organisation's products and processes [26] [79]. A defect is simply any component that does not fall within the customer's specification limits [79]. Each step or activity in a company represents an opportunity for defects to occur, and Six Sigma programs seek to reduce the variation in the processes that lead to these defects [26]. Six sigma describes six elements in processes in which variation can occur as shown in Figure A.3

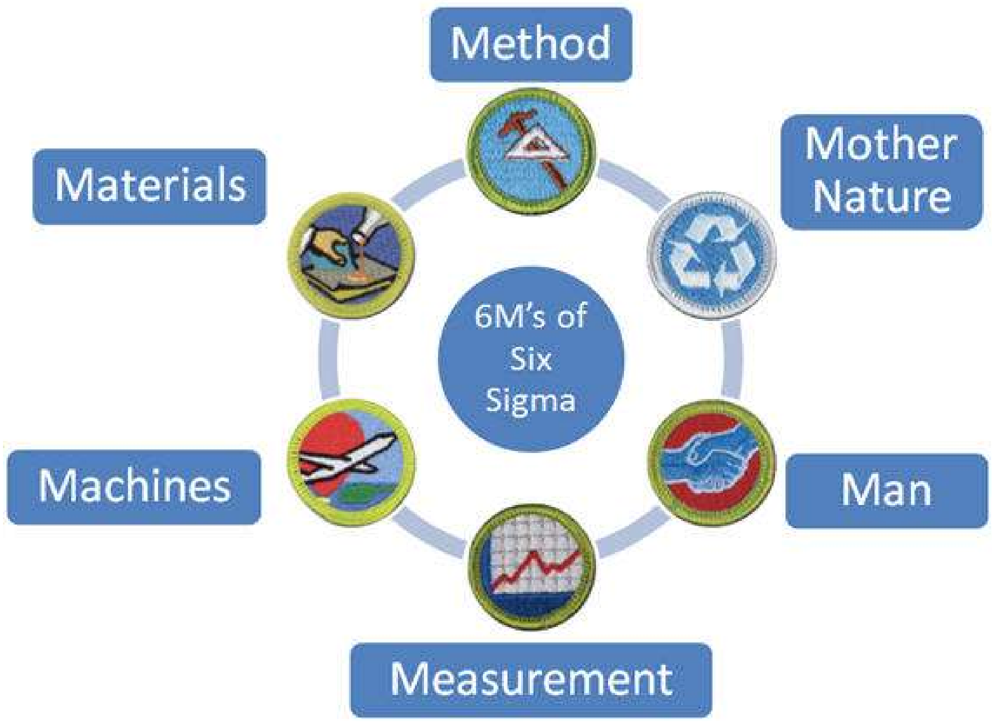


Figure A.3: 6M's of Six Sigma [170]

Analytical Tools for Six Sigma

The analytical tools of Six Sigma described in Table A.7 have been used for many years in traditional quality improvement programs [79][26]. What makes their application to Six Sigma unique is the integration of these tools in a corporate wide management system [26] [25].

Table A.7: Six Sigma Analytical tools [26]

Analytical Tool	**Description**
Flowcharts	They are diagrams of the sequence of processes, movements or actions of people or things involved in a complex system or activity
Run charts.	They depict trends in data over time, and thereby help in understanding the magnitude of a problem
Pareto charts	These charts help to break down a problem into the relative contributions of its components. They are based on the common empirical finding that a large percentage of problems are due to a small percentage of listed causes.
Checksheets	These are basic forms that help standardize data collection. They are used to create histograms
Cause-and-effect diagrams	Also called fishbone diagrams, they show hypothesized relationships between potential causes and the problem under study.
Opportunity flow diagram	This is used to separate value-added from non–value added steps in a process.
Process control charts	These are time-sequenced charts showing plotted values of a statistic, including a centerline average and one or more control limits. They are used to assure that processes are in statistical control.

Other tools that have seen extensive use in Six Sigma projects are failure mode and effect analysis (FMEA) and design of experiments (DOE) [26].

- **Failure mode and effect analysis:** This is a structured approach to identify, estimate, prioritize, and evaluate risk of possible failures at each stage of a process.
- **Design of Experiments:** This is sometimes referred to as multivariate testing and is a statistical methodology used for determining the cause-and-effect relationship between process/input variables (X's) and the output variable (Y).

The Six Sigma Methodology

While Six Sigma's methods include many of the statistical and analytical tools shown previously, here they are used in a systematic project-oriented fashion through the define, measure, analyse, improve, and control (DMAIC) cycle shown in Figure A.4.

Table A.8: The DMAIC process and sequence outcomes [79]

Step		Description
1	**Define**	The problem/opportunity is defined and summarised with other critical to quality elements in a project charter.
2	**Measure**	The appropriate measure(s) that influence quality are identified as a pre-requisite for data collection. Measurement systems may be analysed to ensure the data collected is reliable.
3	**Analyse**	Collected data is analysed to identify what is happening and where it is happening. A root cause analysis may be undertaken to identify potential causes of the problem or observed variation.
4	**Improve**	Ideas for treating the root cause of the problem or the variation are generated with the most appropriate ideas being selected and implemented
5	**Control**	A system of monitoring and responding is established to ensure that the improvements are sustained

Figure A.4: The DMAIC Model

Six Sigma in a service industries

A summary on some of the work and research conducted on the Six Sigma Methodology showing its application and outcomes in service industries is detailed in Table A.9 below [171] [172].

Table A.9: Application of the Six sigma in service industries [171] [172]

Paper/Book	**Author(s)**	**Sector**	**Outcome**
Journey for excellence: Kentucky's CHC adopts six sigma approach	Thomerson, L.D.	Healthcare	Significant improvement in radiology throughput and reduction in cost per radiology procedure
Application of six sigma to reduce medical errors	Buck, C.		Reduced medication and laboratory errors
Integrating six sigma with TQM: a case example for measuring medical errors	Revere, L Black, K.		Reduced time to transfer a patient from the ER to an inpatient hospital bed
Six sigma signals	Roberts, C.M.	Banking	Significant reduction in customer complaints and increase in customer satisfaction
Citibank increase of customer loyalty with defect-free processes	Rucker, R.		Reduction in both internal and external call backs, reduction in credit processing time
Service quality six sigma case studies	Keim, E.		Significant reduction in the number of returned renewal credit cards
Back to the future	Stusnick, D.		Reduced trading errors significantly and Reduced costs associated with order corrections
Six sigma– strategy for organisational excellence	Thawani, S.	Logistics	Sigma quality level of the process improved from 2.43 (176,000 DPMO) to 3.94 (7,400 DPMO) Improved customer satisfaction and increased market share, resulted in savings of USD 400,000 (approx.)

INTERVIEW GUIDE

Improving the Efficacy and Effectiveness of Business Incubators using 4IR Design Principles.

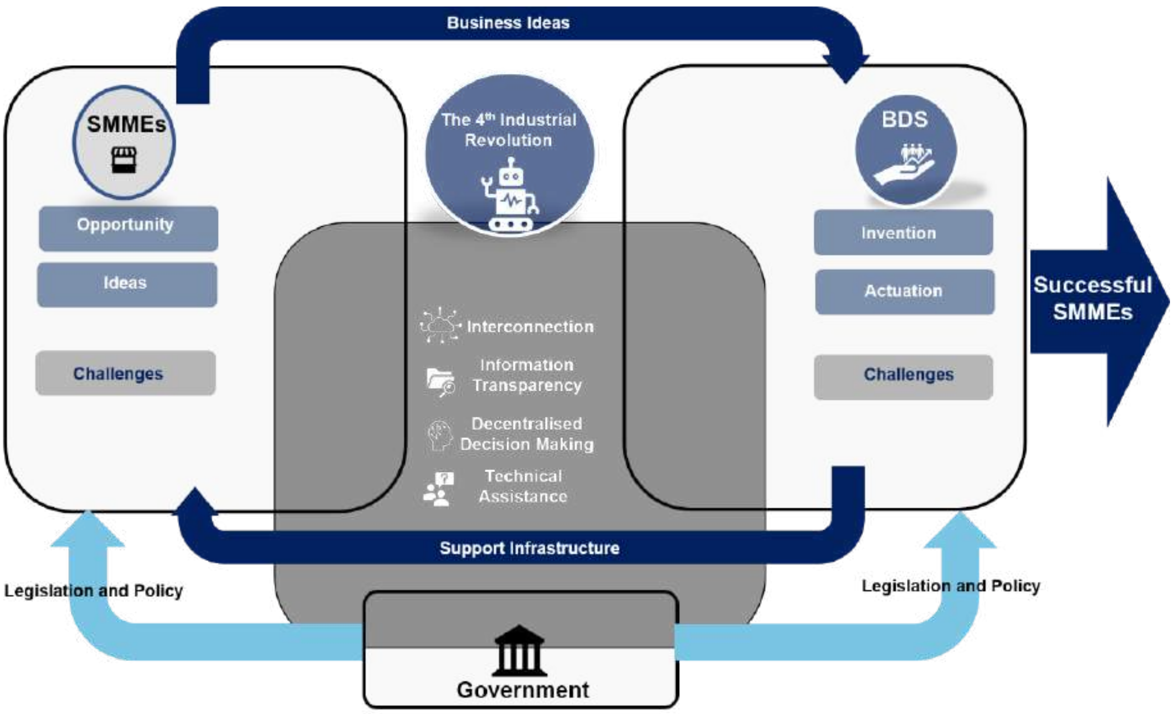
The Problem statement

Government officials and civil leaders have widely recognised that enhanced entrepreneurial capabilities within SMMEs can contribute towards driving economic growth and addressing the high unemployment rate (29%), the high-income inequality and persistent poverty within South Africa. While incubators have been shown to help SMMEs in their infant stage through to inception, the problem of the high failure rate still looms. Several studies within South Africa reveal there is an excessive business failure rate which ranges from 60 to 80% among SMMEs in their first two to five years of operation. There is also no general agreement among scholars and experts as to why precisely this is so. The 4th Industrial Revolution (4IR) presents a potential array of tools but the conceptual framework for the implementation of these tools has yet to be fully explored.

Critical Research Questions

How can the operational processes of incubators be improved so that their contribution towards their objectives be assessed?

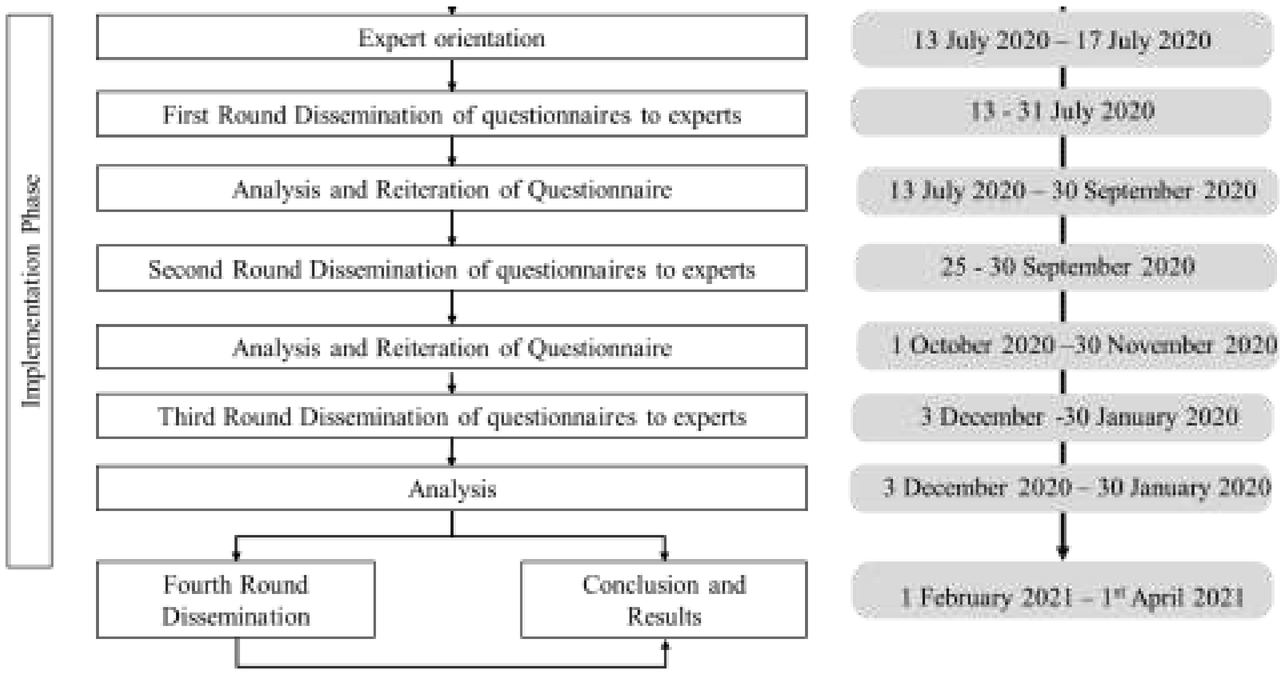
Preliminary guiding framework.



The idea is that the three primary parties in the research should be involved i.e the

Government, the Incubators and the SMME. The connecting thread between them other than their almost “Symbiotic” relationship would be 4IR.

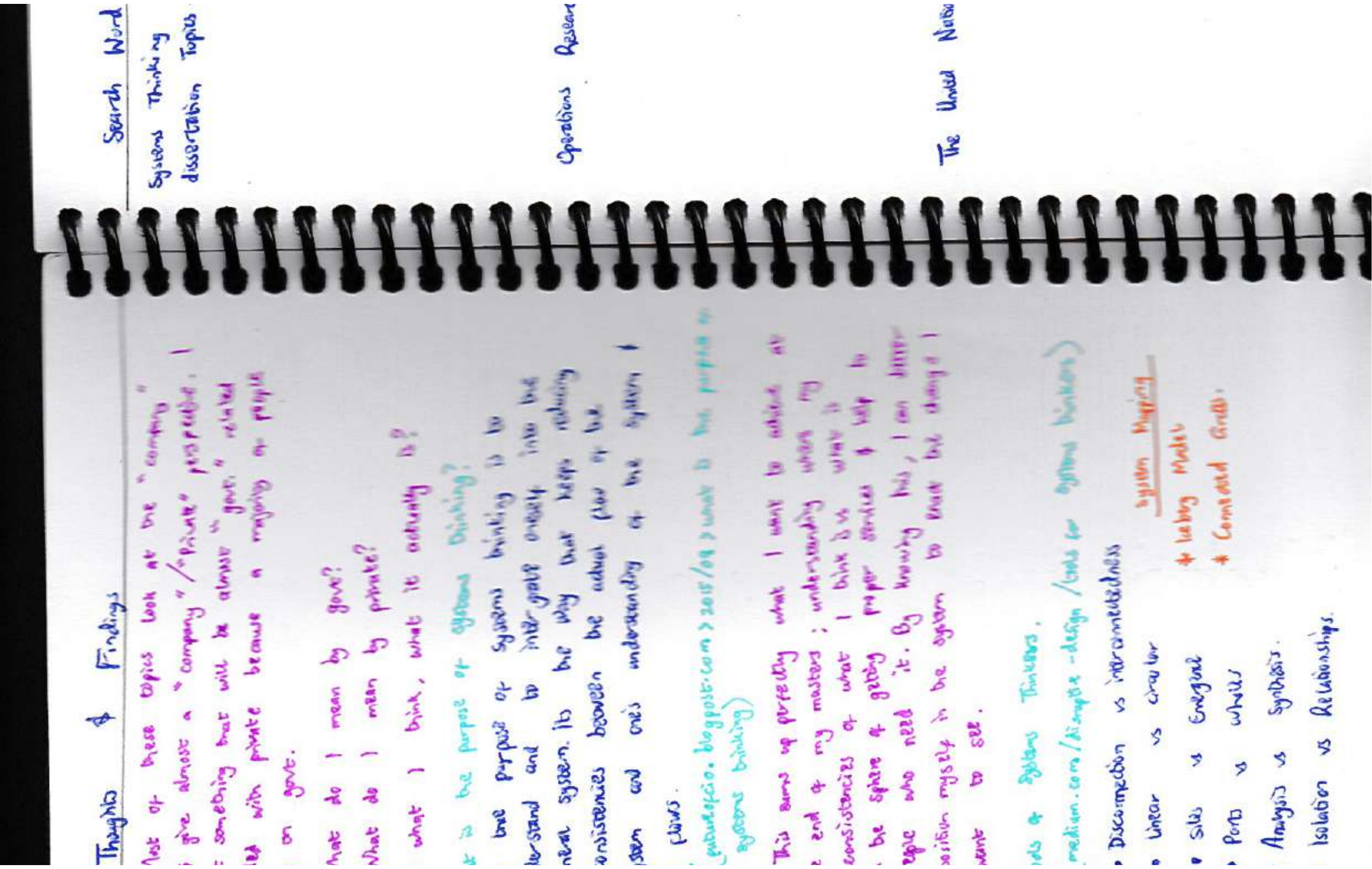
Time Line



Round one Interview Themes

- Organisational Background and structure
- Best practices for Incubation
- Barriers and factors for success of SMMEs and Incubators

A.3 Sample Field Notes



→ Confirming what was said

→ Addressing differences & commonalities.

→ Formulating possible solutions

Pillars of 4IR

Cyber-physical IOT

- Interconnection

- Decentralised Decision Making

A.I

Big Data

- Information Transparency

Variety Volume Velocity

- Technical Assistance

h—h
h–m
m–m

a once off way to see

→ seen by.

→ Time constraints

Challenges of Transnet

- Funding. (One source)
- Deficit on Black Suppliers in the Transnet core value chain
- Poor links between Transnet Initiatives. Inter connected.
  - What makes this poor?
    - → Changes at Transnet head office.
- Majority early stage businesses are the focus; i.e idea stage.
- Incubatees desire to get to market as quick as possible.
- Disconnect between what centres want vs what SMMEs need.
- Lack of external reviewers.
- Undocumented processes in SMMEs
- Analysing success or failure of SMMEs.
- Misinterpretation of factors by external reviewers.

- Focus of Industrialization
- Focus on innovation + Tech.
- Focus on ESD +

→ Which is more; Supplier or Enterprise development?

→ What is the danger of creating generic solutions?

→ How would you recommend assessing impact.

→ What have you had the most impact along the SMME Journey?

→ Who should conduct external reviews?

System challenges

- Quality of levels expected. +
- Poorly defined problem statements. + (No Data behind)
- No set standards for SMME success/impact.

Challenges of SMMEs

- Upholding quality levels required
- Education levels of business.
- Poorly ~~defined~~ understood problem statements
- Obtaining Data on the problem.
- Policy & regulations.
- Lack of Research.
- Funds & Finance (Lack of)
- Book keeping/Record keeping.
- Upholding market volumes. +
- Inefficient business strategies; hero businesses +
- Exploitation by other companies due to undocumentation

- Classification of formal & informal Businesses. +
- Definition of formal documentation
  - → CIPC vs book-keeping. vs Annual Returns
- Checking on annual returns is bad.
- SMMEs not caring about state tenders. +
- Underground businesses. +
- "Incentive" for SMMEs to remain "anonymous" +

Challenges others said

- Governance of Incubators.
- Screening processes
- Incubator hopping.
- Reputation.
- The smaller they are the less data you have. ↓ enterprise

- Requirements for funding. +
- Financial management (Personal) +
- Lack of history.
- Lack of soft skills.
- Upskilling themselves vs employing staff.

→ How did you ensure the correct governance structures? Were these long processes?

* Procurement processes.

Why is a framework so important?

- A framework provides the rules of engagement. Kind of like how in a boardgame, the rules provide the terms of play.
- It helps / They help determine who "wins" & "loses" but ensure everyone is having fun.
- A framework also helps establish the "how" things should be done
- It can give guidance on what can be measured & can help practitioners know what to look for.
- A good framework looks long term and ensures a majority of people are helped who need help.

(*) A framework provides a wholistic picture on all aspects that should be considered.

- Will help to think of cost implications

Why must the framework involve 4IR?

- The world we live in is tech driven. A good example is ~~#~~ seen through the covid pandemic. How many businesses were able to thrive? I'm sure a majority were those which had STRONG TECH SUPPORT, that could facilitate REMOTE functionality.
- Tech laws & regulations are a bain in today's world. We ~~cannot~~ see it with big companies & it would be ignorant & irresponsible not to consider that when dealing with SMMEs especially in term of EDUCATING them about it & showing them HOW TO USE it.
- The sectors might find new ways to use technology & these may provide future loopholes for people to use or abuse.

Strong points of TML

- Mapping out how to take an idea to market.
- Validation processes of businesses.
- Adopting the lean startup Approach.
- Coming to the level of SMMEs
- Dealing with many beneficiaries i.e experience.
- Formalising conversations ; Details.
- ~~Dealing~~ ~~re~~ Instilling & insisting on Entrepreneurial traits.
- Starting with "What are you struggling with"

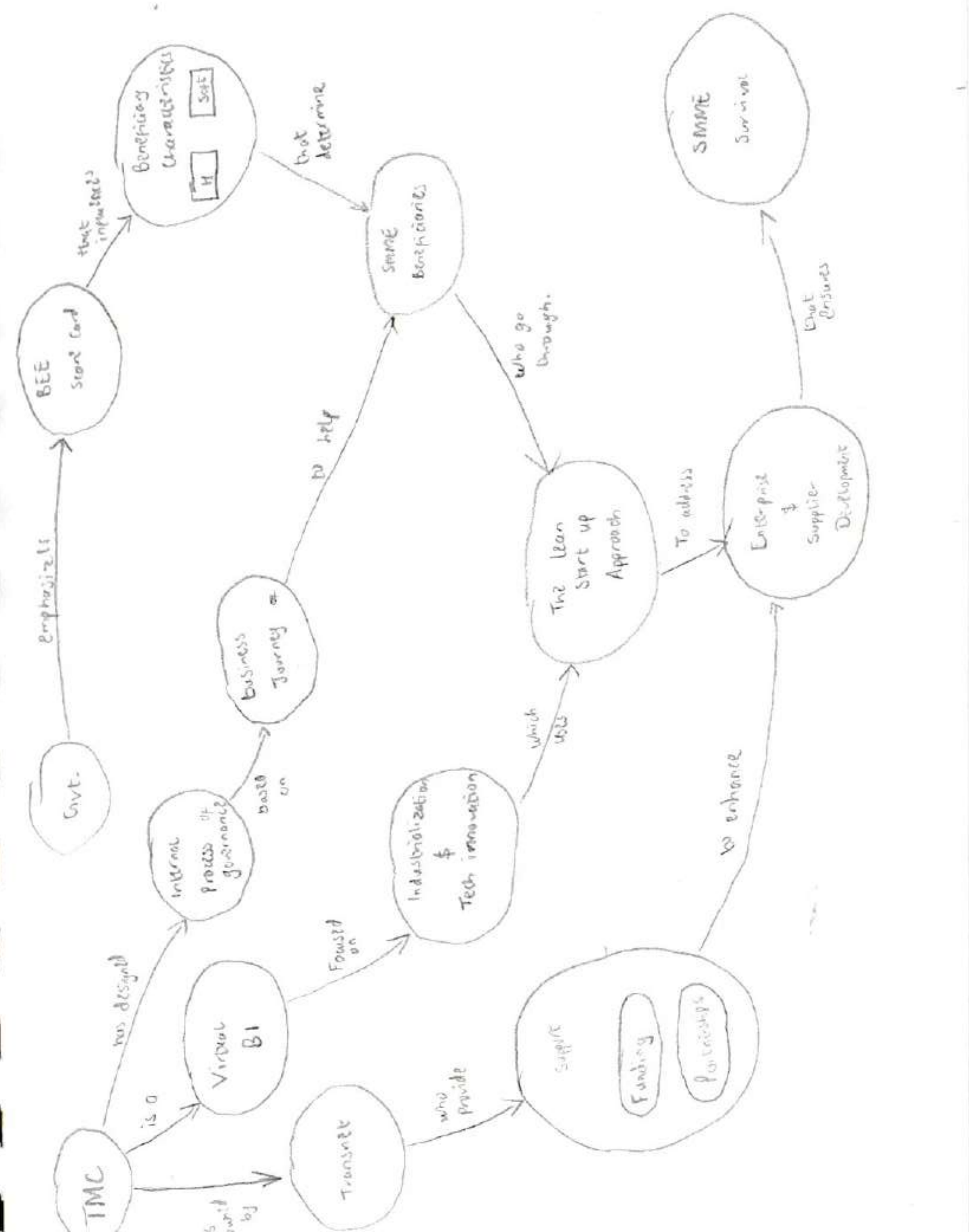
Strong points of SMMEs

- Desire for "Legacy" +
- Good negotiation skills.
- Know-how of how to secure business.
- Finding ways round regulations.
- Made by Entrepreneurs i.e scared by...

Strong points of others.

- Adopting the lean start up approach.
- Comparing programmes delivery yields better consistency.
- Multiple programmes for multiple models

→ why is clustering hard in the Tech Innovation space.



Problems of SMMEs

- Not the right person to start or run an SMME.
- Survivalist / Necessity entrepreneurship vs Developmental Entrepreneurship.
- Inequitable access to capital
- Lack of relevant Business Advice.
- Lack of Networks
- * Inequitable access to Information
- Licensing $ Legislation.

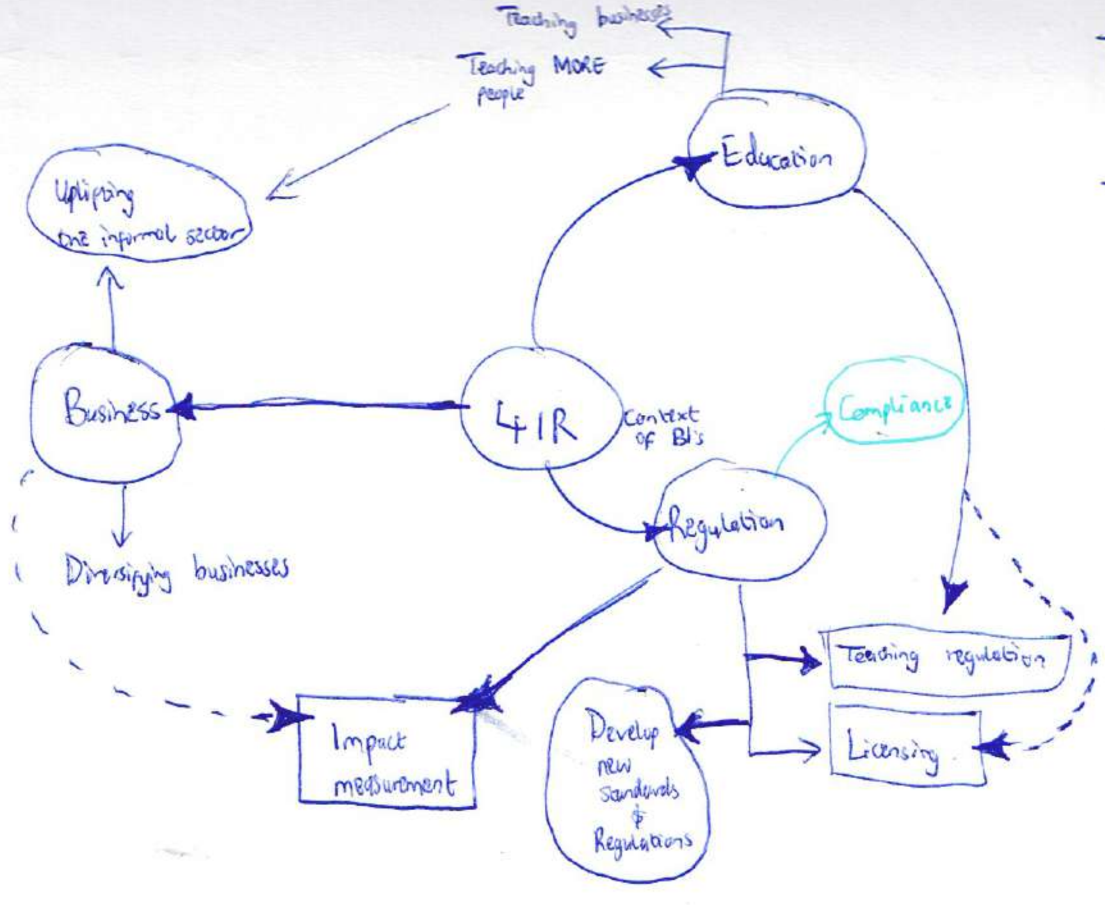
Problems of Incubators.

- Selection of who they should help.
- Impact Measurement.
- Poor Data capturing systems
- Inadequate space $ resources to facilitate SMMEs as possible.
- No clear common language of sorts among ~~SMME~~ Incubators & between Incubators & Govt.
- Disconnect in terms of SMME expectations
- Credit
- Lack of Managerial Skills

(3) How are incubators helping the informal sector if they are helping "high end" SMEs?

(1) There might be problems SMMEs face that Incubators address BUT there might be problems incubators face that no one is addressing.

(2) Addressing problems incubators help SMMEs with could free up time & resources to address their own problems



- Could help in improving selection process
- Help improve the data capturing methods & procedures.

ALL THIS IS INFORMATION RELATED.

How can we use I 4.0 to maximize this?

Approaches

1. Addressing the issues SMMEs face ~~&~~ ~~the~~ go to incubators for i.e. Helping the helper.
2. Addressing the issues incubators face :
   - → Expanding their menu
   - → Better utilizing what they have.
3. Both.

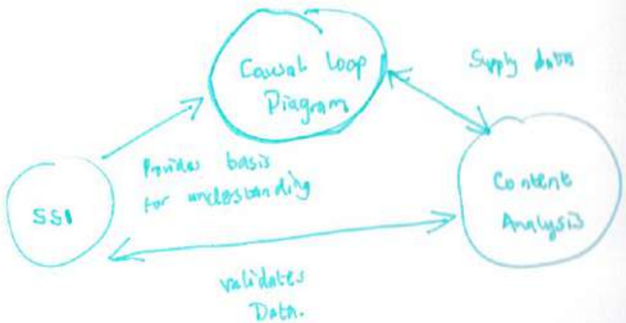
- Shandukani
- Transnet
- Innovation hub.
- SEDA
- Department of Small Business.
- Tshimologong.

→ CODE FREQUENCY TABLES.

* INNOVATION VALUE CHAIN.

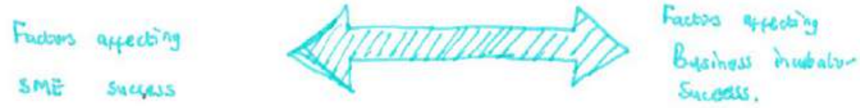
- Management tools
- Operational tools

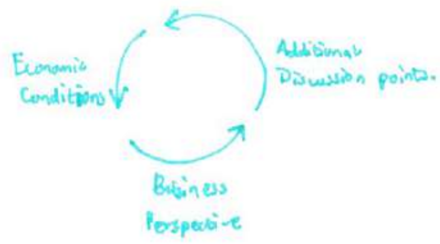
What are the tools of BI's?



- A framework that will show how 4IR can be used across strategy for the ... out.

Visual Framework





BI as a system

Group questions according to conceptual framework

↘ Divide into buckets

↓

The buckets help focus.

Think CATEGORY NOT QUESTIONS.

Thoughts gotten as I'm dealing with Respondent 4 Round 1

* ⚠ Write up the guideline for Round 2 interviews.

* ⚠ Define what survival is.

* Plan out your write up in counter book.
  Take time to write down all the:
  - → Definitions of things that popped up;
    - Innovation
    - Incubation
    - Survival
    - Failure.
  - → Guidelines for interviews.
  - → Documents shared by participants (IDC docs)

→ Ask the question; Do you think people having the perception that incubators provide funding is an issue? (rephrase better later)

=Ro

RESULTS

DATA ANALYSIS

1. Look at the core processes of each.
2. Look at the challenges each face.
3. Look at the synergies each face.

(1) Core processes

+ Start with Definitions.
+ The process flow (Input → Transformation → Output → Outcome)
  Look at it through that lens.
+ The process drives/incentives for each step. (Building up a systemigram)
+ Creating causal loop diagrams with the aid of challenges + synergies had/made/experienced.
+ Look for similarities in all of them & develop a conceptual framework that addresses that.

Write up a pilot interview protocol.

→ Feedback

→

→ Check out transcribers ✓ gotten ; chantal ; R100 per hour.

→ Check out Fiver

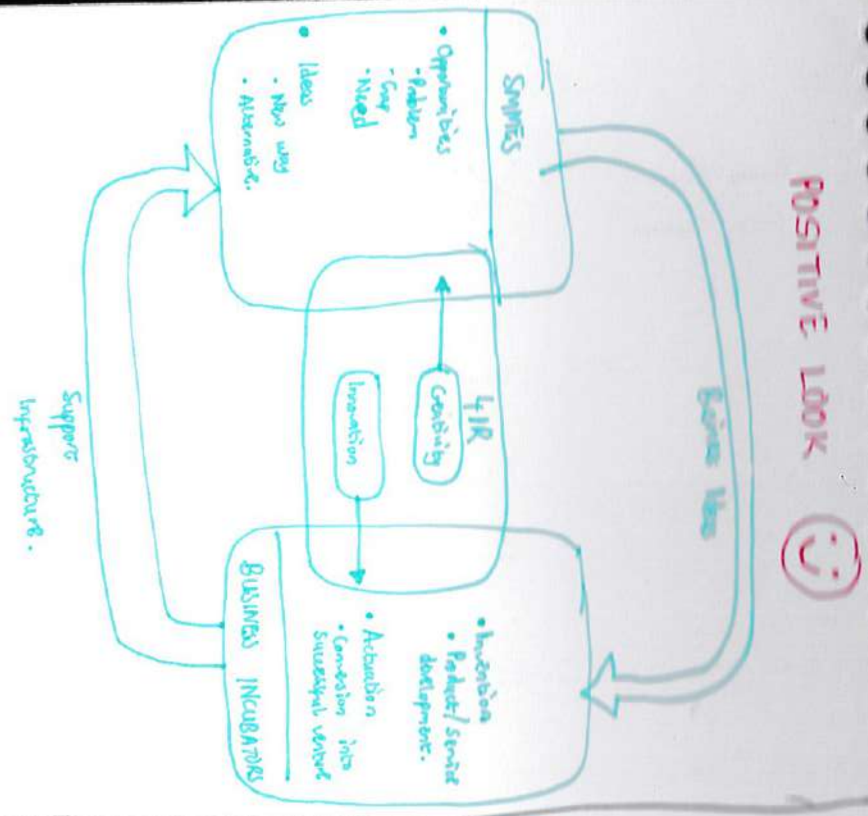
→ Check out Mural

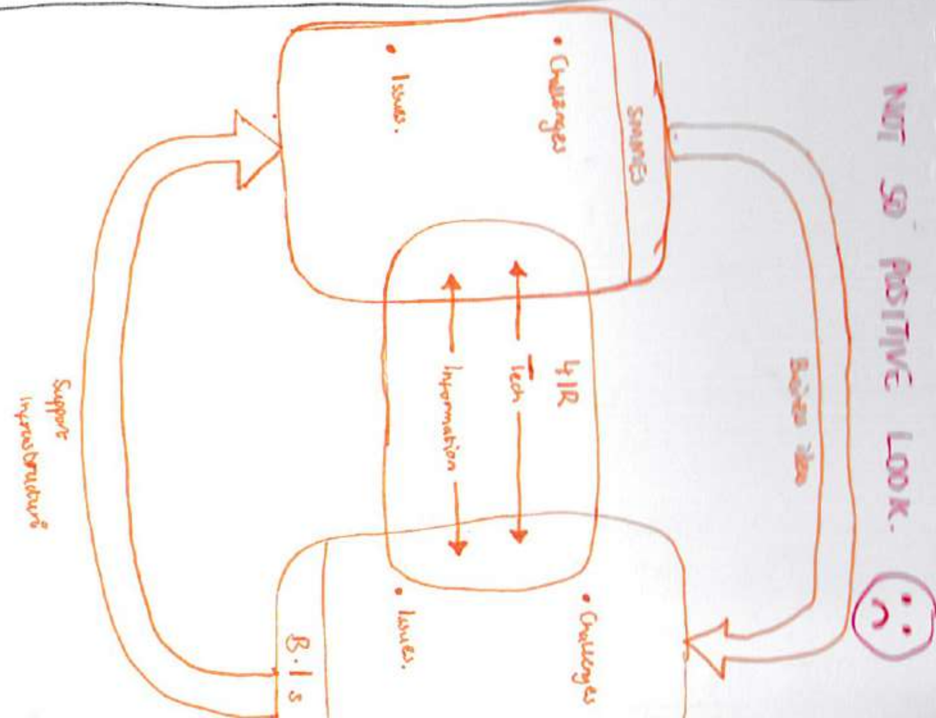
→ Check out Loom ✓

How is the Incubator

Do incubators meet

- Take me through the incubation process
- Is that a thing ; going through more than one incubation process?
- How is govt. involved in the process?
-





What story do you want to tell

Results

1. Summary of theme ie. describing the theme
2. Evidence of the theme (Excerpts & quotes from data)

- Go theme by theme.
- You don't have to cite every participant.
- Focus on the theme NOT the participant.

Second Structure	DF OS BP
Leverage points	C SF
Emergent	

Start the chapter by introducing the thematic framework; use a table?
Describe the framework

Chart with average theme talking points

Name	Mentioned across #	π Part

- For round one use a table
- For round 2 use a diagram to show how the themes are linked.

- Objective of round one analysis is to show the linkage between themes.
- Start with the initial framework.

- The objective is to see how 4IR D.P can be used to enhance the incubator space
- Is NOT a relatively straight forward topic to approach hence casting the wide net.
- Mention this in the beginning of the chapter

→ challenges affect structure

Themes

Major Themes

+ Definition & Function ✓
+ Organisational Structure
+ Best practices ✓
+ Challenges ✓ • Success factors
+ Emergent

- Goals & Incentives
- Research
- Personal Reflection
- Covid Interruption.
- Impact
- Concern
- System structure

* Make a table showing how prioritization was chosen

- Frequency
- Availability of literature
- Respondent Urgency

ATTRIBUTE ANALYSIS

Attribution Analysis.

WHAT DRIVES THE SECTOR?

WHO DRIVES CHANGE

* A "LIVING" FRAMEWORK. → Helps with Tracking.

* INCORPORATE GOALS & TARGETS *

Single document but can be understood by all

- VDT for framework.
- Put a time line on it??
- Quantification of metrics ⚠

Consolidation → standardized charter / Documentation.

Capture mechanism

- Metric → what metrics am I using in the framework.
- Trend

Charters give Metrics

FRAME WORK + TOOLS

OSCM LESSON

* The conceptual framework we are working on is more on the operations $ supply chain strategy. side of things (Txt bk pg 26)

* The framework should include *forecasting*
* One of the things we want from the interviews is a clear set priorities that they have in the SMME space.
* Look also for a CORE OBJECTIVE

A successful strategy will anticipate change $ formulate new initiatives. in response.

Maybe getting this is what you're really after?

* Have a triple bottom line strategy

BIGGEST POWER IS INFORMATION !!

RISK IN THE STRATEGY

MAYBE COMPARE NEW FRAMEWORK TO CURRENT FRAMEWORKS.

→ Services offered
→ Processes
→ Finances.

→ Use Complexity $ Divergence Txt Bk pg 56

→ Use interviews to develop systemigrams

→ Use interviews to get pivot points.

→ Develop a strategy where 4IR is used to help these pivot points move

→ * Develop the system model (simple) in Stella $ show that as analysis as well.

* → Financial Risks →
* → Implementation Risks → EXCEL MODELS ???
* → Comparative Analysis!!!!

THINK ABOUT EARLY ADOPTERS.

- In the write up, have a "Table Timeline" showing the different BI generations and the different Industrial Revolutions.

ROUND 2 Q

- Who ~~who~~ would be an early adopter of the framework?

1st	2nd	3rd	4th
Steam Engine	Mass Production	Info. + Data	??

understand impact of tech $ harness it to our needs

* Computer screening + AI for the diagnosis of businesses
* Personalised business plans.
* Using 4IR to tap into the informal sector. → Through Facebook??

A.4 Preliminary Map Value Flows

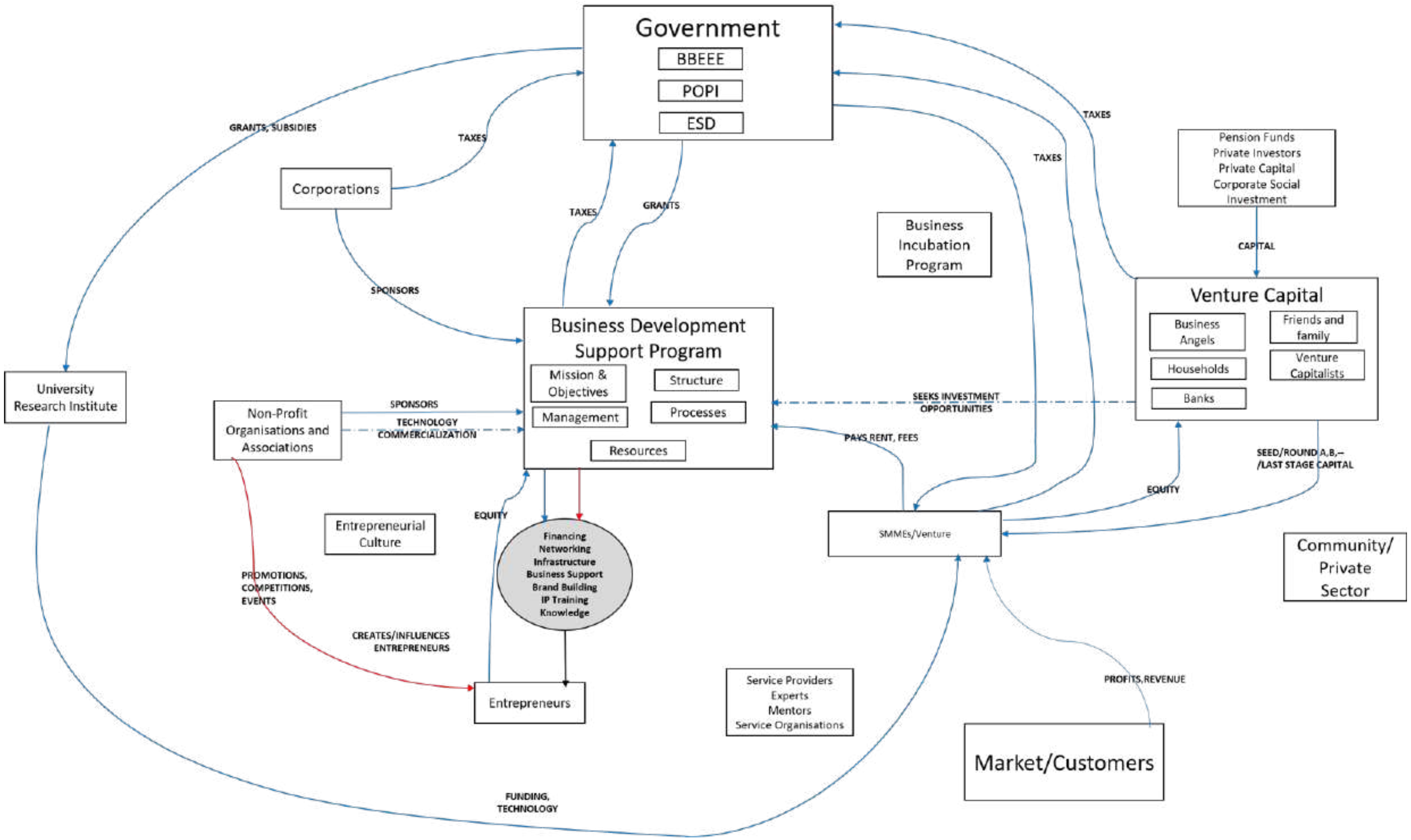


Figure A.5: Financial capital value flow from respondents and readings [41],[5]

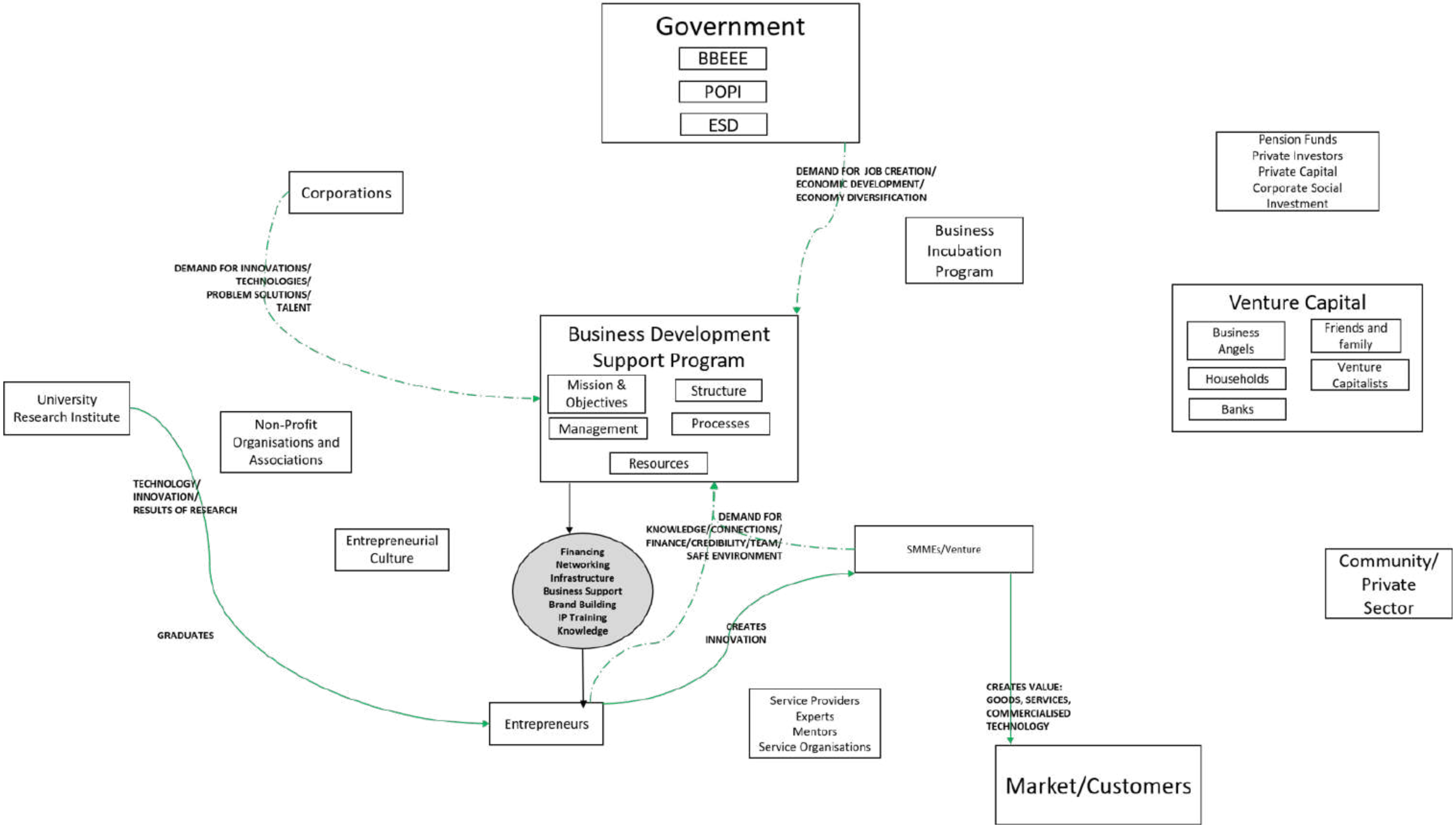


Figure A.6: Innovation value flow from respondents and readings [41],[5]

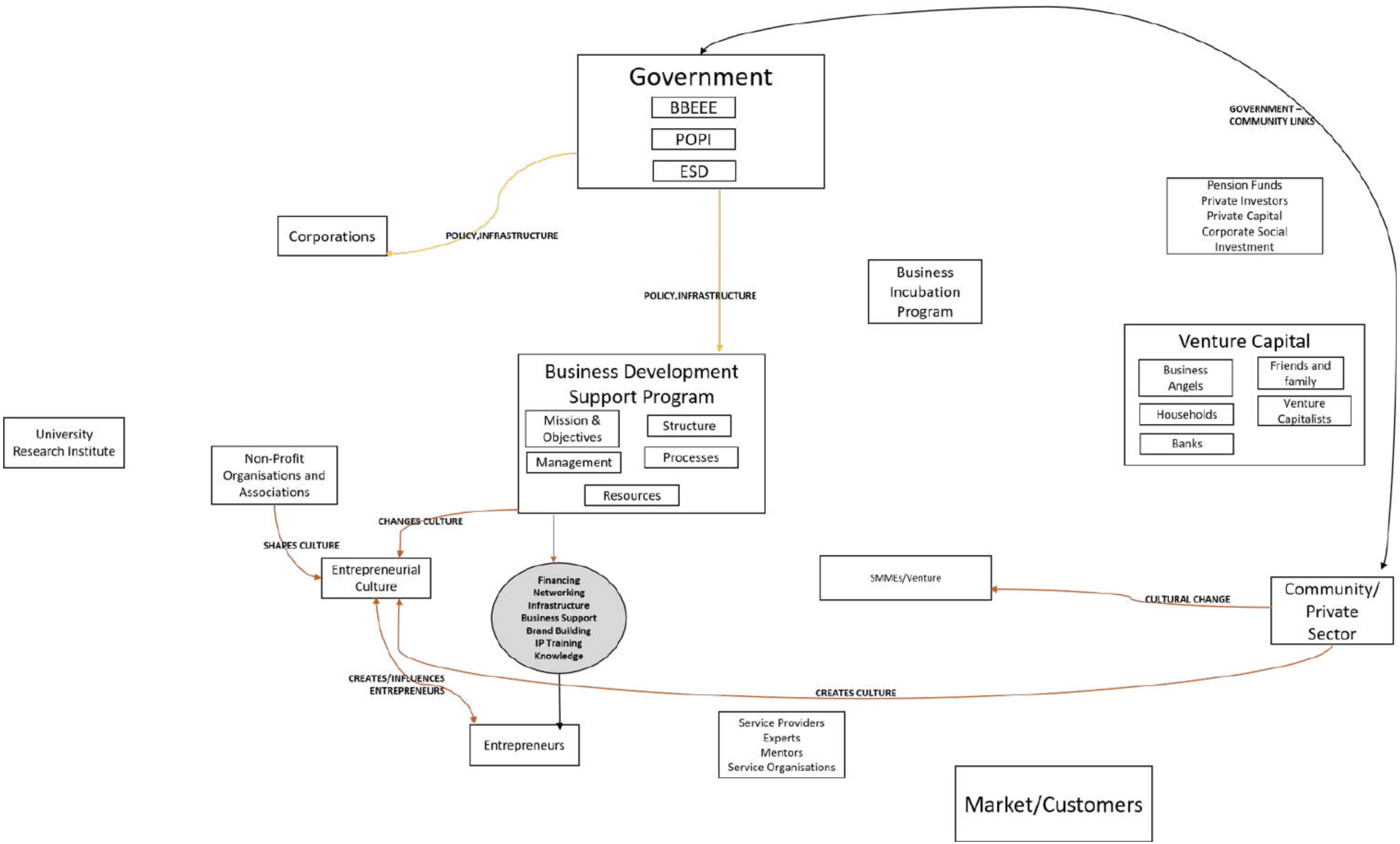


Figure A.7: Policy and cultural value flow from respondents and readings [41],[5]

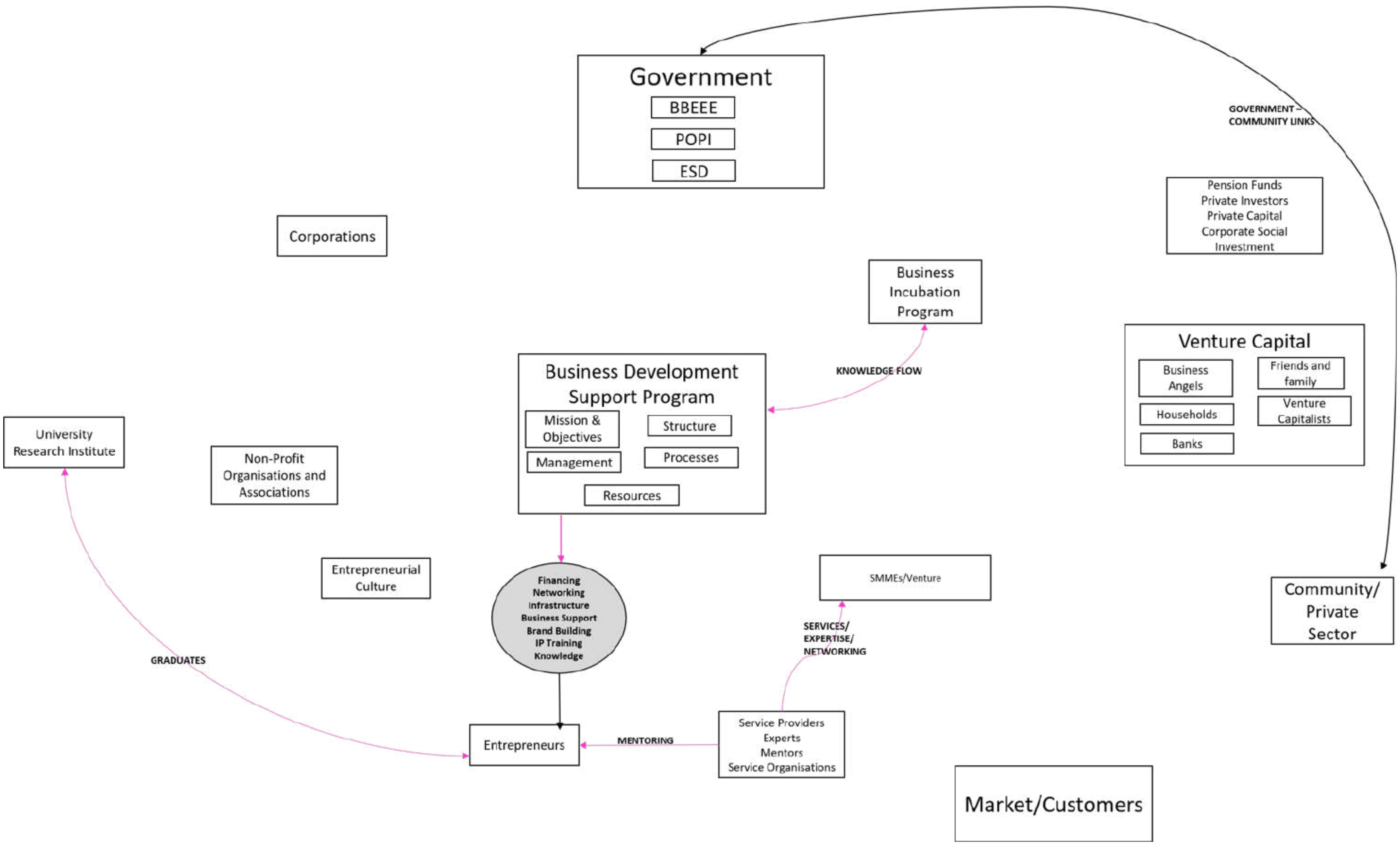


Figure A.8: Knowledge value flow from respondents and readings [41],[5]